Celebrating the Capstone
Also inside:
Engaging students in the Land O’Lakes Global Food Challenge
he primary goal of the Capstone design class in the University of Arizona’s Biosystems Engineering program is to provide a student-driven interdisciplinary design experience for our students. Benefits for the students include expansion of skills, opportunities to work with professionals in industry, and ultimately obtain a job. A benefit for the Department of Agricultural and Biosystems Engineering is contact with industry supporters and outside funding for projects. Recruiting meaningful projects for the students is a year-long effort with our industry partners. This effort steps up in the summer as the fall semester looms. Most studentsregister for their fall classes in March or April. Once the class roster is available, the instructor starts polling the students on their interests and backgrounds. This information is used to prioritize the search for projects and establish the number of projects that will be needed. Faculty members are solicited to mentor the projects, and the industry sponsors are asked to cover the material costs. The ABE department has some funds of its own ($1,000 per project), so we also accept one or two projects per year from faculty or industry without funding.

The first few class meetings in the fall are used to continue the project selection process. Questionnaires are distributed to the students to gather details on their skills and interests. A second handout provides short descriptions of the available projects. Normally, the instructor can readily assign students to the various project teams. In rare cases, there may be groups of students who do not connect with any of the available projects. When that happens, the instructor meets with them to identify common interests, and the search begins for additional projects.

The primary instructional goal of the fall semester is to teach the design process to the students. The lectures start with preliminary tasks, such as process diagrams, data collection, and identification of standards applicable to the design, ethics, safety, and environmental consequences of the projects. The lectures include a presentation on LEED because students are encouraged to evaluate their projects based on life-cycle costs. The students’ ultimate goal for the semester is to have a final design completed and accepted by their mentors.

Once the preliminary skills needed for design are mastered, the students meet with their mentors to obtain further project information so that they can move ahead with alternative formulations. These alternative designs are based on client-provided constraints, but the students are encouraged to formulate outside-the-box solutions. The alternatives are then compared in a decision matrix using standard criteria that include capital cost, operation and maintenance costs, skill level required to operate the design, and environmental impacts. The students present their decision matrixes to the class and their mentors in a round-table format. The preferred alternative is typically a combination of features from multiple designs. Once a preferred alternative has been identified, the students prepare a final design. Designs should include computer-generated drawings (ACAD or Solid Works), material lists, a refined budget, and a detailed implementation schedule. We teach Microsoft Project. This software is an expensive add-on to the MS Office package, but we feel that it is an important skill for the students, as they will encounter this tool in industry.

The design phase is the key to success in the construction phase. If the students don’t have a detailed design, then they will have trouble staying on schedule.

All of our students are expected to fabricate their designs. Our instrument maker teaches the students how to use the shop fabrication equipment. Many teams start with models printed using department 3-D printers. Most teams have a team leader, whose job is to update the MS Project schedule, assist with procurement of materials, serve as primary contact with the mentor, and manage the team. So far, we have mastered the technical side of teaching project management; in the future, we will spend more time on the personnel side of the equation. The construction schedule is dictated by the Design Day competition, which is sponsored by our College of Engineering. The college brings in judges from industry to review over 100 Capstone projects and award cash prizes to the teams. Team management becomes critical as the semester winds down and Design Day approaches.

A container-based growth chamber was developed at the request of a UA donor who challenged students to provide a percentage of daily nutrition needs for a family of four living in an apartment.

**Mushroom Growth Chamber**

An inquiry came from an individual in Atlanta looking for a student team to design and build a container-based mushroom growth chamber for a food desert. Twelve students were interested in this project, so we divided the project into three teams: irrigation, plant infrastructure, and growth chamber. A student project manager was chosen by the students to handle communication between the teams and the mentor, acquire the needed supplies, update the MS Project schedule, and manage the team members. Each team also had its own team leader. The project was a great success and culminated with the sponsor coming to Tucson for Design Day. The success of this project has inspired the sponsor to fund other projects in the future.
Dear Kitt,

Just a small note of gratitude for your excellent contribution to Resource's first-ever capstone issue. You pulled off a wonderful article in record time! And what a "copy"—solid, polished writing that is so engaging. I wish we had more room for pictures, but the cover is the best. Thank you for everything.

Comps are enclosed for you and Peter. I hope you are pleased—we certainly are! Many, many thanks!

Jane