

The FIRST Robotics Competition, now in its 14<sup>th</sup> year, continues to transform the lives of its participants. Though labeled a “robotics competition,” FIRST is much more than robots. In the words of one participant, “FIRST is not about using people to build robots. It is about using robots to build people.”

### ***FIRST: For Inspiration and Recognition of Science and Technology***

FIRST Robotics is a mentorship program which immerses high school students in the wonders and rewards of engineering. FIRST partners youth with adults and challenges these groups to become high performing engineering teams capable of designing, building and debugging a competitive robotic device in just 6 weeks.

With the design challenge changing each year, and kept secret until revealed at the beginning of the competition season, all teams start from an equal footing to build their machines from a common kit of parts. The season concludes with regional and championship competitions where teams gather to not just score points on the playing field, but more importantly to inspire the participants to continue their journey of learning.

The FIRST awards system emphasizes the greater value of the experience by formally recognizing teams for their entrepreneurship, creativity, sportsmanship, cooperation, and, most importantly, their ability to inspire students. While FIRST teams immensely enjoy the on-field competition with their robotic creations, they covet the chance to be recognized as the team that best achieves FIRST’s goal to

transform their community to one which values science and technology and inspires students to pursue technical careers. A spirit of gracious professionalism permeates the FIRST Robotics Competition where teams cooperate with one another in the midst of competing against one another on the playing field.

### ***The Origins of FIRST***

Founder Dean Kamen articulates the purpose of FIRST. “The competition is designed to be fun – but it’s about learning, and even more basically, about learning to want to learn, by discovering how infinitely enriching and fulfilling the rewards of learning can be.”

According to MIT Professor and FIRST Robotics Competition Co-Founder Woodie Flowers, FIRST is a microcosm of engineering. A team faces a real problem that must be solved with limited time, materials and money. Cooperation, creativity, careful thought and knowledge are essential. “It is not an academic exercise. As the season progresses, since Mother Nature applies all of her rules all of the time, thousands of people come to understand what was really important in the problem.”

The correlation between FIRST and real engineering is hardly a coincidence. The origin of the FIRST Robotics Competition is Prof. Flowers’ famous introduction to design course where for decades MIT students have been tasked with solving design challenges using a standard kit of parts. From this humble beginning FIRST has expanded in all dimensions to be a sophisticated robotics challenge with nearly 1,000 teams and 25,000 participants in 2004.



*This discussion of the opportunities for university involvement in FIRST was produced by the American Society of Mechanical Engineers.*

### **University Involvement with FIRST**

As a high school mentorship program there is a natural relationship between FIRST and universities as the next phase of the students' intellectual development. Many universities are drawn to FIRST not only to join FIRST's mission, but also to help the university achieve its own goals. Thus many universities participate in FIRST to recruit these very talented and experienced high school students into their programs.

Universities hosted a majority of the FIRST Robotics



Competitions in 2004 where typically 4,000 students swarmed the campuses for 3 full days of competition and inspiration. As another means of increasing their visibility with the select group of FIRST participants, many universities and benefactors, including the American Society of Mechanical Engineers, provide scholarships to FIRST participants. In 2004, universities and

sponsors offered \$4.5 million in scholarships exclusively for FIRST participants. In addition, scores of university faculty and administrators volunteer at FIRST competitions where they are role models for the students.

A growing percentage of FIRST teams benefit from being affiliated with universities. University contributions range from cases where the university provides full sponsorship and leadership of the team to instances where a few university students volunteer as team mentors. On some campuses students participate in FIRST as non-credit engineering outreach activities while other programs offer credit for FIRST activities that are part of academic courses.

A few case studies are presented to illustrate a range of methods for university involvement with FIRST. While these examples are not exhaustive, they do illustrate varied approaches to incorporate FIRST in the college environment.

### **Project Based Team Learning at Clarkson University**

Clarkson University has a long history with competitive based engineering projects, including FIRST. Clarkson, which annually offers 12 full scholarships and 6 partial scholarships to FIRST participants, provides its students with a variety of opportunities to participate as mentors to the high school students on their FIRST team. By design, all Clarkson student participants in FIRST enroll in credit awarding courses.

