

# MoMEntum

Department of  
Mechanical Engineering  
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## Branam Innovation Center is a Hub of Activity for Student Teams

The teams run the gamut, from underwater robotics to Formula SAE. Yet, like diverse siblings, they have a common origin—gestation in the Branam Innovation Center. The BIC houses a full machine shop, power tools and equipment, and student work spaces with 3-D printers, white boards full of ideas, and projects in progress.

Students can also delve into their own projects in the BIC, and the MakerLab club provides the opportunity for students to learn everything from soldering to Arduino programming.

Assistant Professor of Mechanical Engineering Ashley Bernal is faculty advisor for Make It Happen. Launched last fall, the program gives students the opportunity to work on humanitarian-based projects for credit. Tim Balz, a Mechanical Engineering student, was in on Make It Happen from the beginning. It was his idea, with roommate Stephen Misak, to tie such projects to academic credit, and to start an endowment to fund MIH projects.

"We're training students who will change the world," Balz says. "More than ever, they'll think about using their engineering for good and to help people." Helping solve real-world, humanitarian needs, he feels, "makes us better communicators, better team workers, better citizens." (Read more about the [Make It Happen pilot project](#), benefitting a Moldovan youngster with disabilities.)

Balz and Bernal both foresee an expanding role for alumni to serve as mentors, perhaps consulting by phone on projects that match their skills and interests.

Whether they're addressing third-world needs or solving torque problems in a racing vehicle, students involved in BIC-based clubs and programs gain experience that makes them better prepared to enter the engineering field.

Balz recounts a career fair where he and his roommates showed recruiters an electric vehicle they had made—a move which helped them land internships. This summer, Balz is designing and testing components for SpaceX. "They were so excited about the MakerLab that I think that's why we got hired. It demonstrates your passion for engineering when you create a project that you design rather than just an assignment."

MakerLab, Make It Happen, and the Branam Innovation Center allow students to complement their classroom lessons with hands-on application and problem solving. As Bernal notes, "A lot of our students want to have a positive impact on



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the world. Sometimes it doesn't take a lot of money to make a difference. They can benefit society—not just a for-profit venture.”

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### Efficient Vehicles Team Aims for 2,500 MPG

Their sleek racer sustained some damage in transit to Motor City, but the [Rose-Hulman Efficient Vehicles Team](#) repaired it with supplies and tools they'd brought with them and proceeded to compete April 22-24 in the [Shell Eco-marathon Americas](#). The RHEV squad is in elite company—the winning vehicle, from Quebec's Université Laval, logged 2585 mpg.

Rose-Hulman is one of only four colleges or universities to have competed in all 10 Shell Eco-marathons. This year's event drew a record 124 teams from seven countries: Brazil, Canada, Ecuador, Guatemala, Mexico, Puerto Rico and the United States. The RHEV entry resembles a recumbent bicycle on a carbon fiber chassis, with a small, ethanol-powered motor in the rear and a molded, aerodynamic body.



RHEV's redesign of its vehicle, nicknamed "Double Down," included a significantly lighter carbon fiber unibody with aluminum mounting points.

One of the lessons learned this year, says Sean Moseley, team advisor, is time management. "This year, the team simply did not do enough testing and shakedown. The problems they had at competition were solvable had they occurred a month before competition." Designing and building a vehicle from scratch, he notes, "can be an exercise in project management, team dynamics, testing and refining, and systems integration. Having a good design on paper isn't enough—it has to be realized by everyone on the team."

The design/build/compete cycle provides a wealth of real-life experience for the student engineers. The RHEV team has been led for the past two years by Jacob Rigelman, whom Moseley calls "the glue that kept the team together." RHEV plans to be ready when the Shell Eco-marathon Americas returns to Detroit from April 28-30, 2017.

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### Tracking Success: Rose GPE Team Delivers

They run open-cockpit, open-wheel racers at a legendary track, but at heart it's not about the speed. They work late hours to wrest better performance from their vehicle, but the stats don't tell the whole story. For the Rose Grand Prix Engineering (Rose GPE) team, it's an endurance contest. Rather than trophies and cash prizes, the payoff is portfolio of experience in project management, problem-solving, teamwork and straight-on engineering.

Each year the team designs, builds and competes with an original racer according to standards set by the Society of Automotive Engineers. The experience, says Assistant Professor of Mechanical Engineering Daniel Kawano, gives team members a leg up with corporate recruiters. These students, he says, face "a lot of time pressure, budget pressure, and constraints...It's a complex project that they're working on, involving many long hours. Recruiters see all of that."



