The Race Is On!

And mechanical engineering students are ready for the challenge
The Race is On!

Experiential learning is thriving at Colorado State, as senior design projects bring the business world into the classroom

By Michelle Ross

The millennium is fast approaching, and Colorado State's College of Engineering is arming its students with the power to control the future. In the college's senior design class students must envision the future, while at the same time create a working specimen under today's limitations. This class requires a marriage between business sense and engineering knowledge. The students do not have a choice but to face the world head-on and create a project that intrigues the engineer in all of us and satisfies the businessperson controlling the purse strings.

"The exciting thing about senior design, as it is structured now, is that it models the real world, especially a large corporation," says mechanical engineering Professor Fred Smith. Smith has a long history with the senior design class. He has watched the course evolve over the past several years, and he believes the quality of Colorado State's senior design course in the 90s is far superior to that of the past and surpasses similar courses taught at other universities.

Before 1996, students in senior design worked in small groups on individual projects. Often those projects involved working with a company to help solve a problem. But in that environment the consistency of the experience was lacking. "We found a wide variation in the quality of the projects and therefore a wide variation in each student's experience," says mechanical engineering Associate Professor Don Radford.

The course was restructured in 1996 to include three basic projects, with several teams working on each project. Radford likens the new course design to the cutting-edge corporate practices of the 90s. "The premise is in the idea of building concurrent engineering principles. Instead of taking three people at random and putting them into a group, we take people who specialize in certain areas and put together a team based on the needs of the project."
Students submit applications and interview for positions on one of the three projects: the walking machine, the human powered vehicle, or the SAE Formula One racecar. The competitive nature of the team appointments provides students with a preview of the job search process. And the final competition provides students with strong motivation to build outstanding machines. That dedication to senior design has brought home trophies to Colorado State. Members of the Walking Machine Team have earned First Place in eight of the last twelve Walking Machine Decathlons. And last year, Colorado State was the highest placed rookie team in the HPV Collegiate Competition.

"I think the students are reacting quite differently to the class now," says mechanical engineering Associate Professor Patrick Fitzhorn. "I'm surprised at how many freshmen we have in mechanical engineering who have told me they have come to Colorado State specifically to be involved in the senior design course."

What makes this course so special? Fitzhorn names three overall goals of the program: 1) motivate and excite the students, 2) provide students control over the project, and 3) make the experience relevant. These objectives are reached by structuring the course like a business and entering the final product into a national competition at the end of the year.

Improving communication skills is another goal of the senior design class. Students are required to make oral presentations throughout the life of the project. "If you are a good engineer you have to be a good communicator so you can relay what you know," observes Weishaar. Steven Abt, a civil engineering professor and senior design instructor for fifteen years, agrees with Weishaar. Abt says engineers can be very good communicators but may lack the opportunities to exercise their communication skills. Senior design is one avenue for students to practice speaking in front of a group. "The course is now far better at teaching communication skills and tying communication skills to technical content," says Abt.

Good communication skills, job interviewing experience, fundraising practice, and a job in a corporate atmosphere are just a few of the benefits of the senior design course. Mechanical engineering Assistant Professor Mick Peterson sums up the experience of senior design. "What I see us doing is internally giving students the corporate experience, except a lot more efficiently and a lot more pleasantly than sending them out to work in a factory or on an industrial project.

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Kerrie Thompson, a mechanical engineering senior, realized the positive implications senior design could have on her future when she was just a freshman at Colorado State. As a sophomore she worked on the redesign team for the walking machine. As a junior she was co-captain and helped select the current machine's design. "I think it is very valuable to allow undergraduates to work on projects like senior design," says Thompson. "It is valuable because it creates a legacy." Now that Kerrie is a senior she wants to try working on the human powered vehicle.

As in any business, management of the budget and fundraising are key components of the project. Senior design student Derek Weishaar has spent countless hours on the phone raising money for this year's human powered vehicle, and says the fundraising process is a good learning experience. "I'm a hands-on person, I like to get down and start building, but I know that financing is a big part of the project. Making those phone calls helps with the communication skills I will need in the future."
Our Fall 1998 issue of REVIEW highlighted ongoing research in the Department of Atmospheric Science. Many thanks to our readers who took the time to respond to this article on the important topic of global climate change. If you missed the publication, please contact us.

In contrast, this issue deals with important aspects of undergraduate engineering education. We are proud of our long tradition of offering senior design courses where we pose realistic engineering problems. We are equally proud of our systematic attempts to bring the opportunity for research closer to the undergraduate curricula: Research Experiences for Undergraduates (NSF-sponsored REUs) have been part of our summer activities for many years. Last summer we hosted four of these programs in the College of Engineering at Colorado State University, one each in chemical engineering, civil engineering, electrical engineering, and mechanical engineering.

The third contribution in the Winter issue of REVIEW focuses on the way our discussions in the planning of our new and expanded engineering building impacted our curricula. All our students will benefit from the integrated learning experiences emphasizing experiential learning. Experiential learning has been a component of the College undergraduate program for at least ten years, but now all the pieces are falling into place.