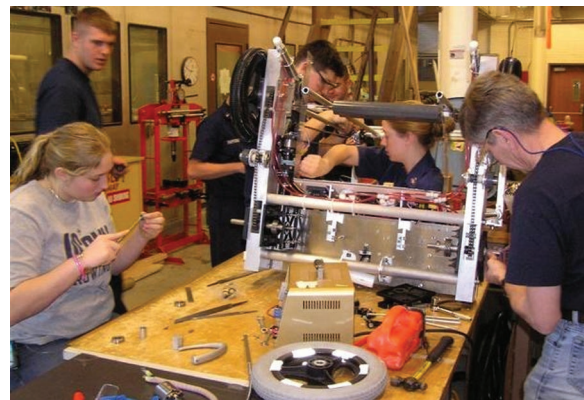
Clarkson offers an introductory level "Multidisciplinary Design" course as a means for students with high school FIRST experience to remain involved in the program. The course is also open to students with no prior experience in this area. The emphasis of the course is for students to contribute as a team member to the various aspects of robot design, construction, modeling, subsystem design, programming, control, and sensor applications. Students pursuing "Directed Studies" credit at Clarkson must satisfy a higher threshold for the analysis and design portions of the project and more completely document their design decisions.

At the upper division level, Clarkson engineering students can enroll in an "Integrated Design" course. This yearlong course addresses project planning, specifications, concept generation and selection, engineering design, and manufacturing. Students bid on the projects they wish to participate in, including FIRST, and follow the project from its inception to completion. The "Capstone Design" course is an option for students who desire to concentrate in advanced analysis and detailed design of specific subsystems on the robot.

Clarkson has established a clear record of success with FIRST as a rich design environment for honing critical skills. In addition to those FIRST graduates who attend Clarkson because of the FIRST team, Clarkson's involvement with FIRST is also unique in at least one other area. A number of Clarkson graduates who participated in FIRST have started FIRST teams at their place of employment, thereby creating additional pipelines for future Clarkson students.

### **Sponsoring Multiple FIRST Teams at The Ohio State University**

The Ohio State University, which has participated in FIRST since 1996, is developing a new model for university involvement with FIRST. Instead of supporting a single team, OSU sponsors 3 FIRST teams along with 2 teams in FIRST's Junior Robotics program for middle school students. Each OSU team is unique in its origin and makeup. The OSU teams include a traditional high school, an all-girls high school and the home school community. The OSU FIRST team includes 70 university students and 90



high school students. In addition, there are approximately 50 OSU alumni who periodically contribute to the project. Several alumni have started new teams. A small contingent of OSU faculty and staff are also members of OSU FIRST. The FIRST experience at OSU encourages creativity and introduces project management and leadership into the university students' engineering education. Like other universities that sponsor FIRST teams, OSU sponsors scholarships that are only available to FIRST participants.

OSU students participate in the project as an extra-curricular activity, but are afforded the option of participating in FIRST as a course which can be used to satisfy technical electives. With such large-scale involvement, and acknowledging that graduating students leave and incoming students are always entering the program, OSU is developing a systematic approach to lead FIRST teams. The OSU team hosts a seminar series in the fall to indoctrinate all team members on the basics of design,

Engineering has been collaborating with Hendrix College, a hands-on liberal arts school, since their initial participation in FIRST in 2000. A two-semester course has been developed at UALR that integrates lecture material, practicum experiences, homework exercises and community service using the FIRST Robotics Competition as the focal point of the course.



The first semester course "FIRST in Engineering I" is comprised of lectures and workshop activities while the second semester course "FIRST in Engineering II" is devoted to the design, construction and competition aspects of the FIRST Robotics Competition. Mentorship of the high school team members occurs during each course.

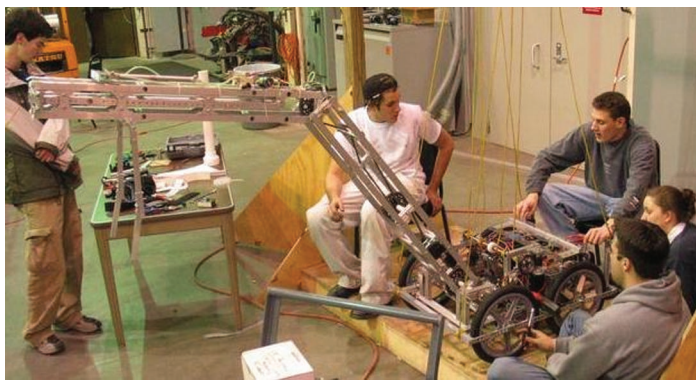
The course stresses the significance of an engineer's ability to train young engineers in industry. An essential portion of the course is service-learning. As engineering mentors the university students train the high school students in basic machine shop operation, electronics, fabrication, computer aided design software and engineering measurements. The progress of the high school students' skill level is considered when assessing a grade for the course.