Members of RoseGPE put their vehicle through its paces at a nearby airport several times in the last few weeks in an effort to work the out the bugs.

Rose GPE impressed SAE judges at Michigan International Speedway in May, tying for 12<sup>th</sup> place for design in a field of more than 100. Teams are also judged on cost and presentation, in addition to dynamic events such as acceleration, endurance and fuel efficiency. While some teams may give short shrift to non-racing aspects, says Kawano, "SAE stresses that, at heart, it's not motorsports competition. It's an engineering competition." Judges reward teams that demonstrate the organization, budgeting and problem-solving skills the competition is designed to foster.

Those skills were on display again in June 15-18, when Rose GPE competed at Formula SAE Lincoln. The event, at Lincoln Airpark in Nebraska, drew 70 teams representing institutions in Japan, South Korea, Canada, Mexico and Brazil, in addition to the U.S. Rose GPE finished in the top tier, with an impressive seventh overall. The team's No. 96 car scored particularly well in the endurance event, placing second.

While mechanical engineering majors make up most of the Rose GPE team, an electrical engineering sub-team brings important skills to the complex task of designing, building, testing, documenting and competing a vehicle built from scratch. One challenge, says Kawano, is keeping everything on track to allow sufficient time for testing before



competition. More prep time, he notes, might have allowed the team to prevent the drive chain from coming off a sprocket during the endurance competition at Michigan.

The team's [Facebook page](#) allows alumni and friends to keep track of the team's progress. Several alumni turned out for the competition in May, including one who served as a judge.

Kawano notes the encouragement such participation can give to students who put in long hours.

"If you're ever in the area during competition,

we encourage you to come out and see what the team has done."

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### HPVC Team Meets the Challenge

Yvonne Lumetta doesn't soft-pedal the challenges facing the Rose-Hulman Human-Powered Vehicle Challenge (HPVC) team May 13-15 at Athens, Ohio. "It was rainy at the start, and then it was windy. It was a good stress test for the bikes and for us." The students rose to the challenge, capturing second place overall and topping the field in design and men's sprint. The team also excelled at women's sprint (second) and innovation (third). "We had a blast," says Lumetta, a computer engineering/computer science major.

The team also did well at the HPVC West event April 22-24, placing sixth overall out of about 30 entrants. Both HPVC competitions are sponsored by the American Society of Mechanical Engineers. Teams design and build a human-powered vehicle from the ground up using sound engineering practices, then race it in sprint and endurance events. Mason Lott, an avid cyclist who plans to participate all four years at Rose-Hulman, notes that not all HPVC competition takes place on the track. The documentation supporting the team's design work spans more than 30 pages, plus another 20 or so pages of appendices.



This year's human-powered vehicle incorporated several innovations, including an active aerodynamic wing to counteract crosswind instability.

This year's vehicle sported several innovations, including an active aerodynamic wing to counteract crosswind instability. It's designed to sense wind speed and direction, adjusting automatically to keep the vehicle stable. "We could have used it in the [HPVC East] competition," he says. However, the motor failed days before the event and the wing was removed.

Also new for this year's vehicle was a motorized, adjustable seat designed to accommodate drivers who range in height from 5' 5" to 6' 5". Re-engineering of the vehicle's front sub-frame, which holds the wheel, tiller, drive train and other parts, solved a torquing problem by mounting it on four points rather than two.

Driving the human-powered vehicle isn't reserved for the most athletic students, says Lott. "Riding is a reward. If you help build it, you should get to ride it. We'll sometimes take turns riding it in the parking lot until three or four in the morning."

The team's greatest achievement, according to advisor John McSweeney, is that "learn a wide range of skills, many of which can't be taught in a traditional course: teamwork, budget management, fundraising, big-picture design decision making, the importance of advertising, public relations, and maintaining relationships with alumni and sponsors."

McSweeney, an assistant professor of mathematics, cites the importance of companies that sponsor the teams and the Branam Innovation Center. The Rose-Hulman HPVC team's [Facebook page](#) cites "Bruce Mueller and Rich and Gail Dovalovsky for donating their time and support to the team throughout the entire course of the year and especially in getting the bike to and from our competitions." The Dovalovskys' son, Jeff, participated on the HPV team while a student.

