

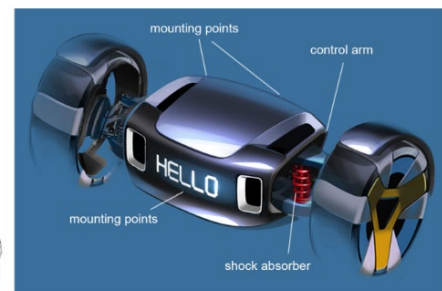
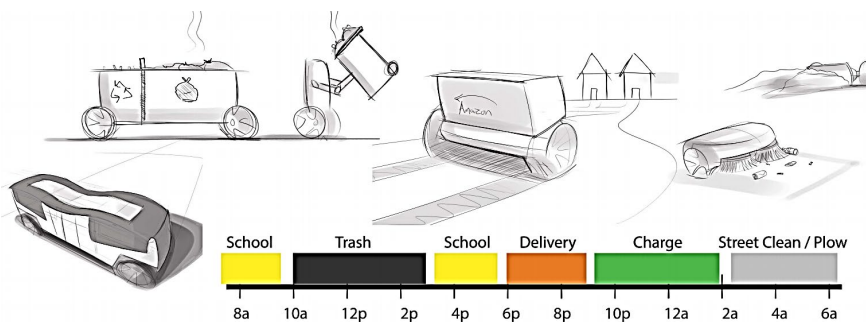
High Efficiency Robotic Operator (HERO): Autonomous Drivetrain

Two Sentence Elevator Pitch:

Imagine a world where consumers owned the cockpit interior of a vehicle, but the drivetrain was modular, autonomous, and could be ordered to pick up the cockpit and its passengers. Students on the BorgWarner team will engineer a working prototype of this high efficiency robotic operator - HERO. All team members will become BorgWarner summer interns in Auburn Hills, MI.

Abstract:

BorgWarner is a propulsion leader for combustion, hybrid and electric vehicles. They have worked with the College for Creative Studies to develop a concept for a sustainable modular autonomous vehicle system that consumers could order like an Uber or a Lyft to interface with a cockpit that the consumer would own. The part that contains the propulsion system is known as HERO (High Efficiency Robotic Operator). HERO will contain the suspension, drive train, steering components, and autonomous controls for the assembly. The students on the BorgWarner team will engineer and build a working prototype proof of concept of HERO.



Impact:

Autonomous vehicles are one of the future paths for the automotive industry. BorgWarner is a part of this future, and wants to use this prototype to help communicate one innovative vision of what this future might look like. The system will fundamentally deliver improved total cost of ownership, new revenue streams for the industry, and improved mobility access. The system will also embrace dominant trends in mobility – electrification, connectivity, controls/soft-ware, thermal management.

Scope:**Minimum Viable Product Deliverable (Minimum level of success)**

- Feasibility study of system integration of required components
- Approved design proposal of end to end system design (mechanical, suspension, battery/power, and controls)
- Working prototype of HERO drivetrain operable by remote control. Level of functionality to be defined.

Expected Final Deliverable (Expected level of success)

- Basic simulation modeling of the system that substantiates the viability of the systems
- Functional integration of autonomous control sensors and propulsion systems into HERO and evaluation against 1-2 test use cases.

Stretch Goal Opportunities (High level of success - May include one or more of the following)

- Integration of HERO unit is a meaningful vehicle top-hat that will positively resonate with students/potential customers/OEMs
- Business and Marketing assessment and proposal

Student Skills:

MDP Sponsored Projects are both a professional and academic learning experience for students. By participating in this program, students are actively preparing for graduate school and a professional career. As part of the experience, MDP expects professional behavior. To best prepare you for future professional opportunities, your experiences on this MDP team will be very broad. In addition to key technical skills that you will bring to the team, you will engage deeply in the self-directed learning of new and important concepts, demonstrate flexibility, collaboration, and cooperation, and develop strong professional communication skills. This also means that you will need to be able to work outside of your traditional area of study in the true multidisciplinary nature of our projects. You won't always be able to anticipate how your skills and expertise will be used, so the MDP Sponsored Project will challenge you to grow and develop as a professional.

