The College of Engineering at Carnegie Mellon University is recognized worldwide as a leading research institution. Housed within the College are more than 22 major research centers. These centers or “pillars of excellence” give researchers the freedom to push the boundaries of technology, while providing unique educational opportunities for students. To keep our researchers attuned to the real problems facing engineers in the field, the College collaborates extensively with industry, resulting in mutually rewarding relationships.
The College of Engineering receives research funding from a variety of sources. Government entities, such as the National Science Foundation and the Department of Defense, for example, provide numerous grants. However, many of the College’s centers receive substantial funding from corporate sponsors through membership programs of varying flavors. These programs enable companies to influence research projects and derive benefits that have positive effects on their bottom line. As expected, CIT gains tremendously from these programs, too. We receive financial support that helps maintain our thriving research enterprise; however, just like our corporate sponsors, we benefit in ways that transcend dollars and cents.

The Beginning of Beneficial Relationships
The College has a long history of partnering with companies for research purposes. For example, in the 1980s, the Center for Iron and Steelmaking Research (CISR) was established with industry money that was matched by the National Science Foundation (NSF). “Back in those days, you had to go out and get industry members and funding. An NSF grant was continent on you getting industrial support,” says Richard Fruehan, the U.S. Steel Professor of Materials Science and Engineering and the founding director of the CISR. “If you got 10 or 11 companies to come on board, the NSF would give you your money,” says Fruehan. The culture encouraged interaction between academia and industry.

Today, like during the dawn of the CISR, Fruehan persuades companies to join the center by explaining how they can get a greater return on their R&D money. “Steel companies say, ‘We can’t justify or afford to do the long-term research we need to do.’ I say, ‘Let’s do it on a collaborative basis. The research won’t be of unique benefit to one company—all of our members will get access to 8 or 10 projects instead of just one,’” states Fruehan. His approach works. The CISR started off with 11 industry partners, and that number grew to more than 23, with a third of those companies outside of the U.S. (Our research was garnering international interest decades before “globalization” became a buzzword.) Since the center was founded, the steel industry has endured a number of recessions. Yet, in spite of mergers and companies folding, the center has more than 20 members and is the largest academic center for steelmaking research in the world.

“Most steel companies that produce in the U.S. belong to the center” and there are international partners, too, says Fruehan, adding, “If we were not the very best, we would not have survived.”

Similar to the CISR, other leading CIT research centers, including the Data Storage Systems Center and the Center for Advanced Process Decision-making, were founded in the 1980s with combinations of industry and government support. However, during this same period, a “new model for interaction” between academia and industry took root at Carnegie Mellon: the Center for Silicon System Implementation was founded solely with industry funding. “This type of collaboration was unheard of before, that is industry and universities coming together to do fundamental research,” says Shawn Blanton, a professor in ECE and the director of the Center for Silicon System Implementation (CSSI). “The impetus for this industry support was that Japan was surpassing the U.S. in the semiconductor industry. The Semiconductor Industry Association (SIA) got together and said, we need fundamental research, and the Semiconductor Research Corporation (SRC) was formed. Carnegie Mellon was the first school to get a Center of Excellence for chip design.”
People First

Though the years, funding has ebbed and flowed, yet CIT’s large, mature research centers are still running strong as a direct result of the relationships that have developed between the faculty, staff and students who work in the centers and their industry counterparts. Pointing to a shelf of books hanging above his desk, Fruehan says, “Every one of these black books is a Ph.D. thesis. I’ve been at Carnegie Mellon for 28 years and 30 of my Ph.D. students are in the steel industry, and they are strong supporters of the center.” Support from alumni working in the field has proven instrumental in maintaining a connection between companies and the College.

Blanton concurs with Fruehan’s assessment of alumni importance. This past fall, the CSSI celebrated its 25th anniversary by hosting an expanded Technical Workshop. (Invitations to participate in workshops and annual research review meetings are valuable benefits that companies receive when they sponsor CIT centers.) More than 125 people attended the two-day CSSI event that highlighted the center’s “technical homeruns” and visions for the future. Several leading industry figures delivered presentations, including John Cohn, Chief Scientist of Design Automation at IBM. During his talk, Cohn (Ph.D. ECE, 1991) explained that a number of the key technologies utilized in an IBM server came from the seminal work conducted in the CSSI. Other guest speakers included John Shen, the founding head of Nokia Research Center, Palo Alto and Ralph Cavin, III, chief scientist at the Semiconductor Research Corporation.

Working with prominent engineers from the private sector raises the level of Carnegie Mellon’s research. Ignacio Grossmann, the director of the Center for Advanced Process Decision-making (CAPD) explains that the majority of industry people who are active in the CAPD engage in leading-edge R&D. “The researchers who are involved in our center are high-caliber. They are the leaders in their fields, such as Jeffrey Siirola, who is a member of the National Academy of Engineering,” says Grossmann. By joining the CAPD, eminent researchers from over 20 major corporations gain opportunities to network. “They have access to newly published papers or papers that have been submitted for publication, giving them a head start on accessing useful information,” says Grossmann.
meetings, companies are able to influence the center’s research.

While benefits for partnering abound, Grossmann emphatically believes that access to our students is the chief benefit companies derive by sponsoring the center. Referring to the drilling project, Grossmann says “One of our students spent three summers in Houston working on the offshore project. Many CAPD students spend summer internships with companies.” He says, “We produce students with unique skills. It is difficult in the U.S. to find students that have education and training like ours. Places like Berkeley, Caltech, Stanford don’t have programs like the CAPD.”

