Engineering

PENN STATE

The Magazine of the Penn State College of Engineering

Fall 2011/Winter 2012

FALL 2011/WINTER 2012
Vol. 27, No. 2

EDITOR:
Curtis Chan

WRITERS:
Jane Harris
Brittany Kenworthy
Victoria Fryer
A'ndrea Messer
Kent Jackson

EDITORIAL ASSISTANT:
Stefanie Tomlinson

ALUMNI EDITOR:
Jennifer Theiss

PHOTOGRAPHY:
Curtis Chan
Paul Hazi
University Archives

GRAPHICS & DESIGN:
Snavely Associates

ADMINISTRATIVE OFFICERS:
President, Rodney A. Erickson; Interim Executive Vice President and Provost, Robert N. Pangborn; Harold and Inge Marcus Dean of the College of Engineering, David N. Wormley; Associate Dean for Research and Administration, Anthony Atchley; Associate Dean for Academic Programs, Renata Engel; Assistant Dean for Student Services, Jean Landa Pytel; Assistant Dean of Engineering Diversity, Amy Freeman; Director of Development, Mark Sharer.

Engineering Penn State is published twice yearly by Engineering College Relations.

Telephone 814-865-9031
FAX 814-863-4749

Penn State College of Engineering

Printed on recycled paper.

U.Ed. ENG 12-22

MIX
Paper from responsible sources
FSC® C007894

Contents

FEATURES

NEWS & NOTES

ABOUT THE COVER

Adding a global component to the engineering curriculum is a major College goal. Because not every student can travel abroad, classes have started incorporating 'virtual teaming' and using information technology to give students an international experience. One such class teams engineering leadership students with Hungarian students at Corvinus University. The campus is located at the foot of the Szabadság híd, or Liberty Bridge. The structure is the physical link to the city's two sides of Budapest and a symbolic link to Penn State.

Photo credit: Brittany Kenworthy

AE career fair remains a hit

More than 120 companies descended on the Bryce Jordan Center for the 18th annual Penn State Architectural Engineering Career Fair on Sep. 27. The companies were recruiting students for co-op, summer, research, and full-time employment for all design and construction specializations including construction, lighting/electrical, mechanical, and structural.

$2.6 million DOE contract creates Penn State nuclear security education program

Penn State received a $2.6 million contract from the U.S. Department of Energy (DOE) to create a nuclear security education program.

The contract is part of the DOE National Nuclear Security Administration's Global Threat Reduction Initiative and brings together Penn State, the Massachusetts Institute of Technology, and Texas A&M University to create a nuclear security curriculum. The combined total of contracts for Penn State, MIT, and Texas A&M is approximately $6.5 million.

Each university was tasked with developing one or two courses for the nuclear security curriculum. The universities will then teach their respective courses and transfer the materials to the other two institutions. The goal of this approach is to create a unified nuclear security program.

Aydin named interim electrical engineering head

Kultegin Aydin, professor of electrical engineering, was named interim head of the electrical engineering department effective July 15.

He replaces **Kenneth Jenkins**, who stepped down on Aug. 15 to pursue teaching and research in signal and image processing.

A member of the Penn State faculty since 1985, Aydin has served as director of the Communications and Space Sciences Laboratory since 2008 and is the department's graduate program coordinator.

Dong named new head of bioengineering

Cheng Dong, distinguished professor of bioengineering, was named the new head of the Department of Bioengineering, effective Aug. 1, 2011.

The major focus of Dong's research is to elucidate biomechanical, biophysical, and biochemical aspects of cellular function in the circulatory systems, with particular interest in cellular biomechanics, cell adhesion, cell migration, cell signaling, systems biology, and multi-scale modeling of biological systems.

New minor in sustainability leadership launched

Penn State's Faculty Senate approved a new intercollegiate minor in sustainability leadership, which is open to students in any major. The program was launched this fall.

Advising for the minor is handled by the Center for Sustainability. Requirements for the 18-credit minor include a new course—SUST 200 Foundations of Leadership in Sustainability—and a capstone project that will provide students the opportunity to gain experience applying sustainability principles in the field.

More information on the minor can be found at www.cfs.psu.edu/programs/minor-in-sustainability-leadership.html.

DOE awards $1.2 million for offshore wind power project

The Department of Energy awarded Penn State a $1.2 million grant for a project on offshore wind power.

The project's goal is to develop a computational Cyber Wind Facility that will provide wind energy researchers the capability to collect data that cannot be gathered from a field wind turbine facility, which has limited data collection capabilities.

The work is a collaborative effort between **James Brasseur**, principal investigator and professor of mechanical engineering, bioengineering, and mathematics; and co-investigators **Eric Paterson**, chief scientist at the Applied Research Laboratory (ARL) and professor of mechanical engineering; **Sven Schmitz**, assistant professor of aerospace engineering; and **Robert Campbell**, research associate at ARL.

ENGINEERING

newswire

STAY INFORMED, THE PENN STATE WAY

Keep up-to-date with what's going on in the College of Engineering through the Penn State Newswire. The Newswire keeps people who are interested in Penn State plugged into the latest University news as it's happening, often before the news media have the information. To have the Newswire delivered to your e-mail for free, go to **newswires.psu.edu**. Users can choose to receive news about the College of Engineering, general news, sports, arts and entertainment, and much more. Sign up for as many Newswires as you please!

Internet users can also find the latest Engineering Newswire stories, as well as new and archived issues of Engineering Penn State, on the college's dedicated news site at **www.engr.psu.edu/NewsEvents**.

EcoCAR team wins 4th place at nationals

Penn State's EcoCAR team garnered a fourth-place finish out of 16 universities at the EcoCAR: The NeXt Challenge's Year Three finals last June.

The team also won the Overall Safety Award, Editor's Choice Award, Best Outreach Progress Reports Award, Spirit of Outreach Award, AVL Drive Quality Award, Fastest Autocross Award, Best Well-to-Wheel Greenhouse Gas Award, and runner up for lowest fuel consumption.

The group also earned a berth in the next competition, EcoCAR 2, a three-year program that will require student teams to explore a variety of powertrain architectures focusing on electric drive vehicle technology.

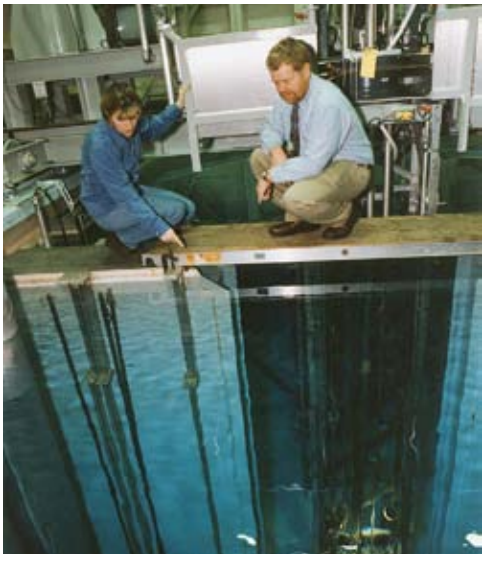
Schiff testifies to congressional committee

Steven Schiff, director of Penn State's Center for Neural Engineering and Brush Chair Professor of Engineering, testified before the U.S. House of Representatives Committee on Foreign Affairs, Subcommittee on Africa, Global Health and Human Rights, on Aug. 2, 2011.

Schiff discussed hydrocephalus—a buildup of fluid inside the skull—which is one of the most common treatable neurological conditions in childhood. Recently, Schiff and other researchers have shown that the majority of childhood hydrocephalus in East Africa, and perhaps much of the developing world, occurs after infections. According to Schiff, the broad implication is that most of the world's hydrocephalus is preventable.

There are more than 100,000 cases per year of post-infectious hydrocephalus in sub-Saharan Africa.

The hearings highlighted novel surgical techniques that have shown to be effective alternatives to time implantation of fluid shunts in children with hydrocephalus in developing countries.



Trustees OK Breazeale reactor classroom, lab renovations

Penn State's Board of Trustees approved plans to renovate 8,000 square feet of classroom and laboratory space on two stories of the Breazeale Nuclear Reactor Building.

The improvements will include a new elevator and renovated bathroom to comply with Americans with Disabilities Act mandates and will update all mechanical, electrical, and plumbing systems on the ground level and first floor of the facility's west wing. The renovations, which will cost $3.6 million, are slated for completion this fall.