We hope you will enjoy reading about our innovative undergraduate curricula and the opportunities we provide to our students. We would love to hear from you if you feel like responding to any or all of these contributions.

Johannes Gessler, Interim Dean
The new Engineering Design Studio in the College of Engineering at Colorado State is the culmination of over six years of effort by faculty in Civil, Mechanical and Electrical Engineering. It is a key laboratory in the major revitalization of the College of Engineering’s undergraduate laboratory and teaching building: a $23.2 million campaign that includes a $17.2 million renovation/expansion of the Engineering Building, $1 million for capital extensions, $2.5 million for student scholarships and faculty position endowments, and a minimum of $2.5 million for furnishings and equipment. The 5,500 square foot Design Studio, strategically located in the second floor of the center wing of the building between the two new high-bay integrated laboratory complexes, combines a number of discipline-specific laboratories in the old building into a single new and exciting facility. The Design Studio has three major goals:

1. It will act as the host facility for interdisciplinary undergraduate student teams working on complex engineering design problems.
2. It will act as a bridge facility between academia and industry by providing “real-world” facilities and an environment modeled after similar facilities at Hewlett-Packard and Lockheed Martin, and
3. It will be cooperatively managed by an interdisciplinary team of faculty.

The Design Studio is a direct response to members of our business and industry advisory panels, who are issuing calls for graduates who function well in teams and groups, who understand and respond positively to cross-training, and who can discover integrated solutions that support the vitality and competitiveness of our society. The American Society for Engineering Education, the Carnegie Foundation for the Advancement of Teaching, the Boyer Commission on Educating Undergraduates in the Research University, and the National Science Foundation have all placed a high priority on teamwork and collaboration in undergraduate education. In response, Colorado State has made integrated learning — learning across academic and professional disciplines — its highest academic priority.

This open, shared facility is modeled after engineering offices found in industry including the Hewlett-Packard Fort Collins facility and Lockheed Martin Astronautics’s Shared Technology Laboratory. The studio will support the engineering design activities of student teams, including communication in all forms (telephones, fax machines, printers, projectors, virtual communications abilities, and so on), group dynamics requirements (conference and group work areas), and significant engineering design, simulation and analysis needs (high-performance workstations with appropriate software and peripherals). Like most undergraduate labs in the new building, it will be open 24 hours a day, 7 days a week using student ID card locks.

No longer will concrete walls separate our disciplines. For students, these changes mean more relevant educational experiences and the chance to work with students from other disciplines. For faculty, this means a more collegial environment and closer interdisciplinary collaboration.
Summer Sojourn

NSF program provides undergraduate students with the opportunity to test their skills in a research lab

By Michelle Ross

Colorado State mechanical engineering senior Amy Lyons watches intently as a herd of snowboarders swoosh past her on the Colorado mountainside. She surveys the boards with a critical eye. You see, Amy’s dream is to design the best snowboards in the world. Little did she know that researching artificial hip replacements would bring her closer to that dream, but it has.

Amy is one of eight students who recently participated in a ten-week summer research program at Colorado State called Research Experiences for Undergraduates in Mechanical Engineering (REUME). The program is funded by the National Science Foundation. NSF’s goal is to advance science and engineering in the best interest of humanity. REUME’s goal is to promote engineering research and entice undergraduate students to continue their education on to graduate school.

“Most undergraduates do not know if they are going to go to graduate school, and a lot of them just don’t even consider it,” says NSF/REUME Program Director Sue James. “With the REUME, we are giving them an opportunity to see the benefits of postgraduate education. A master’s or doctorate in engineering will open career paths to these students that they could not pursue with just a bachelor’s degree. There are important roles in both industry and academia for engineers holding graduate degrees. With the excellent job market for engineering undergraduates, we have to put a little extra effort into demonstrating the rewards of graduate study in order to entice our good undergraduates into graduate school.”

Colorado State has hosted the REUME program for three years. In addition to the REUME, the College of Engineering and NSF were co-sponsors of three other REU programs during the summer of 1998: civil engineering, chemical engineering, and electrical engineering. James, an assistant professor of mechanical engineering, feels the program has been a great success; 80 students annually apply for the eight REUME positions open each summer.

REUME student Amy Lyons adjusts the load-soak station she designed and built to accompany a hip simulator for wear testing implants.

Last summer the REUME program offered four areas of research: biomedical engineering, manufacturing monitoring, implantation, and composites. Amy Lyons found herself working in the biomedical engineering area, a popular engineering field for women. “I’ve just learned so much,” says Lyons. “Research is really intense, but I’ve realized how much I like the design aspects of engineering.”

For ten weeks in the summer, students accepted into the REU program are given the opportunity to live the life of a graduate student and perform research alongside faculty members. For Amy Lyons and others like her, those ten weeks may be all she needs to decide to change her life and set new goals...goals that reach beyond anything she had imagined.

Carolyn Avne pours the liquid nitrogen trap attached to the vacuum oven used during her synthesis of new polymers for total hip replacements.

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