Fruehan and Blanton agree with Grossmann on the great value companies place on CIT students. “Companies hire our Ph.D. students because they can hit the ground running,” says Blanton. By working with industry personnel and enlisting for internships, students pick up on the culture and issues that different companies are dealing with explains Blanton. “Our students are smart,” he says, “and when they spend the summer working with corporate partners, they get real-world, practical knowledge.” Continuing he explains that it is through the students that knowledge migrates from companies to the centers and vice versa. “In a seamless manner, technology is transferred,” says Blanton.

Then There’s the Research

Our students are heavily recruited and that’s because in part, they are working and studying in research centers that have earned international acclaim. Research that has literally transformed industries is conducted at Carnegie Mellon, and a good case in point is the information storage technology that has been developed in the Data Storage Systems Center (DSSC). “We are the best academic center in the world for hard drive technology,” says Jimmy Zhu, the ABB Professor and director of the DSSC. “All of the major hard drive companies sponsor us because we can help them resolve current technological hurdles and identify and develop the next wave in storage technology,” says Zhu. These are not overreaching remarks. A look at the DSSC Web site (http://www.dssc.ece.cmu.edu) reveals a list of their patents and affiliates.

The center formed in the late 1980s, led by University Professor Mark Kryder, and by 1989, the National Science Foundation (NSF) designated the DSSC an Engineering...
Another way in which both industry and CIT benefit from partnerships pertains to our students: research provides them with invaluable educational opportunities. The DSSC’s comprehensive approach attracted sponsors. “We understand the hurdles in storage technologies and we can walk the road that is financially too risky for industry,” says Zhu. The center, unlike a company, can engage in theoretical research without worrying about stockholders and quick financial returns. Another selling point is that the DSSC (like all CIT centers) is adept at leveraging interdisciplinary teams. Developing hard drive technology calls for expertise in a wide range of areas, including physical science, materials, electrical and computer engineering, etc., and people with all these backgrounds are at Carnegie Mellon. Thanks to a long list of achievements, alumni sited in key positions in key companies, and top faculty and students, the DSSC engages in productive collaborations with its industry affiliates.

“Companies will invest in us because of the quality of our research, our vision and drive for innovation,” says Zhu, adding that “a $250,000/year investment in the DSSC could result in many millions of dollars in net gains for a company.” Highlighting some of the key benefits sponsors receive, such as access to faculty, student recruitment, and networking opportunities, he notes the value companies place on advance viewings of...
In this industry, all you need is a six-month lead and you can have the next big thing.”

In With the New
Because of their success and longevity, the DSSC and the other major centers serve as models for newer Carnegie Mellon research groups. CyLab, which was founded in 2003 primarily with Army funding, is following in step and building a substantial industry membership program. Driven to secure computer and communications systems, CyLab is attracting both large companies and start-ups, including a number in the Pittsburgh area. “We are one of the largest university-based cybersecurity research and education centers in the U.S. Our partners get access to world-class research and experts,” says Gene Hambrick, the director of CyLab’s Corporate Relations. He explains that “start-ups become partners because they get to network with people from a number of national and international companies.”

“We like to say that there are four reasons to partner with CyLab: reputation, recruiting, research and return on investment,” begins Hambrick, as he outlines the merits of membership. Designated an NSF CyberTrust Center, the center commands respect. (The National Security Agency named the Information Networking Institute (INI), which partners with CyLab to extend educational and training programs, a Center of Academic Excellence in Information Assurance Education.) “Our partners find that aligning with us enhances their reputation,” he says. Another deal-making benefit states Hambrick, echoing his peers throughout CIT’s research centers, “is that companies can recruit CyLab students. Partners get preferential access to our brightest and best.” And what makes these students the best relates to Hambrick’s third motive for partnership: research.

“We are here for the research,” states Hambrick. “We have over 50 faculty members and 130 graduate students associated with the center, and these people go across a broad spectrum of disciplines—technology, policy, education. We are a one-stop shop. We can help companies solve their technical problems or train their employees. We are a resource for our partners. We are positioned to capture trends.”

The ability to identify and leverage trends is evident in CyLab’s thrust in mobility, which represents a significant growth area. “We have been doing work in mobility for years, but it became evident to Dean Pradeep Khosla that we need to create a center in CyLab to focus our mobility research,” say Hambrick. The genius surrounding the Mobility Research Center is that it is based both in Pittsburgh and at Carnegie Mellon Silicon Valley, which broadens opportunities for partners, faculty and students to interact.

Smart, agile moves like the Mobility Research Center, the enlistment of top faculty, and bright students draw companies into CyLab’s fold. When other benefits are factored in—the capability for companies to band together to stretch their R&D monies and early access to research findings—companies gain a lot of knowledge for a price that would be difficult if not impossible to achieve in house. And this case scenario holds true not just for CyLab, but for all of CIT’s major research centers. The work underway in our centers has a direct affect on engineering education, the field of engineering and often, a company’s bottom line.

For more information about the centers in this article:

Center for Advanced Process Decision-making
http://capd.cheme.cmu.edu

Center for Iron and Steelmaking Research
http://neon.mems.cmu.edu/cISR

Center for Silicon System Implementation
http://www.ece.cmu.edu/~cssi

CyLab
http://www.cylab.cmu.edu

Data Storage Systems Center
http://www.dssc.ece.cmu.edu

Jin Nakano, a post doc in the CISR demonstrates to journalists the experimental and computational work associated with steel research.