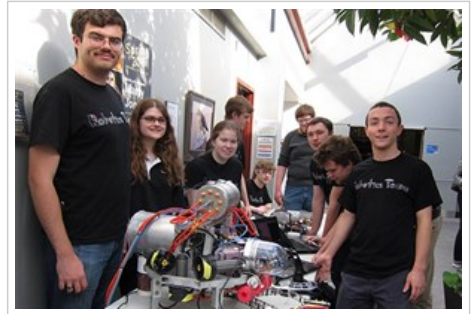
"We absolutely love our alumni," says Lott. "Four or five came to the East Coast competition to cheer us on and help us out. They're always willing to help, which is awesome." The team is already percolating ideas for next year's competition. "We do a lot of emailing and texting each other over the summer," Lott explains. "When we get together in September, we say 'Let's prototype this' or 'Let's try that.'"

The [Rose-Hulman Robotics Team](#) is multi-faceted, designing and building robots that roll, swim and fly.

In addition to Underwater Robotics (see next article), these teams include:

- **Aerial Robotics:** A new DRQ 250 drone with a light, carbon fiber frame and four motors that combine to provide four pounds of thrust. This allows the addition of attachments such as a remotely operated claw to manipulate objects. A second new drone, the Parrot BeBop, offers increased stability and a sophisticated camera. Plans for 2016-17 include the addition of image processing and other programming features.
- **Intelligent Ground Vehicle Competition:** Astraeus, the IGVC robot, has been able to autonomously navigate and map the Branam Innovation Center with its stereo camera and precision GPS system. The team participated in the 24<sup>th</sup> Intelligent Ground Vehicle Competition at Oakland University in Rochester, Mich., in June, pitting Astraeus against other autonomous vehicles to navigate a challenging course.
- **Combat Robotics:** Team members are improving the two fighting robots, named Deathblade and Steve, to make them more stable and durable. Thanks to a generous donation from Rockwell Collins, the R-H Robotics Team will be able to construct a new, 8' x 8' combat enclosure of polycarbonate on an aluminum frame. This will allow the team to host both intercollegiate and intramural competitions.

The Robotics Team was well represented at the Rose-Hulman STEM fair May 10, giving area youth a glimpse into robotics as part of the Institute's Explore Engineering program.



Robotics team members design, build, and compete with devices for air, land, and sea.

### Sink or Swim for Underwater Robotics Team

As the Rose-Hulman Underwater Robotics Team prepared for international competition, Betsy Tainer's mood was buoyant. The team built on last year's success (placing seventh out of 31 teams in its first international bout) and members were eager to take their remotely operated vehicle – a ROV named Floyd – to NASA's Johnson Space Center in Houston.

Floyd sports a new claw, designed to perform specified tasks in NASA's 40-foot-deep Neutral Buoyancy Lab. "Design took months," says Tainer. "Construction took a matter of days, using the water jet and 3D printing. We spent a lot of time budgeting weight." With scoring affected by each entry's weight and size, the team designed a more compact gripper to earn extra points as it lays cable, connects parts and collects samples at depth.

Problems with buoyancy and water leakage compromised Floyd's performance during the June 23-25 competition, and the team scored 25<sup>th</sup> overall. Team members are already incorporating the experience into plans for next year's competition.

Required documentation includes a design report with schematics of electronics and controls, as well as budgeting and an explanation of team members' roles in designing and construction the ROV. In addition, the judging panel can ask any team member about any aspect of the project. "You have to have a basic answer for everything," says Tainer. "We all have to try to understand the parts that other people worked on."

Mentoring and informal support play a big role. The Underwater Robotics Team traveled to Chicago in late April to test Floyd under conditions similar to the competition, and to work with high school and middle school students developing ROVs according to grade-appropriate specs. Team President Sam Lawrence says "We were excited to learn that some of the high school teams whom we talked to last year were inspired to incorporate some of our design choices this year."

The team benefits from an inclusive, supportive culture, says Tainer. "Everybody on the team belongs. If you come and do good work, we'll give you respect. We're kind of a social club as well as a robot-building club." Tainer, who will be a junior this fall, was selected to be MATE Subteam Leader for 2016-2017. She credits Joe Schornak, a 2016 graduate and president of the Rose-Hulman Robotics Club, with doggedly leading the team's progress toward qualifying for the international competition sponsored by MATE (the Marine Advanced Technology Education center). Sam Lawrence spearheaded improvements in electronics. Alumni Allison Crump and Ben Griffith played a role as well, meeting with the team in Chicago and even treating them to dinner featuring (what else?) deep-dish, Chicago-style pizza.



Team members are already analyzing Floyd's performance during the June 23-25 competition in order to incorporate lessons learned into plans for next year's contest

For Tainer, serving on the Underwater Robotics Team is leading toward her goal of working with human-style robots, which she envisions as "getting paid to play with expensive toys."