Commissioned in 1955, the Breazeale Nuclear Reactor is the nation's oldest operating university reactor and is part of the University's Radiation Science and Engineering Center.

Photo credit: Curtis Chan

During a September 2011 ceremony, General Motors donated a 2011 Chevrolet Volt to the Center for Sustainability. The electric vehicle will be used to support the center's ongoing research of new transportation technologies. The Penn State Volt is one of only two Chevy Volts donated to institutions of higher education in the U.S. and the only one donated for the purpose of sustainable energy research.

Library dedicated in professor's memory

The Department of Electrical Engineering honored the late **Nirmal Bose** by naming a library in his honor.

The library is located in the Christopher Raspanti Memorial Digital Signal Processing Laboratory in 204 Electrical Engineering East.

Bose, the HRB-Systems Professor of Electrical Engineering, died on Nov. 22, 2009, at the age of 69 while on sabbatical at the University of Wuppertal in Germany.

His wife, Chandra, donated Bose's extensive library to the department.

White House honors Thole

The White House honored Karen Thole, head of mechanical and nuclear engineering, in December as part of its "Champions of Change" program.

She was recognized along with 11 others for her work in helping to recruit and retain women in the fields of science, technology, engineering, and mathematics.

The event can be viewed online at www.youtube.com/watch?v=qkapBbp3Vuo.

Photo credit: Anthony Atchley

Sponsors support Penn State

Industry officials who sponsor student capstone projects each semester in the College of Engineering presented Penn State with a signed banner expressing support for the University in the wake of the Jerry Sandusky child abuse scandal.

Photo credit: Brittany Kenworthy

Helping hands

The Engineering Ambassadors braved cold November temperatures to gather signatures for a support wall they erected in front of Old Main to express student, faculty, and staff support for the Second Mile charity organization.

The Second Mile was rocked by charges that its founder, former Penn State football defensive coach Jerry Sandusky, sexually abused children.

Photo credit: Department of Public Information

Wind turbine installed at Center for Sustainability

A 70-foot-tall wind turbine was installed at Penn State's nine-acre Sustainability Experience Center. Serving as both a source of clean, renewable energy and a research tool, the turbine is being funded by a Pennsylvania Energy Development Authority grant awarded to the University's Center for Sustainability in 2007 for development of the Hybrid Residential Energy Systems Laboratory.

In addition to providing renewable energy generation for the laboratory, the turbine will be used as an educational tool in the Pennsylvania Wind for Schools program.

The turbine, a Southwest Windpower Skystream 3.7, produces a peak of 2.4 kW of electricity when the wind blows above 25 mph. The 3.7 in the product's name indicates the rotor diameter in meters—equivalent to 12 feet. The rotor is installed on a 70-foot tower with a motorized winch to raise and lower the tower for easy access to the turbine for demonstrations and research.

Penn State ranked top school for aerospace hires

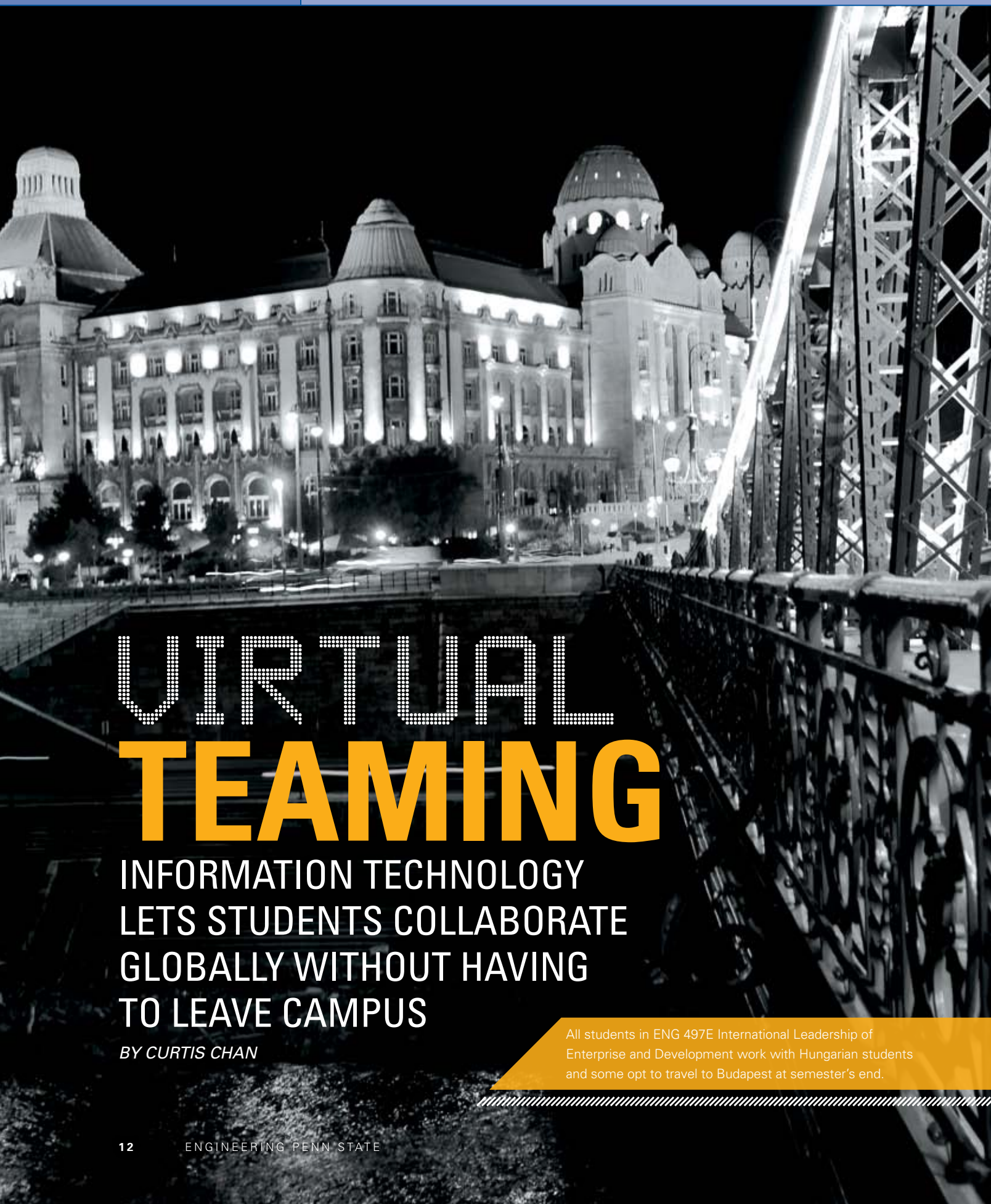
The University was ranked the top engineering school for aerospace and defense company recruitment in the 2011 Aviation Week Workforce Study.

In the study, Aviation Week polled aerospace and defense companies to find out from which institutions they hire the most graduates. The respondents ranked the universities based on the school's reputation, degree program offered, location, and diversity.

Penn State was ranked first among a list of universities including Georgia Tech, California Polytechnic-San Luis Obispo, Purdue University, Virginia Tech, and the University of California Los Angeles.

Follow Us!

The Penn State College of Engineering can be found on Facebook at www.facebook.com/psuengineering and on Twitter @PSUEngineering!



VIRTUAL TEAMING

INFORMATION TECHNOLOGY LETS STUDENTS COLLABORATE GLOBALLY WITHOUT HAVING TO LEAVE CAMPUS

BY CURTIS CHAN

All students in ENG 497E International Leadership of Enterprise and Development work with Hungarian students and some opt to travel to Budapest at semester's end.

Say "global experience" and visions of architectural engineering students studying ancient Roman ruins in Italy or a team from Engineers Without Borders providing assistance to an African village may spring to mind.

But for students in an engineering leadership development class, International Leadership of Enterprise and Development, their global experience begins in Hammond Building.

The room itself is nondescript—a long table with a wood veneer surrounded by executive-style high-back chairs. The front wall sports a camera and microphone mounted on it, flanked by two 52-inch HDTVs.

But moments later the flat screens come alive with the images of other twenty-somethings.

"Hello? Hello? How are you?"

At the other end are students from Corvinus University in Budapest, Hungary.

STAYING HOME FOR INTERNATIONAL EXPERIENCE

For the College of Engineering, a major effort has focused on providing students some type of global experience. But mandating that every engineer travel overseas would be unrealistic, not to mention expensive.