This use of the FIRST Robotics Competition is a model service-learning program for it reaches beyond the classroom and into the community and profession. The experience provides students with the opportunity to learn and utilize skills that not only benefit society but will also help the graduates as they mature in their engineering careers.

### ***FIRST and U.S. Service Academies — Powerful Allies***

The U.S. Naval Academy and the U.S. Coast Guard Academy experiences with FIRST have greatly benefited a large number of student participants and the institutions as a whole. Though separate institutions, these two U.S. Service Academies have each sponsored teams, used FIRST in the engineering curriculum and have recruited FIRST students to their academy. The USNA has further distinguished itself as a host of the Chesapeake Bay FIRST Regional Competition which brings thousands of students to the Naval Academy for a weekend of competition and camaraderie.

Both academies sponsor FIRST teams as a component of



construction and teamwork. The winter quarter is devoted to the competition season and that work is immediately followed in the spring quarter by project documentation, fundraising and planning for the next season.

With this large number of participants and the volume of information to share, OSU makes a special effort to convey essential information efficiently and effectively to all team members. The seminars and web-based communications have been essential tools in this area. To improve the process, OSU plans to create a FIRST class for the fall quarter. This class will formally introduce OSU students to robotics design and construction and simultaneously be a mechanism to record, preserve and share the many lessons learned from leading 3 FIRST teams.

### ***Service-Learning at the University of Arkansas Little Rock***

The University of Arkansas Little Rock (UALR) and Hendrix College have successfully participated in the FIRST Robotics Competition as a service-learning project. UALR's Donaghey College of Information Science Engineering and Systems

the midshipman/cadet capstone design course in Mechanical Engineering. At each institution the cadets/midshipmen lead high school students from their local community through the project during the spring semester. Given the tight timeframe of the design/build cycle and the intensity of the competition



phase, these future officers obtain significant experience leading technical teams. The remainder of the semester is devoted to additional analysis, experimentation and documentation of the subcomponents and completed design.

FIRST technology is also used in other courses at both academies. For example, the FIRST control system, a C-programmable microprocessor architecture with an integrated wireless communication system, and the sensors from the FIRST kit of parts have been used in non-FIRST robotics courses at the U.S. Naval Academy. At the U.S. Coast Guard Academy a mini-version of the FIRST project has been added to the sophomore level "Introduction to Mechanical Engineering Design" course. Also, a summer program for engineering outreach, which brings 500 high school seniors to the USCGA for a weeklong engineering challenge, has been modeled on the FIRST Robotics Competition and hardware.

Each academy continues to benefit from its investment in FIRST as a number of incoming midshipmen/cadets have FIRST experience. FIRST team members are highly desirable at these institutions since the members are technically literate, motivated team players with high levels of initiative.

### **FIRST and Universities — Partners Working Together**

These examples are just a few of the many valuable ways universities have used FIRST at their institutions. FIRST has proven to be a powerful tool to teach engineering design, energize university students about their profession and draw new students to participating universities. While the majority of these case studies have focused on the FIRST Robotics Competition, other universities have had success using the FIRST Junior Robotics Program to connect with and inspire middle school students.

Because of the impact FIRST has on its participants it is not

surprising to find FIRST high school graduates starting new FIRST teams at their university. Nor is it uncommon for university graduates who have participated in FIRST to start new FIRST teams as young engineers. As demonstrated by this commitment to share the experience with others, it is obvious that FIRST works — transforming the lives of its participants.

### **Contact Information**

For information on how your university can be involved in FIRST, or to contact a university faculty member who participates in FIRST, please call FIRST ([www.usfirst.org](http://www.usfirst.org)) at 800-871-8326.

### **ASME & FIRST**

The American Society of Mechanical Engineers is a 125,000 member professional association committed to technological literacy by supporting improvements in the quality of math/science education for grades K-12. ASME and FIRST joined forces through an agreement of affiliation whereby both agree to work together to foster technological literacy. Central to the partnership is ASME's commitment to extending the reach of FIRST.

ASME encourages its members to get involved at every level of the competition including sponsoring teams, joining teams, hosting FIRST workshops, and volunteering at FIRST events. ASME sponsors college scholarships for FIRST participants who are nominated by ASME members from their team.

ASME has documented the opportunities for universities and its members to participate in FIRST at: <http://www.asme.org/education/precollege/first/first.htm>.

