INDUSTRY SATISFACTION

I/UCPC faculty advisors meet on a regular basis to discuss improvements to the senior design course sequence so there will be continuous improvement in student team performance. This review process has resulted in steady improvement in the performance ratings that the student teams receive from industry sponsors. Sponsors have consistently awarded CU engineering students an average industry satisfaction rating of 4.1 on a 5-point scale, where 3 indicates "satisfied" and 4 "very satisfied."

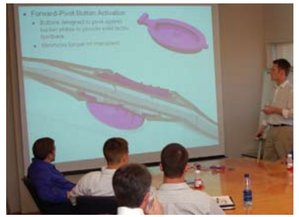
> "The students in the I/UCPC are allowing us to solve product design problems more quickly. At the same time, they're learning skills that will better prepare them for an engineering career. By developing new testing concepts for our drives and streamlining the data they acquire, they are ultimately helping to improve Seagate products and their time to market."
>
> – Wally Dague, Sr. Engineering Manager, Seagate Technology

> "MicroMotion feels that the senior design projects that we have done over the past several years have been quite successful. The first two projects involved the design of flow test stands that are now part of MicroMotion's standard testing facilities. The students provided significant engineering effort in the design of these stands, allowing MicroMotion to implement the test facilities with less impact on our people's time. The next two years of projects involved some proprietary research into a new technology. MicroMotion was able to guide the students into researching the feasibility of this new technology."
>
> – Denis Henrot, Vice President of Engineering, MicroMotion

I/UCPC PROJECT SPONSORS

More than 185 engineering projects have been completed in the I/UCPC since 1999. Our sponsors have included the following companies:

Agilent Technologies • ATK
Ball Aerospace & Technologies Corp.
Boeing • BP • Cobe • Colorado MedTech
Composite Technology Development
CONMED • Coors • Covidien (ValleyLab)
Exabyte • Ford • Gambro
Hewlett Packard • iCast
InfoPrint (IBM/Ricoh) • Intel • IBM
Karsten (Ping) • Lockheed Martin
Maxtor • MicroMotion
National Institute of Standards & Technology
National Renewable Energy Laboratory
Nautilus • Sashco • Seagate Technology
Seaton • Shell • StorageTek
Toucan Design • Transit Marketing
United States Ski Association
CU Health Sciences Center
Woods Hole Oceanographic Institution



An integral part of the education process, the Covidien (ValleyLab) senior design team presents its project results to Covidien engineers and management.

Industry Sponsor Fee for 2008-2009: $15,000.

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About the Department of Mechanical Engineering

The Department of Mechanical Engineering at the University of Colorado at Boulder enrolls more than 550 undergraduate and 120 graduate students. Its 27 faculty members are distinguished in teaching and research, working in the areas of fluid mechanics, thermal sciences, environmental engineering, solid mechanics, materials sciences, design, and manufacturing.

The department sponsors or co-sponsors four interdisciplinary research centers and receives more than $4 million annually in sponsored research awards. The department has leading research programs in micro/nanosystems engineering, biomechanical engineering, advanced materials, energy, and environmental engineering.

www.colorado.edu/mechanical

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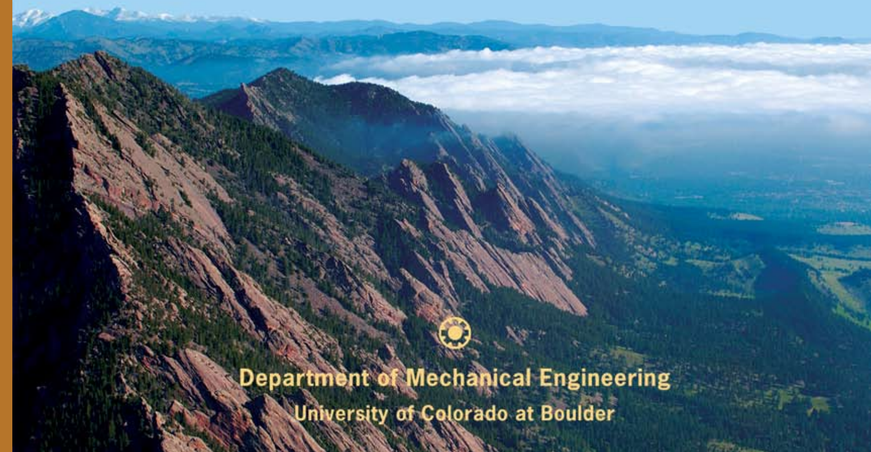
An Innovative Partnership Benefiting Students and Engineering Industry