So numerous faculty have turned to information technology as a means of delivering their students such an experience, all while never having to pack a single suitcase.

"When you look at global components, what's the most cost-effective way of doing those things? Information technology is still the low-hanging fruit," says **Richard Devon**, professor of engineering design in the College's School of Engineering Design, Technology, and Professional Programs.

Devon was an early proponent of internationalizing the engineering curriculum beyond traditional study abroad and class trips. Recalling his experience with early computer messaging in the 1980s, he began thinking about how he could leverage the technology—primitive by today's standards—into a teaching tool.

Heading overseas isn't feasible for every engineering student. Students in International Leadership of Enterprise and Development can choose to go to Hungary to make their final project presentations. The students who travel can see ancient Roman ruins and Soviet-era architecture.

"The screen was split. It was just chat technology. At the top of the screen were the incoming messages and at the bottom of the screen were the outgoing messages," he says. "It was very crude. Just text on the screen, but it was live."

That experience in mind, Devon proposed a partnership with L'Université d'Artois in Bethune, France, in 1998 to do a design project.

Despite his best intentions, Devon says the effort wasn't as successful as he had hoped.

"It didn't work very well," he states, explaining that many of the French students weren't committed to the project and Devon's counterpart saw the partnership not as a way to get American and French students to work together, but as a vehicle for the French students to hone their English-speaking skills.

A major key to successful virtual teams, Devon believes, is that the two sides must be in sync with their goals and expectations for the partnership.

Photo credit: Curtis Chan

Although technologies such as Skype, texting, and instant messaging allow Penn State engineering students to communicate with their foreign partners, participants say it doesn't replace meeting a person face to face. Here American students and Hungarian students sit together in lectures and presentations at Corvinus University.

THE REALITY OF VIRTUAL TEAMING

Today a number of engineering courses integrate some type of international component in class. But successfully melding a global element with a course can be tough for both the faculty and the students.

"Finding the right partner universities was an interesting challenge," says **Martin Trethewey**, the Arthur L. Glenn Professor of Mechanical Engineering Education. He and colleagues **Ed De Meter**, professor of industrial engineering, and **Leland Engel**, director of mechanical engineering design projects and instructor in mechanical engineering, sought to add a global component to the traditional capstone engineering course, where an industry partner sponsors a semester-long project for a student team to solve.

"We started making telephone calls to India, China, France, and England," Engel recalls.

De Meter states that many foreign universities don't have a capstone requirement for their seniors and when they did, the projects were usually individual senior thesis papers.

Adding to the difficulty in securing a partner is the difference in calendars between institutions.

"Each semester there's a potential for a small to a very large mismatch in academic schedules, and so that puts restrictions on what you can or cannot do," De Meter says.

For the capstone course, Penn State's fall schedule coincides very nicely with the trio's partner institutions of National University of Singapore and Seoul National University in South Korea, Trethewey remarks. In the spring semester, China's Shanghai Jiao Tong University takes the place of Seoul because the schedules match better.

They began a pilot program in spring 2010 with two student teams. A year later, the ME 440W Virtual Cross-Culture Capstone course effort grew to encompass half a dozen teams across mechanical and industrial engineering.

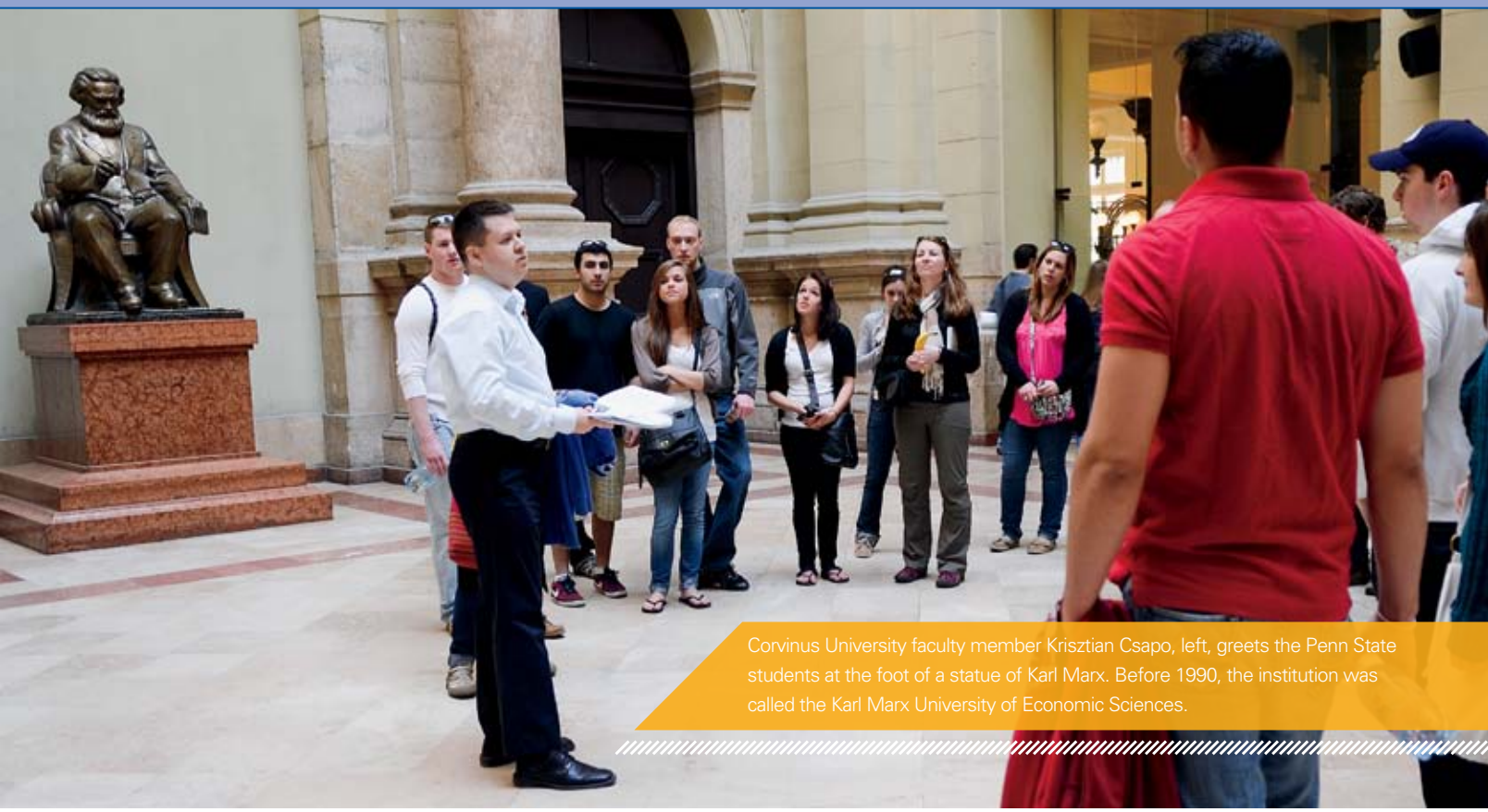
As expected, students encountered a number of hurdles when it came to working with their overseas partners.

The time difference between Penn State and its partner universities is the first thing students must reconcile when communicating with their colleagues. In the case of the engineering leadership course, Penn State students confer with Corvinus students at noon EST, which is 6 p.m. in Budapest.

But for classes working with the Far East, the time difference can be 12 to 13 hours or more.

"You've got to be very flexible," Engel said. "This past semester I had teams Skyping at 3 a.m."

"We start our lectures at 7:30 a.m. our time, which is 8:30 p.m. Korean time," **Andris Freivalds**, professor of industrial engineering, says about a human factors and



Corvinus University faculty member Krisztian Csapo, left, greets the Penn State students at the foot of a statue of Karl Marx. Before 1990, the institution was called the Karl Marx University of Economic Sciences.

product design course he co-teaches each summer that gets beamed to Seoul National University.

Students in Freivalds's course analyze products made from Korean manufacturers LG, Samsung, and Hyundai, as well as design new products.

Freivalds admits it isn't convenient for the Penn State students, but there's a shared sacrifice to make the collaboration work. "Because the university is located on the outskirts of Seoul, there's a shuttle bus that takes them to the subway, but it stops running at 11 p.m. So we timed the course so the students could take the last shuttle."

"You have to have a can-do attitude" about these collaborations, De Meter says.