Project Area	Specific Skills	Likely Majors
Mechanical Design (2-3 Students)	Mechanical Design, CAD, NVH, Techniques for fast prototyping. Experimental Testing and Evaluation. Experience in systems engineering a plus	MECHENG ISD-AUTO ISD-GAME Any
Embedded Systems/Power Electronics (1-2 students)	Integration circuitry, intermediate processing requirements	CE EE CS
Controls (1-2 students)	Sensors and autonomous control	EE ECE MECHENG ISD-AUTO ISD-GAME

Battery/Power Management (1 student)	Battery selection, battery sizing, battery management system interface	MECHENG EE ISD-AUTO
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Additional Desired Skills/Knowledge/Experience

Any of the following Skills, Knowledge, Experience, Interest or Outlook, would be valuable to the 2020 team. We don't expect students to be familiar all or even most of the technical items, but strong candidates will have familiarity or experience with some of them and a positive attitude to learn what is necessary as the project gets underway.

Please highlight your experience with any of the items on this list in your personal statement on the application.

- Experience in multisystem engineering design (student competition team experience would be particularly valuable).
- Excellent, pragmatic maker skills
- Vibration evaluation
- Battery and power management, systems integration of battery components
- Interest in new product innovation
- Interest/experience in industrial design, graphic arts
- Interest/experience in creating business plans and marketing of new products

Location:

Meetings will take place on campus in the Winter and Fall. Some bench build work will be done on campus, and in the summer, the students will work at BorgWarner in Auburn Hills to build the full scale prototype.

Sponsor Mentor:



Joel Maguire

Joel Maguire is the Director - Portfolio Strategy Team (PST) at BorgWarner Corporate Advanced Engineering in Auburn Hills, Michigan, USA. Joel's work in the PST involves the prospecting and evaluation of new business and technology opportunities. In addition, Joel supports advanced electrification activities (components and full systems). Prior to joining BorgWarner in 2013, Maguire was Technical Fellow for Electrification at General Motors Powertrain. He holds a BS in mechanical engineering from Michigan Technical University, and Masters in the Management of Technology from Rensselaer Polytechnic Institute.

Faculty Mentor



Alanson Sample

Associate Professor, Electrical Engineering and Computer Science

Professor Sample's research interests lie broadly in the areas of Human Computer Interaction, Cyber-Physical Systems, and wireless technology.

He has spent the majority of his career working in academic minded industry research labs. Most recently he was the Executive Lab Director of Disney Research in Los Angeles where he led a research lab focused on delivering scientific & technological innovation to The Walt Disney Company through advances in Robotics, Artificial Intelligence, Computer Vision and Human Computer Interaction. Before that he was a Principle Research Scientist at Disney Research in Pittsburgh where he led the Wireless Systems Group, which created new interactive experiences by applying novel approaches to electromagnetics, RF and analog circuits, and embedded systems. Alanson received his Ph.D. in Electrical Engineering in 2011 from the University of Washington.

Legal Requirements:

Citizenship Requirements.

- This project is open to US Citizens and Permanent Residents only.

Intellectual Property Agreements / Non-Disclosure Agreement

- Students will sign standard University of Michigan IP/NDA documents

Summer Project Activities

- Summer Internships at BorgWarner (in Auburn Hills) are required to participate on this team.
- All students must pass a background and drug test
- Offer letters will include required dates, compensation, and other conditions of the internship.

Company Information:

Reliably delivering what's needed today

There are few challenges as important today as creating solutions that support a cleaner, more energy-efficient world. This requires a commitment to constantly improve the transportation of people and things. We, at BorgWarner, made that commitment decades ago and have since been creating technologies to improve efficiency, emissions and performance in all types of vehicles.

Constantly pursuing what's next

Our proven track record has made us a propulsion system leader for combustion, hybrid and electric vehicles. We uncover strong trends and use smart science and technology to address a future based on varying regulations, consumer demands and automaker requirements.

Product leadership that's changing the world

Our employees have earned trusted partnerships with customers and suppliers around the world. We leverage these relationships to gain a deeper understanding of the challenges at hand and then do what it takes to develop the next solution. Our strong operations and commercialization expertise result in high volume availability of competitive, efficient products that truly drive change.