INDUSTRY/UNIVERSITY COOPERATIVE PROJECT CENTER



Department of Mechanical Engineering
University of Colorado at Boulder

INDUSTRY/UNIVERSITY COOPERATIVE PROJECT CENTER

WHAT IS THE I/UCPC?

The Industry/University Cooperative Project Center is a new concept in engineering education, fostering innovative, technical collaborations with business, industry, and government agencies.

The I/UCPC brings real industry projects to the senior design course sequence in mechanical engineering at the University of Colorado at Boulder, where integrated teams of 4 to 6 students, a professor, and an industry mentor develop workable solutions.

Student teams, which also may include a graduate student or a student from another engineering discipline, work on assigned projects for two consecutive semesters and deliver tested, functional hardware and documentation to the industry sponsor at the completion of the project.

HOW IT WORKS

Throughout each I/UCPC project, the student team works closely with its faculty advisor and industry mentor, who provide technical support and oversee the project to ensure it meets specifications and is delivered on time.

Industry sponsors pay a fee for each project and benefit from students' fresh ideas, gain an edge in recruiting top students to their company, and obtain a working piece of hardware at the end of the project. A company's investment also can result in a competitive advantage, with the company retaining exclusive rights to the intellectual property developed.

While the students gain valuable experience working with professional engineers, the sponsorship fee helps to support the Durning Laboratory in the Department of Mechanical Engineering where students design and build hardware for their senior projects. Students also may work in the college's state-of-the-art Integrated Teaching and Learning Laboratory or at the sponsor's work site if desired.

Sponsors are asked to provide a mentor who can commit 10 hours per semester to support the student team. Each student team will commit more than 1,000 hours to the project, and the engineering faculty advisor will devote approximately 40 hours.

Each year, the team submits approximately four written reports and as many oral presentations on product development and testing. Students work within time and materials budgets, while gaining experience with industry procedures such as writing purchase orders and meeting deadlines under pressure. Over the academic year, a dynamic relationship is developed, allowing the student team's invention to come to fruition as a real engineering innovation benefiting the industry sponsor.

The Covidien (ValleyLab) senior design team, which includes five students, a faculty advisor, and two Covidien mentors, meets to discuss preliminary test results obtained for a new medical device the team developed.

> "The senior project allows Agilent Technologies to investigate a technology, process, or other product feature that we can utilize in our business and to find individuals for employment. Students from CU have developed new technologies for X-ray enclosure shielding, an X-ray shut-off mechanism, and a new printed circuit board conveyor. During the year-long project we are able to get to know students while they are training in real world engineering processes."
>
> – Patrick Batten, Development Engineer
> Agilent Technologies

> "Seagate Technology has sponsored a senior project for the past two consecutive years. Both times, the results have been very satisfactory. The objective of the most recent project was the development of a test fixture. We found the students to be very enthusiastic when presented with an opportunity to resolve a 'real life' problem. As the school year progressed and we met with them periodically, you could see growth in their thinking processes and communication skills."
>
> – Shirley Chessman, Sr. Engineering Manager
> Seagate Technology

The Intel senior design team performs tests to characterize new thermal electric modules from Intel. The team developed an entire test system and efficient test methodology for these thermal electric devices.

SAMPLE I/UCPC PROJECTS

Agilent Technologies - Product Improvements Students developed an improved shutter mechanism for an electronic board reliability analysis product sold by Agilent. The shutter subassembly consists of actuator devices that provide a somewhat complex motion to the shutter within a restricted geometry. The shutter operates reliably and with a relatively short cycle time. There was also a significant cost reduction associated with this new design. The mechanism operates automatically and is controlled by various optical sensors.