Beyond time zones, a major barrier between the teams is language. Though students in partner universities have a working knowledge of English, the Penn State and overseas teams often have difficulty understanding each other.

Steve Garjuilo, who participated in the 2008 Hungary class and is now based in Europe helping Johnson & Johnson develop emerging markets, recalls, "My world view was very siloed in just thinking about Pennsylvania and the United States."

Teaming with the Hungarian students made him appreciate the much larger world. He says, "We were working with them via Skype, via teleconference. That process is difficult because you don't fully understand each other so you're going through the 'storming' phase longer than you would be than if you're working together in person."

Devon says, "I did videotaping in one of the first cross-national teams, and I was looking at the puzzled expression on the French students when our students were talking.

"Then I listened to what our students were saying: 'So how you guys doin'? You been gettin' stuff done over there? We're gettin' a little traction at this end.' To people who have got one or two years of English under their belt—that was incomprehensible. They didn't get a word of it."

The trick, faculty members say, is to keep it simple.

"Their English is very good," Trethewey notes about the foreign students. "But we have to train students to use simple communications. No slang. Slow down."

SOCIAL COLLABORATION

The engineering leadership course gives the virtual collaboration model a different spin, teaming Penn Staters with Hungarian economics students on many projects that have an altruistic goal.

"They are more systems-oriented, socially oriented, social-development kind of projects," says **Andras Gordon**, instructor in engineering design, who teaches the course along with **Rick Schuhmann**, the Walter L. Robb Director of Engineering Leadership, who developed the class in 2005. "This is about preparation of leaders."

Many of the projects are aimed at improving the quality of life of local populations and have an eye towards sustainability. This past spring's assignments included mushroom farms in Gaza, water bottle recycling in Haiti, Indian wine, and Pakistani rose oil.

Gordon explains that the students don't actually grow mushrooms or press rose oil. Instead, the Penn State–Corvinus teams leverage their engineering and business expertise to serve as consultants.

"Their goal is to learn what the problem is," he says. Then the teams begin their work, doing things such as examining logistics, conducting feasibility studies, and analyzing the market.

And today's students have access to some of the most advanced technology available, making communication and collaboration easier than ever.

At the onset of the leadership course, the students use a Polycom video communications system to confer during class.

Although the students use the Polycom system to interact with their Hungarian counterparts during class time, Gordon says they quickly move to email, Skype, Google Apps, Google Translate, social networks, and other technologies to continue their work.

Adam Gyorgy, a senior at Corvinus, says he was amazed at the ease of collaboration despite his team's geographic dispersion.

Photo credit: Victoria Fryer

Industry project sponsor Tyco was so pleased with the results of its inaugural virtual teaming project that it paid for the students at Shanghai Jiao Tong University to travel to Penn State for the project showcase.

"Our group was a little bit more difficult compared to the other groups because there were seven of us working together. To coordinate seven people, it's almost impossible," he recounts. "So for our Skype meetings, I was in Vienna in a café, Hemit [Gandhi, a Penn State student]—it was Easter time—was in his home town [in India], some guys were at Penn State, somebody was here at Corvinus, so we were all spread out everywhere. I had my cell phone, and I could Skype from my cell phone.

"I was actually having this meeting from a café in Vienna—it was an amazing experience. I don't know how technology could develop this far! It made me discover there were no borders anymore. I never thought it could happen."

Looking back on it, **Joe Giordano**, an engineering science junior, says, "Building a working relationship over Skype or telecom is one of the hardest things, I think, to do in the business world. Communicating virtually is really difficult, especially at the beginning when you're strangers."

Faculty say that experience—breaking through the barrier to forge strong working relationships—is going to be exactly like the one they'll eventually encounter in a global work environment.

"The beauty is that all the hoops and troubles the students have to go through are the same hoops and troubles they have to go through in the real world," De Meter states.

Rick Schuhmann, the Walter L. Robb Director of Engineering Leadership, speaks with his students while students at Corvinus University look on through videoconferencing.

Throughout the semester, engineering leadership students utilize a Polycom system (left and center) as one method to communicate with their Hungarian partners. Penn State students can travel to Hungary at the end of the semester to give their final project presentations (right).

For students like mechanical engineering senior Matt Zellers, international politics senior Meg Finley, and engineering science junior Joe Giordano, the culminating trip to Hungary for ENG 497E was their first time outside of the United States.

Although sending students overseas will remain an option in the college experience, the College of Engineering will continue integrating a global component in courses without forcing students to travel abroad.

MEET AND GREET

Although technology makes it easier than ever to communicate with people on the other side of the planet, there are some things about meeting a person face-to-face it can't replicate.

Because of the cost of travel to the United States, it's difficult for foreign student partners to come to Penn State. But in the case of the inaugural global capstone project, Trethewey says the sponsor, Tyco, was so pleased with the results that they paid for the Shanghai Jiao Tong students to attend the spring 2010 Project Showcase.

"Tyco wanted to reward the students on the first project," he says.

Meanwhile students in the engineering leadership class have the option of flying to Budapest at the end of the semester to work with their Hungarian counterparts, finishing their reports and doing a final presentation before the class and Penn State–Corvinus faculty.

Says Giordano, "My favorite moment was coming out of the airport, seeing my partner, and actually shaking his hand for the first time. That was really exciting because we put all this time into developing the relationship over telecom and to be able to physically look somebody in the face, it's really rewarding."

And that's what it's all about, Devon says.

"Information technology is a tool to achieve human ends. It is not the endgame. It is a means. The endgame is getting to know people, getting to work with people." ■

GAME PLAN

BY JANE HARRIS

ARCHITECTURAL ENGINEERS LOOK FOR BETTER WAYS TO GATHER FEEDBACK DURING DESIGN REVIEW

A picture may be worth a thousand words, but when it comes to designing a specialized building that truly meets the needs of the end users, it can take more than a two-dimensional image to get it right.

One option is to build a full-scale physical model and have stakeholders interact with it during the design review process.

A more cost-effective solution is to create a life-size interactive virtual prototype.

Sonali Kumar, a graduate research assistant in the Computer Integrated Construction Research Program, and **John Messner**, associate professor of architectural engineering, are using Penn State's Immersive Construction (ICon) Laboratory to do just that.

The ICon Lab, explains Kumar, features a three-screen projection system that allows computer-generated prototypes to be displayed in stereo at full scale.

"We've done a lot of studies where we developed three-dimensional facility models and then displayed them in the lab," she says. "It's kind of like being at a 3D movie. You really feel immersed in the space and think that you are actually there."

Kumar and her colleagues are taking the technology a step further, however. Using a 3D game engine, they're developing an interactive computing platform that designers can use to capture domain-specific knowledge from stakeholders early in the design process.

Dubbed the Experience-Based Virtual Prototyping Simulator (EVPS), the system functions a lot like a multiplayer video game.

In such games, a player assumes the role of a particular character and completes various quests or a series of clearly defined tasks in exchange for in-game rewards.

Kumar and her colleagues have applied the same concept to hospitals—one of the more complex types of buildings to design—and have come up with different tasks that patients, nurses, and facility managers might have to perform.

Photo credit: Paul Hazy

Graduate research assistant Sonali Kumar is using a game engine to develop an interactive virtual prototyping system.

"It's just like playing a video game and running different scenarios," she explains. "If you're a patient, you can imagine that you're looking at the facility while lying on the bed. Or if you're a nurse, you can run a 'patient emergency' scenario where you have to find a crash cart and take it to the patient's room."

This type of approach, Kumar says, helps the design team communicate more effectively with stakeholders and gather valuable, decision-making feedback early in the design process.

"As an architectural engineer, I don't really understand the work the end users are going to be doing. So I'm going to put outlets at a place in the wall where it's easy to build because that's how I think about my job. But a nurse might say, 'Why do you have the outlets here?' "

As nice as this sounds, developing an interactive virtual prototype is a time-consuming process. One of the questions Kumar and her colleagues are trying to answer is how to do it efficiently.

"The 'how' of it is a big challenge," she says.

Her team begins by creating a three-dimensional model with AutoDesk® Revit®, a building information modeling software.

"We then transfer the model to visualization software like Autodesk 3ds Max to add realistic textures and then to the Unity game engine to incorporate interactivity. The ability to simulate scenarios and tasks requires considerable coding as well," she states.

