A Winning Collaboration Between Academia and Industry

By Liz Callanan

Student competitions were once considered purely extracurricular activities. Today, recognition of the value they bring to both academia and industry has turned them into important vehicles for educating tomorrow’s engineers. Competitions help educational institutions attract and retain motivated students and enable those students to solve real-world engineering problems while developing skills in collaboration, time management, and leadership. Competition veterans become employees who can be productive on the job from day one.

An Engineering Trial Run
Spanning such diverse fields as robotics, solar power, advanced vehicle design, synthetic biology, and software defined radio, student competitions challenge engineers-in-training throughout the world to tackle the same technical issues—under the same budgetary, time, and resource constraints—as professional engineers. Students are expected to maintain their academic course load, interact with suppliers and competition sponsors, and learn new software.

Sponsors like The MathWorks provide software, financial support, teaching materials, training, and mentoring. Sameer Prabhu, director of industry marketing at The MathWorks, mentored teams participating in Challenge X, and can attest to the tremendous time pressures that students are under: “I’ve received e-mails at two and three o’clock in the morning with urgent requests like, ‘I need to finish this by tomorrow, can you help me?’ You want to help, get them going; that’s the fun part.”

Competitions are a total-immersion experience in which students follow a project from beginning to end. Their commitment may last anywhere from a single semester to several years. Their learning extends beyond problem-solving strategies. Competitors also discover, for example, that having a common goal is just one component of a successful team. “I was surprised at how important it was to get everyone on the same wavelength, working with the same tools on the same platform, and speaking the same language, even though we all came to the project knowing we were building a car,” says Nii Armar, a member of MIT’s Vehicle Design Summit team.

Far-Reaching Influences
The collaboration between academia and industry has brought lasting benefits to both. Competitions have spawned new teaching materials (curricula, labs, and courses) and in some cases, have generated technological innovations.

By working closely with industry leaders, faculty members gain a better understanding of job skill requirements and recruitment benchmarks that they can incorporate into their curricula and coursework. “Companies find that students with competition experience are two years ahead of those who stayed in the classroom,” says Glenn Bower, a faculty advisor to student teams at the University of Wisconsin-Madison since 1994.

Competitions allow students to put all their courses into perspective and see how
Clockwise from top left: RoboCup, MathWorks mentor Sameer Prabhu, Tufts University Nerd Girls team, EcoCAR planning board, Challenge X vehicle door panel, students verifying design models, Smart Radio Challenge T-shirt.
the theory can be applied to a system-level design problem. Not many engineers get this opportunity. As a result, these students are highly sought after in the job market.

“From controls to electrical development to mechanical systems, these students take real-world industry experience with them into the job market,” says Cindy Svestka, a former student competition participant and executive technical assistant and business process manager for the powertrain vehicle integration organization at General Motors. “When we hire a Challenge X student, we know that they understand our vehicle development process and can work on cross-functional teams.”

MathWorks Sponsored Competitions Worldwide

For a complete list, visit www.mathworks.com/nn9/studentcompetitions.

<table>
<thead>
<tr>
<th>Competition</th>
<th>Description</th>
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<tbody>
<tr>
<td>Eurobot</td>
<td>Create a robot that can complete the annual contest challenge—in 2009, to build the tallest Temple of Atlantis.</td>
</tr>
<tr>
<td>EcoCAR: The NeXt Challenge</td>
<td>Design and build advanced vehicles that demonstrate full-function electric, hybrid, plug-in, and fuel-cell vehicle automotive technologies, with the goal of improving energy efficiency and reducing greenhouse gases.</td>
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<tr>
<td>Vehicle Design Summit</td>
<td>Design, build, and bring to market the VDS Vision 200, a hyper-efficient 4- to 6-passenger vehicle that will demonstrate a 95% reduction in embodied energy, materials, and toxicity.</td>
</tr>
<tr>
<td>SDR Smart Radio Challenge</td>
<td>Design, develop, and test a software defined radio addressing the problem(s) defined by the SDR Forum and supporting the target waveform(s).</td>
</tr>
<tr>
<td>iGEM (International Genetically Engineered Machine) Competition</td>
<td>Design, build, and test simple biological systems and operate them in living cells using standard interchangeable biological parts and parts designed by the competitor.</td>
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</tbody>
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A student team reviewing their work with judges at the 2009 Formula SAE competition in Brooklyn, Michigan.
A Competitor Comes Full Circle

FRANK FALCONE is a vehicle systems engineer for Argonne National Laboratory and former team lead for San Diego State University’s Challenge X team. Challenge X, which ran from 2005 to 2008, challenged engineering students to reduce total energy consumption and emissions in a crossover vehicle.

I realized that I wanted to work on cars when I was about two-and-a-half years old, standing on the bumper of a rusty old 1960s Mercedes-Benz watching my Dad synchronize carburetors. He was a mechanical engineer, and I followed in his footsteps.

When we were researching schools, we toured San Diego State University. I saw a red hybrid sports car in an exhibition on campus, and I told myself that somehow, some way, I was going to work on that car. During my senior year at San Diego State I wanted more hands-on experience with automotive design, and that was the beginning of Challenge X for me.

Challenge X helped me realize that I wanted to pursue an engineering career in alternative fuels. I hadn’t been planning to go to grad school, but I was so inspired by the first year of Challenge X that I decided to stick around and see it through to the end.

I was the Challenge X team lead at San Diego State for three-and-a-half years. That role required me to ask the right questions of teammates, mentors, sponsors, and suppliers, and to seek out expertise when we were lacking. It also let me grow in terms of getting things done and dealing with different personalities. We used to go out to sing karaoke as a team bonding event, adopting the rule that if you wanted to drive the car, you had to sing.

In courses on Model-Based Design at MathWorks training camps, we gained the skills to model a vehicle, develop an architecture, and then put our control code onto the vehicle. Our faculty advisor and our industry mentor helped us stay on top of things even when the pressure was intense.

Student competitions give you the opportunity to accomplish substantial engineering tasks while you’re still in school. Often it takes years at a company before you’re entrusted with designing things at this level.

After earning my master’s degree from San Diego State, I accepted a position at Argonne National Laboratory. I began there as a technical coordinator and grew into the role of vehicle systems engineer. I’ve come full circle now, in that I am responsible for helping to design the three-year EcoCAR Challenge, which kicked off in August 2008.

Student Team Develops World’s First University-Built Hydrogen Fuel-Cell Vehicle

During the four-year Challenge X competition, students from the University of Waterloo in Ontario, Canada, turned a Chevrolet Equinox into a zero-emission hydrogen fuel-cell vehicle. University of Waterloo was the only team to select hydrogen as the primary source of vehicle propulsion.

A hydrogen fuel cell produces electricity by converting hydrogen and oxygen into water. The technology is difficult to implement in a vehicle, as it requires the replacement of almost every part of the drivetrain.

Working in Canada put the team at a further disadvantage because vehicle data for empirical models could be collected only during the eight warmer months of the year. From December through March, temperatures in Ontario range from 0 to -20 degrees Celsius, and the hydrogen fuel cell could not be used below -2 degrees Celsius.

To maintain productivity during the winter, the team used software-in-the-loop and hardware-in-the-loop simulation. They developed Simulink® vehicle models generated with the Powertrain Systems Analysis Toolkit (PSAT) from Argonne National Laboratory to determine the optimal vehicle powertrain architecture.

Resources

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