Ball Corporation, Container Division - Test Equipment CU students developed a device to measure the wear experienced by dies used in the aluminum can forming process. A variety of die materials and lubricants can be tested in concert with aluminum cans. Tribology theory and the experimental data obtained are used to make wear predictions. Wear is controlled by the geometry of the die material used and by the contact forces between the aluminum can and the die. A data acquisition system and analysis program are utilized to calculate stresses, coefficient of friction, and distances traveled, and to store the data obtained.

The Composite Technology Development senior design team performs tests to characterize a new shape memory polymer material for which they are investigating product applications.

Exabyte - Manufacturing Process Improvements Working one to two mornings a week at the company's Boulder manufacturing site, CU students designed a mechanism to improve the assembly of a robot for a tape library product. The subassembly design made use of pneumatically activated devices to accurately clamp and/or move components to specific datums. Exabyte personnel successfully completed the assembly of the robot mechanism using the students' design.

MicroMotion - Advanced Technology Investigations A team of students investigated the possible use of MEMS (Micro ElectroMechanical Systems) technology for very small size flowmeter applications. Design constraints such as size, signal output, cost, accuracy, etc., further complicated this effort. The team ultimately developed and fabricated a novel hybrid design for a very small flowmeter that met the design constraints.

PROJECT STAGES

FIRST SEMESTER

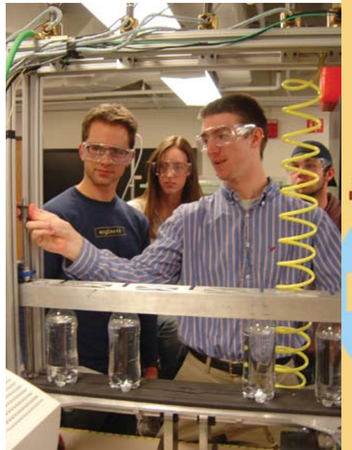
- **Project Selection** Sponsors select a student team after reviewing one-page project proposals submitted by one or more teams.
- **Specifications and Concepts** Students teams meet with faculty and industrial mentors to ensure a full understanding of the project.
- **Concept Selection/Analysis/Design** Teams select a course of action after appropriate theoretical, manufacturing, and specification analysis. Initial design work is completed and reviewed by faculty and industry members.
- **Theoretical Analysis** Relevant analyses are performed to improve the functionality and reliability of the design.
- **Comprehensive Design Review** A second design review with the faculty and industry mentors establishes final direction of the project.
- **Fabrication/Prototype Assembly** Fabrication of parts and assembly of the first prototype may be done in the Integrated Teaching and Learning Laboratory, Durning Laboratory, or at the sponsoring company's site.

SECOND SEMESTER

- **Initial Testing and Redesign** The prototype is tested to evaluate its performance relative to specifications.
- **Fabrication/Test/Redesign/Retest** The last two-thirds of the second semester is spent creating a fully tested and satisfactorily operational product. Two design iterations typically occur.
- **Operations Manual/Final Report** The student team compiles drawings, instructions for assembly, operation and maintenance, and other data necessary for easy duplication and maintenance of the hardware.
- **Final Presentation** The student team makes a final presentation to the sponsoring company.
- **Technology Transfer** The project may be further transferred to the sponsoring company via the hire—intern or permanent—of one or more student team members.

> "Senior Design Project was simultaneously the most challenging and rewarding of all my courses. It allowed me to apply complex engineering ideas I had already learned while broadening my skill set into areas that I had not previously been exposed to."
>
> – Brian Cone
> 2006/2007 ME Senior Design Student

> "Senior design is the most valuable component of the mechanical engineering curriculum at CU. By applying the theoretical concepts I had learned in my standard coursework to an actual project where the simplifications made in textbook problems are no longer valid and budget constraints and teamwork are crucial, I was better prepared to face real engineering challenges."
>
> – Darby Odell
> 2006/2007 ME Senior Design Student



The Ball Packaging senior design team demonstrates to its industry mentor a new automated shelf-life testing system for soda packaged in plastic bottles. The new tester dramatically reduces the test time compared to previous test methodologies.