One way she believes they can streamline the process is by creating a database of standard components that can be used over and over. "Every hospital has patient rooms with beds," she says. "So if we create one bed that works really well, we can probably reuse it in the future on other projects."

Kumar's vision is that interactive virtual prototypes such as the EVPS will one day be widely used in the architectural engineering/construction industry.

"The idea is to have a decision-making tool for design review that helps both the end users and the project team," she says. ■

CHARGING FORWARD

NEW CENTER ALLOWS RESEARCHERS OPPORTUNITY TO DESIGN, BUILD ADVANCED BATTERIES UNDER ONE ROOF

BY VICTORIA FRYER

The standard electric vehicles available to consumers on the mass market today have a maximum range, fully charged, of about one hundred miles. If you get in your fully charged electric vehicle in State College, PA, and start driving south, you will barely make it across the state line into Maryland before needing to recharge your battery. Compare this to an average gas-powered vehicle: on a 16-gallon tank of gas, depending on your vehicle's fuel efficiency, you can travel more than four times further before refueling.

Though electric and hybrid-electric vehicles may be the wave of the future, they still make up only about one percent of the vehicles on the road today. Consumers have been slow to invest in these new technologies, citing high cost and reliability concerns. But researchers at Penn State are working to change that.

Under the newly created Battery and Energy Storage Technology (BEST) Center, researchers are working to make advanced vehicle technologies more efficient and affordable for the mainstream U.S. population.

The BEST Center was formed by two energy storage faculty at Penn State: **Chris Rahn**, professor of mechanical engineering, and **Chao-Yang Wang**, the William E. Diefenderfer Chair of Mechanical Engineering. Rahn serves as director of the Mechatronics Research Laboratory, where research focuses on battery modeling, estimation, testing, and control. Wang, the director of the Electrochemical Engine Center, is well-known for his expertise in battery and fuel cell technologies. The center also includes seven other researchers from the College of Engineering, the College of Earth and Mineral Sciences, and Eberly College of Science.

"The formation of the BEST Center allows interdisciplinary research in energy storage technologies and is the first of its kind in the country to lead clean energy research and education," says Wang.

By harnessing multiple disciplines, BEST can address energy storage technologies from design to manufacture for not only electric vehicles, but also renewable energy and smart grids. With expertise spanning from materials to cells to systems, center members will work closely together throughout the research and development process.

Photo credit: Gene Maylock

Photo credit: Gene Maylock

The Battery and Energy Storage Technology Center boasts the ability to build battery prototypes.

Rahn explains, "Materials researchers can see how a new cathode material will affect manufacturing and performance all the way up to simulating a hypothetical pack in a virtual hybrid vehicle. Feedback from systems engineers to the battery designers could motivate changes in chemistry that perform better in a specific application. And systems engineers get first access to batteries made from new materials so they have a leg up on the competition."

In bridging these traditional academic boundaries, the BEST Center can address more facets of the energy storage field than any one discipline or academic college alone.

"The BEST Center is the only academic lab in the United States that can work on all these [energy storage] issues simultaneously as opposed to other labs that work on smaller, separate pieces of the overall electric energy storage problem," says Henry Foley, vice president for research.

The University has allocated more than 10,000 square feet of space in the former Materials Research Laboratory to encourage collaboration and idea generation among BEST members and provide a centralized physical location for projects to be carried out from design to manufacture. Many of the faculty participants will be relocating their labs and office spaces to this building.

"Bringing together such diverse expertise under one roof within the BEST Center is an exciting opportunity for both education and research in energy storage," says Rahn.

Although moving into the co-located space isn't set to happen until later this year, more than ten projects within the center are already under way. With corporate partners such as EC Power, Johnson Controls, Norfolk Southern, Cummins, and Chrysler—and funding from agencies including the Department of Energy and the National Science Foundation—BEST members are working on projects in electric and hybrid-electric vehicle technologies and renewable energy storage.

One of the center's most unique resources is the Battery Manufacturing Laboratory (BML), which features extensive capabilities in the design and manufacture of lithium-ion (Li-ion) batteries.

"The BML is the only one in U.S. universities that can make large-format Li-ion batteries from start to finish, enabling our researchers to create innovation at the interface of materials and manufacturing," says Wang.

Li-ion batteries are critical components of hybrid electric, electric, and plug-in hybrid electric vehicles, but their use in cars presents major engineering challenges. The large format of the battery cell, as well as its high charge and discharge rates, lead to significant temperature changes, which can cause poor battery performance, and potential safety concerns, and other issues. This may be why electric vehicles on the market today are falling short of consumer expectations.

The BML's ability to build these batteries from scratch means that researchers are free to vary materials and interior structures to improve performance, cycle life, and cost. By making these batteries more efficient, Wang hopes to make them more viable for vehicle manufacturers and buyers alike. Between the research going on in the BML and other electrification technology research under way by the BEST Center team, an electric vehicle may take you on your next cross-country road trip sooner than you think. ■

Dr. Rahn can be reached by phone at 814-865-6237 or by email at cdrahn@psu.edu, and Dr. Wang can be reached at 814-863-4762 or cxw31@psu.edu. More information on the BEST Center can be found at www.best.psu.edu.

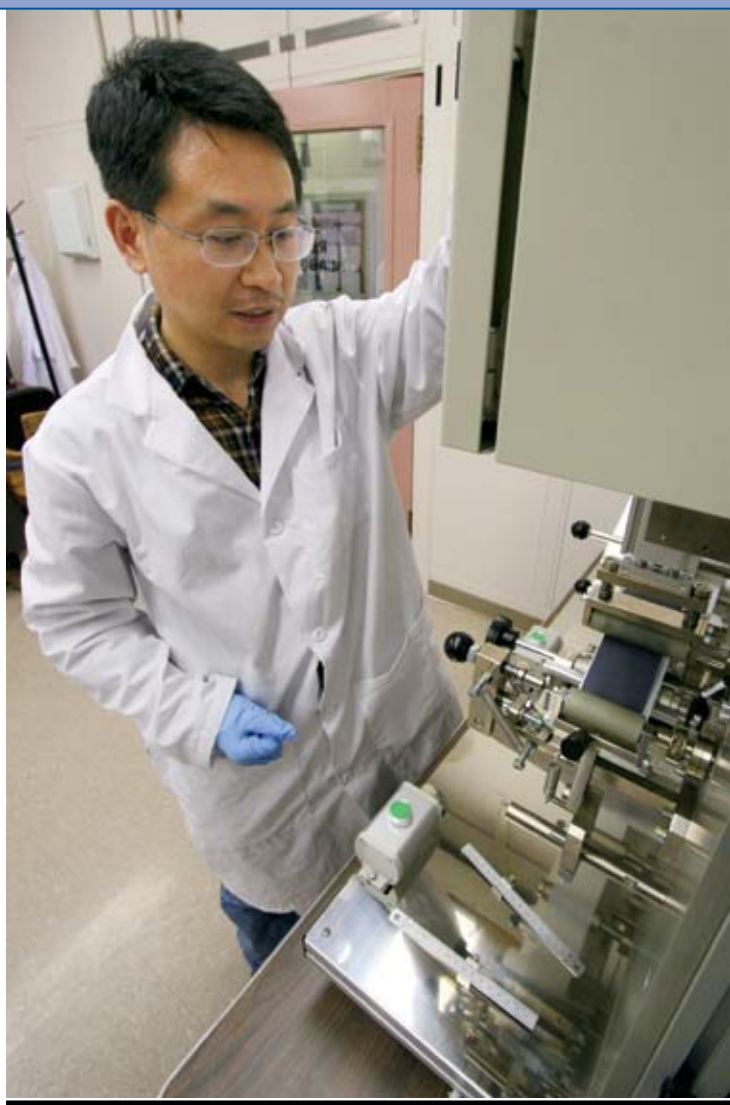


Photo credit: Gene Maylock

Battery Glossary

- Alkaline: The most common kind of batteries, alkaline batteries are used in household items like toys, radios, and clocks and are not rechargeable.
- Lead-Acid: The lead-acid battery, the oldest type of rechargeable battery, is most commonly used in gas-powered vehicles because of its high surge current.
- Nickel-Metal Hydride (NiMH): NiMH batteries come in sizes similar to alkaline batteries and can be used as a rechargeable alternative in some consumer electronics.
- Lithium-Ion (Li-ion): Li-ion batteries are common in consumer electronics like laptop computers and are also growing in popularity for use in electric vehicles, but they are very expensive to produce.
- Lithium-Sulfur (Li-S): Li-S batteries are being considered as an alternative for Li-ion batteries in electric vehicles due to their higher energy density and lower cost.

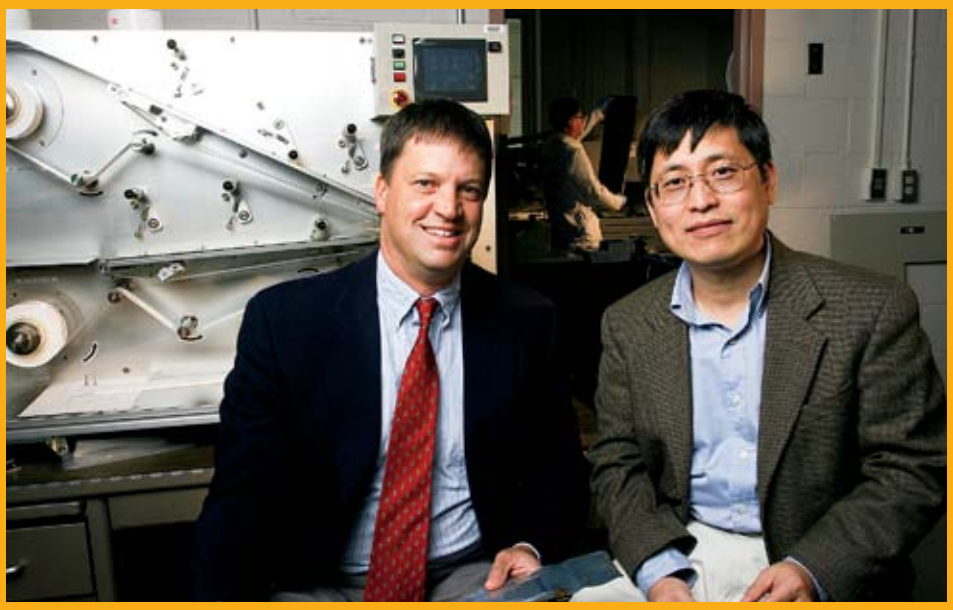


Photo credit: Gene Maylock

Chris Rahn, professor of mechanical engineering, left, and Chao-Yang Wang, the William Diefenderfer Chair of Mechanical Engineering, have merged their expertise to form the cutting-edge Battery and Energy Storage Technology Center.

MAJOR BEST CENTER PROJECTS

MATERIALS

- **Lithium-Sulfur Batteries:** A $5 million project to develop a lithium-sulfur battery for potential use in electric vehicles is funded by the Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy. Corporate partners include EC Power LLC, Johnson Controls, and Argonne National Laboratory.
- **Lithium-Ion Battery Binders:** BML researchers, with support from PPG Industries, are exploring more effective, lower-cost binders for Li-ion batteries.
- **Lithium-Ion Applications in the Military:** A project funded by the Pennsylvania NanoMaterials Commercialization Center partners Penn State with EC Power to develop and commercialize high energy density Li-ion cells for air force applications.
- **Neutral Water Battery for Grid Storage:** With funding from the DOE's Advanced Research Projects Agency-Energy, researchers are collaborating with Proton Energy Systems to develop a novel battery based on neutral water to enable grid energy storage of renewable energy.

CELLS

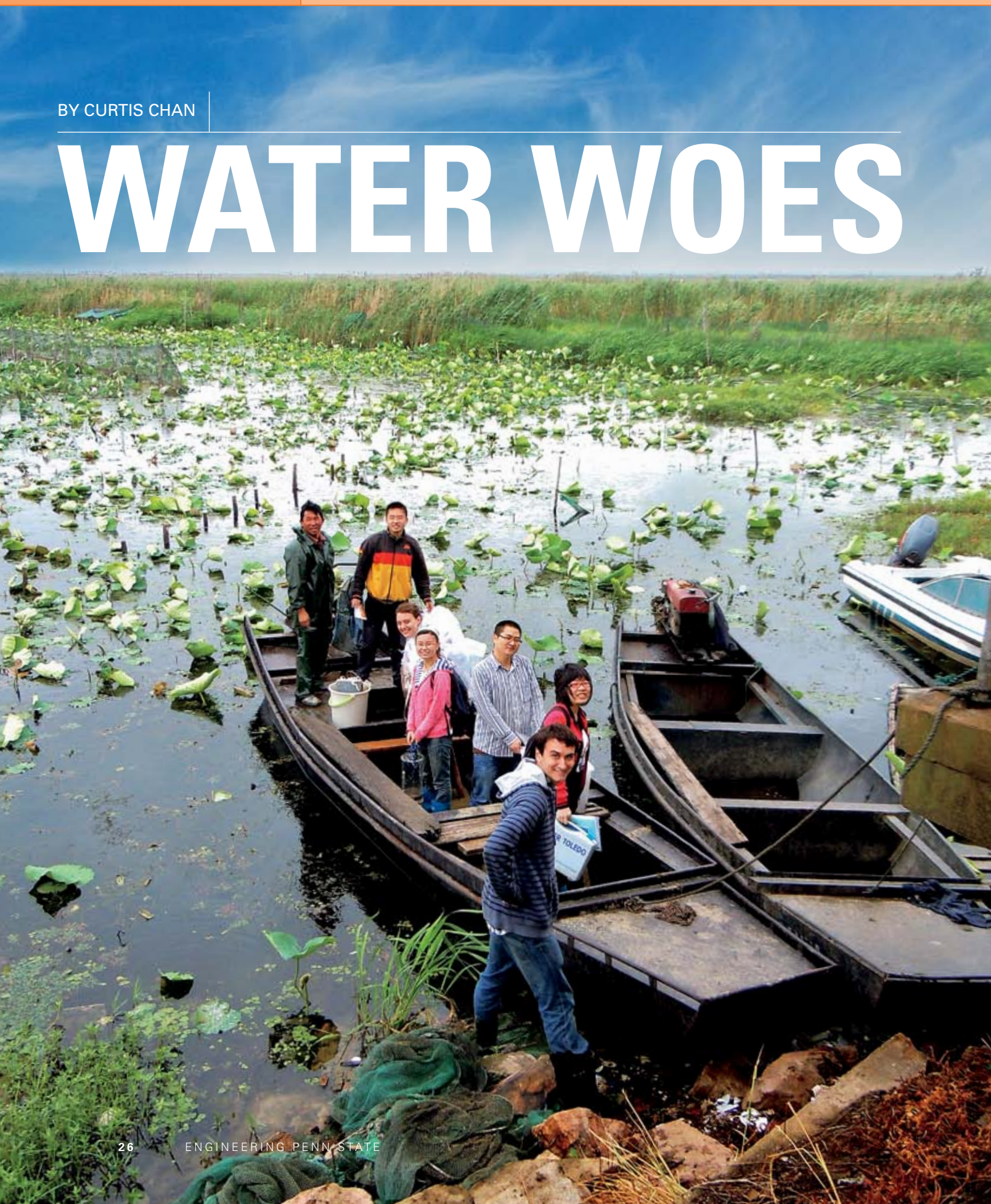
- **Lithium-Ion Battery Development Software:** In collaboration with EC Power, researchers are developing a software program to aid in the design and application of large-format Li-ion batteries to improve energy density and life cycle. This project is supported in part by the DOE's Computer Aided Engineering for Electric Drive Batteries program.

SYSTEMS

- **Lead-Acid Batteries for Micro-Hybrids:** Along with DaimlerChrysler, researchers are developing a lead-acid battery model for micro-hybrid vehicles, which increase fuel economy by eliminating idles and employing the battery to engage in frequent stop-start.
- **Lead-Acid Battery Management Systems for Hybrid Locomotives:** Working with Norfolk Southern, researchers are developing model-based battery management systems that fully utilize the pack without excessive degradation.
- **Lithium-Ion Systems Models for Hybrid Trucks and Buses:** Under support from Cummins, researchers are developing efficient models of Li-ion cells to be used for hybrid electric vehicle simulation and model-based state of charge estimation and dynamic current limits.

BY CURTIS CHAN

WATER WOES



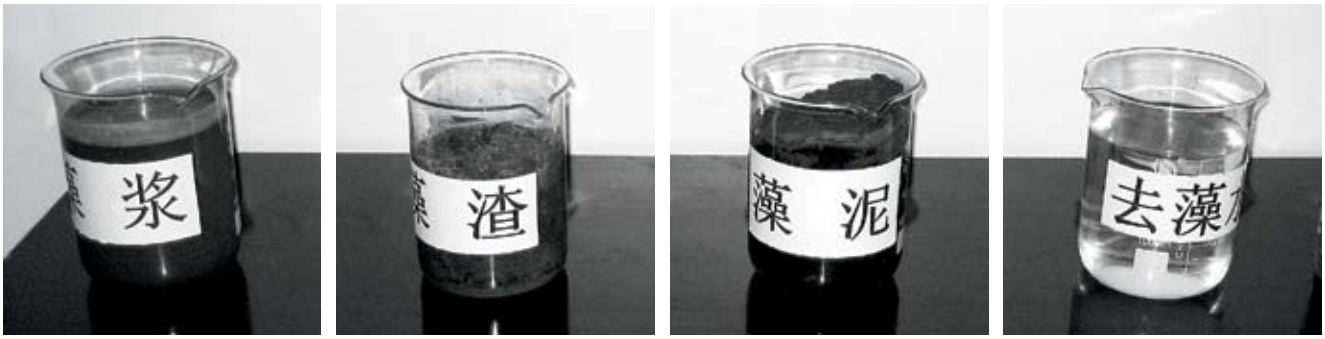


Photo credit: Rachel Brennan

Water samples at Lake Taihu are tested for dissolved oxygen content, pH, biological oxygen demand, chemical oxygen demand, total nitrogen, total phosphorous, and microorganism abundance, according to civil engineering senior Willaim Berger.

PENN STATE ENGINEERING STUDENTS TEAM UP WITH THEIR CHINESE COUNTERPARTS TO EXAMINE A POLLUTED LAKE

For **Rachel Brennan** and a group of Penn State faculty and students, the sight was almost otherworldly.

This past summer, a group of 38 students and faculty from Penn State and Jiagnan University journeyed to Lake Taihu in Wuxi, China, as part of a united research effort to study the country's third-largest freshwater lake. For the team, it was a sobering look at the price China has paid for its meteoric economic growth and expansion.

The experience was part of the embedded field course Biology 497C, "Global Environmental Sustainability: A Field Study in China," co-taught by Brennan, an associate professor of civil and environmental engineering in University Park, and led by **Jacqueline McLauglin**, associate professor of biology at Penn State Lehigh Valley.

"I think it was eye-opening to take [the students] out of Pennsylvania," says Brennan. "It's lush here. We've got trees and water. It's relatively clean. There's biodiversity. There's lots of animals. We go there, and it's just wiped completely out—much higher population, more pollution."

Lake Taihu is located in one of China's most industrialized regions, Jiangsu Province. According to Brennan, the 870 square-mile lake was once renowned for its beauty. "It had these nicknames that implied it was a 'pearl.' It was supposedly beautiful 20 years ago," she says. But as China became increasingly industrialized, lakes such as Taihu started to host more and more factories. "The effluents from approximately 1,300 factories, as well as domestic sewage, were essentially discharged without treatment into this huge lake," Brennan says.

William Berger, a civil engineering senior, says, "Lake Taihu was murky and green, with an abundance of algae and aquatic vegetation. It was impossible to see anything deeper than about a foot in the water."

The water's high phosphorus and nitrogen content resulted in crippling algae blooms. The algae on the surface was half a meter thick. According to McLaughlin, in 2007 the Chinese were pulling 10,000 pounds of algae from the lake daily.

"In 2007, everything was dying," Brennan confirms. "The residents had been using the water in the lake as their drinking water source. They couldn't use that anymore. They had to import all of this bottled water."

Photo credit: Rachel Brennan

The Chinese have been experimenting with hydroponic rafts to help filter out some of the pollution affecting Lake Taihu.

A government-mandated clean-up campaign has used algae-salvage ships, lake-bottom dredging, factory relocation, and other methods to help repair the lake. All of that effort still leaves plenty of contaminants, however.

This summer, the Penn State students and faculty teamed with their counterparts at nearby Jiangnan University to conduct real-world experiments on the lake's water quality and surrounding land use.

"Our group consisted of two American students, an American professor, three Chinese students, a Chinese professor, and our boat captain," Berger recalls. "We piled into a steel boat with an engine bolted on that sounded like a lawnmower when the captain started it!

"From three different locations on the lake, we collected data on water temperature, dissolved oxygen content, pH, biological oxygen demand, chemical oxygen demand, total nitrogen, total phosphorous, and microorganism abundance—both phytoplankton and zooplankton."

What the team found were nutrient levels still indicative of a eutrophic state, making the water unsafe for human consumption.

One avenue of remediation the Chinese have recently started exploring is the use of simple ecological systems that clean and filter polluted water. Such systems use a combination of plants, bacteria, and other organisms to clean water through bioremediation, mimicking what marshes and wetlands do.

For the Chinese, Brennan says, employing nature to clean water is relatively uncharted territory. "They're starting to develop artificial floating islands with plants like water lilies and other macrophytes that have really long, complex root structures. These roots extend down into the water and provide a huge surface area for beneficial bacteria to grow. These bacteria can facilitate the removal of nitrogen and phosphorus from the water," she explains. "The plants themselves also can absorb a lot of metals."

Essentially, she adds, these experimental systems are hydroponics, with plants pulled together into rafts to filter the water circulating around them.

Brennan, whose own research includes investigating advanced ecological restoration methods for cleaning wastewater, believes natural methods might offer the Chinese a viable solution to pollution in Lake Taihu and beyond. "An ecological system may work for them because it's decentralized and you don't need a huge infrastructure," she says.

Her team found the lake's condition has improved over the past few years. "We evaluated it and agree that it is still in a high state of eutrophication," McLaughlin says, "but their technologies are working to lessen the problem."

Electrical engineering student **Alex Devaux** says Taihu appeared better, but the engineers found looks can be deceiving.

"The lake looked good, but it was actually eutrified. The cleanup sounded good, but the pollution was just

Photo credit: Jackie McLaughlin

Water sample gathered at Lake Taihu is tested by the U.S.-Chinese student team.

Photo credit: Rachel Brennan

The Chinese at Jiagnan University are eager to continue their environmental collaboration efforts with Penn State, says Rachel Brennan, associate professor of civil and environmental engineering.

outsourced. It was shipped off to less wealthy parts of the country."

He continues, "It taught me that pollution clean up takes a lot of money and, in the long run, would have been cheaper to do right the first time."

Brennan says the Chinese are keenly interested in continuing their collaboration with Penn State, perhaps having some of her graduate researchers continue to work on the lake.

Adds McLaughlin, "They never thought of using ecological systems. There could be hydroponic rafts everywhere." ■

Engineering intern Brittany Kenworthy contributed to this story.

Dr. Brennan can be contacted at rab44@psu.edu or 814-865-9428.
Dr. McLaughlin can be contacted at jxm57@psu.edu or at 610-285-5109.

HAZLETON CAMPUS LAUNCHES NEW ENGINEERING MAJOR

FOCUSED ON ENERGY

BY BRITTANY KENWORTHY AND KENT JACKSON

Photo credit: Penn State Hazleton Public Information

Wes Grebski, associate professor of engineering, left, discusses the workings of a solar panel with Penn State Hazleton engineering students.

WITH ELECTRIC CARS, SOLAR POWER, AND RENEWABLE ENERGY constant topics of conversation, it's clear that the energy industry is evolving and new professionals prepared to work in the field will be in demand in the coming years.

To fulfill this demand, Penn State Hazleton has established a new major to prepare engineering students to enter the field. The new program, called the Bachelor of Science in General Engineering with an Alternative Energy and Power Generation Track, is now being offered exclusively at the Hazleton campus to students across the Penn State community.

Students' coursework in the major prepares them to design wind turbines, improve the energy efficiency of buildings and businesses, and perfect and utilize alternative energy systems powered by the sun, tides, and heat from the earth. "It will be this generation of students, I think, that defines what our energy future looks like," **Gary Lawler**, the chancellor at Penn State Hazleton, says. The new major will provide students with a unique education and skills that will prepare them to enter the changing industry and make an impact.

The idea for the major was proposed a decade ago by **Wes Grebski**, an associate professor of engineering, in response to what he predicted would be major energy changes in the future. Five years ago, the proposal was revisited and foundational courses were implemented.

In the creation of a curriculum for the major, the engineering faculty at Penn State Hazleton transformed previously offered courses and adapted ideas provided by an advisory committee. The major was approved and available for student enrollment beginning in the 2010 fall semester.

As the program has gained some attention within the Penn State engineering community, some students from other campuses have taken the opportunity to transfer to the Hazleton campus to enroll in the major. More students are expected to transfer in the fall of 2012, when third-year courses on fundamentals of renewable energy, hydrogen fuel cells, electrochemical energy conversion, circuits, and computer-aided design will be offered.

Students choosing to enroll in the major have access to one of the only programs of its kind in the country. "We want to be ahead of everybody else. That is the key. With new technology, the first one out there can make an impact. Right now, we are one of the first programs in the country so we can make a big contribution," Grebski says. "We got ahead of everybody." Students graduating from the major will have the skills and abilities to pursue careers in design, research, manufacturing, or technical sales for the new energy industries.

The learning process takes place both inside and outside of the classroom to best prepare students to enter the energy industry with practical knowledge and hands-on experience. The professors and instructors for the major are working to build relationships with local companies and businesses to provide students with the opportunity to complete internships and obtain employment with companies looking to trim energy costs. "We talk with companies to set that in motion so we make sure students have practical experience and apply the content to real situations," Lawler explains.

Energy developments on campus are just a small view into the impact that the new major is making. In 2008, a wind turbine was installed, and a year later, students installed solar panels on campus that generate 3.2 kilowatts, which is enough to power an adjacent building, and produce excess power to be sold on the grid. A solar car designed by students is parked in a garage on campus, as well as an electric car with solar panels that recharges when parked in the sun.

Photo credit: Penn State Hazleton Public Information

Penn State Hazleton's new program is designed to give students expertise in alternative energy systems powered by the sun, water, and heat from the earth.

"Everybody agrees within the next 5, 10, 15 years, lots of jobs will be created in renewable energy," Grebski says. The new major at Hazleton is preparing Penn State students to fill these jobs of the future. ■

More information on the program can be found at www.hn.psu.edu/Academics/GenEngin.htm or by contacting Dr. Grebski at wxg3@psu.edu or 570-450-3087.

Photo credit: Curtis Chan

Four Penn State engineers were part of the 2011 homecoming court, including two students and two faculty members. Pictured are civil engineering student Will Sheehan, left; Enrique Gomez, assistant professor of chemical engineering; Paul Lynch, instructor in industrial and manufacturing engineering; and electrical engineering student Athena Abate.

THE PENN STATE ENGINEERING ALUMNI SOCIETY

Building an active, engaged community of engineering alumni since 1959

The alumni society provides:

- Membership in a worldwide network of more than 90,000 engineering alumni.
- Fellowship among engineering alumni, faculty, staff, and students.
- Volunteer and service opportunities on campus and in your own community.

We want to hear from you! Visit PSEAS on the Web to submit your latest news and to learn more about becoming a member: www.engr.psu.edu/AlumniFriends/

For more information, contact:

Jennifer Theiss, Alumni Relations Coordinator
112 Hammond • University Park, PA 16802
Tel: 814-863-3384 • jtheiss@engr.psu.edu

Adam Sprankle ('95 ME) identified **Luis Marina** ('95 Aero), third from left. Marina died in a plane crash in October 2005. **Andrew Wnuk** ('95 Aero) identified **Richard Prim** ('95 Aero), center. **Peter Cseke Jr.** ('95 Aero) identified **Edward Barchak** ('95 Aero) on left, **Matthew Gevo** ('95 Aero), and **Marina**.

Cseke remembers that the class was an aerodynamics laboratory course taught by Dennis McLaughlin and included the ground effect vehicle, rocket motor thrust and car rear spoiler wind tunnel experiments.

He says, "The picture was taken in the large wind tunnel during the fall 1994 semester's AERSP 406A Aerodyanamics Laboratory course where they designed, built, and tested a small-scale model of a ground effect vehicle."

Brian Woodward identified himself on the far right and believes the person third from right is **Dan Stephenson** ('95 Aero).

FROM YOUR PRESIDENT

As we closed down 2011 we can look back at a number of great activities that PSEAS has recently completed or that we currently have active.

Let's start with Resumania where we assisted students in writing and composing their story. We continue to actively assist engineering students in a voluntary mentoring program, one on one, providing professional help, where there is a need. We foster and support the individual engineering departments with their Affiliate Program Groups (APGs) aligning with the department heads in whatever alumni support they seek. This is done in conjunction with their individual Industrial & Professional Advisory Council groups.

We even marched in the Homecoming Parade! We displayed last year's winning contestant—the American Society of Mechanical Engineers—in the Rube Goldberg Machine Contest. They were also the runner up in the national contest at Purdue.

Now we are in the planning stage, getting ready for 2012 with a variety of activities and events including the Rube Goldberg Machine Contest on Feb. 11 and a new joint initiative with the Alumni Association City Lights events, highlighting several engineering venues across the country. We will continue to work closely with the individual APGs, which gives you another opportunity to reconnect with your own engineering department.

We are providing a chance for everyone to get involved in a variety of different formats.

As Penn State engineering alums, come and join us! Stay connected or reconnect; you'll enjoy the time spent with both old and new engineering alumni friends.

John Mikita ('67 IE)

A look back...

The Penn State Engineer, November 1931

The Central Unit of This Engineering Building Has Been Completed at Penn State

The School of Engineering

of

The Pennsylvania State College

Offers the following curricula, of four years duration, leading to the degree of Bachelor of Science in

Industrial Engineering
Civil and Sanitary Engineering
Architecture and Architectural Engineering
Electrical and Electro-Chemical Engineering
Mechanical, Railway Mechanical and Milling Engineering

Graduate Courses.

Research Fellows are appointed.

The Engineering Experiment Station for Research.

The Engineering Extension Department teaches the wage earner at home, in night classes, Foreman Training.

For Further Information, Address

DEAN R. L. SACKETT
STATE COLLEGE, PA.

the LAST WORD

As we begin a new year and academic semester, we reflect on the news and events of the past few months at Penn State. We are saddened by Coach Joe Paterno's death and share our sympathies with the Paterno family and his many devoted current and former players and fans. This period has been one of the most difficult in the history of the University. During this time the encouragement and support of our students and faculty by our alumni and corporate partners have been very meaningful to the College of Engineering family.

We are mindful of the tragedies of child sexual abuse and have resolved to implement procedures and policies to protect children. With this in mind, the University has created educational partnerships and outreach to foster healing and raise broader awareness of the issue of sexual abuse. The College of Engineering is ensuring its policy for minors who are involved in youth programs within the College is understood and implemented across all units.

Engineering students continue to inspire us with their good works and positive influence on student life and the community. In this magazine on page 10 is a picture of the "Support Wall" created by our Engineering Ambassadors to raise awareness of sexual abuse. Another picture on the same page contains industry officials holding a sign during our Learning Factory Showcase, showing support for the College of Engineering. I think it is important to highlight some of the good news coming from engineering students and supporters during this challenging time.

Engineering students and faculty continue the proud Penn State tradition of teaching, research, and outreach, including investigating pollution in China; pushing the limits of virtual prototyping; developing new battery and energy storage technologies; using cutting-edge information technology to forge global relationships; and creating new majors in alternative energy—all of which can be found in these pages.

These are but a few examples of the good things I am privileged to witness each and every day on campus—these future Penn State engineers will help to improve the lives of our brothers and sisters across the world.

David Wormley

PENNSTATE
College of Engineering
The Pennsylvania State University
101 Hammond Building
University Park, PA 16802-1400

Calendar of Events



Mar. 21–23	Industrial and Professional Advisory Council
Apr. 13	Penn State Engineering Alumni Society Faculty/Staff Awards
Apr. 25	Penn State Outstanding Engineering Alumni Awards
Apr. 26	College of Engineering Design Showcase
May 4	Spring commencement
May 19	City Lights New York City
May 31–June 3	Traditional Reunion Weekend for classes of 1967, 1962, and Pioneers (classes of 1961 and earlier)
June 1	Penn State Engineering Alumni Society board meeting
July 11–15	Central Pennsylvania Festival of the Arts
Aug. 10–11	Summer commencement
Sep. 28	Penn State Engineering Alumni Society board meeting
Sep. 28–30	Parents & Families Weekend
Oct. 5–7	Homecoming
Dec. 22	Fall commencement