2020's Renaissance Engineer

(see page 12)
Welcome to this issue of *Engineering Impact*. Our theme is education: specifically, how we in Purdue Engineering are rethinking engineering education in order to prepare our graduates for leadership in the 21st century (see page 12). Also in this issue, you’ll read about our dedication of the Neil Armstrong Hall of Engineering (page 4), itself a testament to a new kind of education; learn about some construction engineering and management students’ eye-opening field trip to a new football stadium under way in Indianapolis (page 20); and meet Purdue’s new president, France Córdova, in an interview on page 6.

In these pages, you’ll find the College of Engineering alive with innovation and momentum. We’re changing how students experience engineering education—something I think will have profound impact that extends far beyond Purdue.

Leah H. Jamieson
John A. Edwardson Dean of Engineering
Ransburg Distinguished Professor of Electrical and Computer Engineering

From the Editor

To present you this look at engineering education at Purdue is to recognize the drive and innovation that mark the College of Engineering. From podcasts for master’s-degree students pursuing distance education (some as far away as China) to freshmen touring the Colts’ stadium-in-the-making in Indianapolis, Purdue Engineering is about engaging those bright minds that will, in a few short years, be leading technological change around the world. To do that engagement effectively, Purdue Engineering is committed to remaking engineering education as we’ve known it—and developing “Purdue’s Engineer of 2020” as the well-rounded graduate who combines technological expertise with professional skills and a global sensibility. Engineering education is being transformed, and Purdue is at the lead.

Lisa Hunt Tally
Editor

Letter to the Editor

[Your article on alumnus Dick Freeman’s interest in Amelia Earhart’s disappearance] was a very interesting story [“Volumes to Tell,” Summer 2007], and I do not know why several voids in story are not filled. There must have been prisoners with Amelia in China who could confirm this story. Further, there should be Japanese who were on the Marshall Islands or at the prisoner camp that could shed light on this story. It seems a little more investigating in Virginia by talking to neighbors, checking Social Security signatures or however she financed her living would provide important information. After Amelia’s death (if this Virginia women is Amelia), someone received her belongings, and there should have been some indication of this women’s background, even if it was only a collection of aircraft pictures. There could have been driver’s license evidence.

Richard Rietz
BSME ’56
The Woodlands, Texas
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Tell us a little about yourself.
Well, I’ve been in the distance education business I guess for about 14 to 15 years, but I’ve been here at Purdue three of those. Before Purdue, I worked at Stanford University. Ultimately, I came to Purdue because I thought there was better opportunity here to make a difference.

In a couple of sentences, describe the distance education program.
The primary thing we do is offer master’s degrees in a variety of engineering disciplines to students who are mostly all employed engineers. They may reside anywhere in the world.

Where, specifically, have some of your students resided?
Well, they are all over. We’ve had a handful in India. We’ve also had a few from China, Mexico, and South America. More typically they reside in the United States, but outside of Indiana. About 25 percent are in Indiana, 10 percent are in foreign countries, and the remainder are in the rest of the United States.

How do faculty communicate with students over long distances?
The most common thing we do is to record lectures, digitize them, and make them available to the students via streaming over the Internet. The communication with the instructor is typically done by e-mail but, sometimes, over the phone. Some instructors use the Web-CT course management system that we have here at Purdue. There are other technologies that are less commonly used. For example, Adobe Connect is sometimes used to allow students to make live presentations which can be accessed by their classmates either in real time or after the fact. It provides for a real-time conferencing capability that can be extremely useful.

Are there any new technologies on the distance education horizon?
Last year we experimented with offering lectures via podcasting. It proved so popular that this year we are offering essentially all lectures of all courses via podcast. About 50 percent of our students make use of this service, and about 25 percent watch at least some of the lectures on portable media devices such as video iPods. There are still some quality drawbacks to this mode of access, but it’s clear that the increased mobility is of value to an increasing number of students. As examples, they can access a lecture while on the treadmill at a fitness center, while waiting for appointments, in the cafeteria while eating, and other similar situations.

Do faculty see the distance education students?
No, we do not see them except in rare situations where desktop conferencing might be used. Typically they access the lectures “asynchronously,” which means on their own time. So, in most cases they are not online at the exact time the instructor is giving the lecture.

What courses are offered through the program?
We offer about 45 courses a year. Most of the courses are in mechanical, electrical, industrial, and aeronautical and astronautical engineering. But we have smatterings of courses in other engineering disciplines as well as math and statistics. They are all graduate-level courses.

What classes are you personally offering this semester?
I teach one course this semester called “Globalization and Engineering.”

What’s the strangest thing that’s happened to you in class?
Probably the most unusual thing that ever happened to me in class occurred during the earthquake of 1989 in Northern California. We were recording an online class [at Stanford] when the cameras and everything began to shake. Recording continued until the power went out and we all had to find cover. After that for a number of years, I’d start my classes off showing the video and telling my students “When I speak, the earth shakes.” I wish I could live up to that joke.

—INTERVIEW BY KRISTEN SENIOR
Introducing the Purdue Engineering Logo

Purdue Engineering launched its new logo this fall, following a months-long period of research, development, and testing that involved students, alumni, faculty, and staff of the College of Engineering. Taking its inspiration from the fountain on the Purdue Mall, the logo consists of three stylized triangles reaching upward, reflecting dynamic movement into the future. The fountain, located in the heart of the engineering campus, symbolizes the College of Engineering, and this stylized depiction thus symbolizes Purdue Engineering. In its three-part format, the logo reflects the three-part mission of learning, discovery, and engagement through which Purdue Engineering will achieve extraordinary impact.

Purdue Professor Rob Connor Investigates Minnesota Bridge Collapse

Assistant civil engineering professor Robert Connor (right) was vacationing with his wife in Utah on August 1 when the I-35W bridge collapsed in Minneapolis, Minnesota. “I saw it on the news, and I thought I would probably get a call,” he says. An expert on steel bridges and fatigue and fracture, Connor has consulted on many bridge failures, including the Milwaukee, Wisconsin, Daniel Hoan Memorial Bridge in 2000 and Pennsylvania’s Kinzua viaduct collapse in 2003.

Twelve days after the I-35W collapse, Connor was on site and part of an investigating team comprising the state’s Department of Transportation; Wiss, Janney, Elstner Associates, Inc.; and dozens of engineers and architects. At the meeting with the DoT, Connor says, “They requested I assist with providing an objective review of Minnesota DoT’s inspection practices on the bridge as well as conduct a hands-on examination of damaged members as part of the overall failure investigation being led by the NTSB.” It will likely be 12 to 15 months after the bridge’s collapse, the time allotted for the National Transportation Safety Board to complete an official investigation, before the final cause of the disaster is released to the public.

As you read this, engineers and investigators like Connor are working to reconstruct the story of the bridge’s fall by examining portions of the bridge that have been arranged downstream in a flat area. The demolition phase was completed in October, and the fact-finding portion is even now under way, but the theory and laboratory testing phase—and with it the answers to why the bridge failed—is still in its early stages. “Stay tuned,” Connor says.

—REBECCA GOLDENBERG

After Oil

Peak oil is the day when the world’s supply of oil reaches its peak and then begins to decline. And it could be right around the corner. In After Oil, a radio program produced by the College of Engineering and WFYI Public Radio, Purdue engineering professors Jay Gore and Rakesh Agrawal and retired ExxonMobil executive vice president Mike Ramage, a Purdue alumnus, join other experts from around the country to talk about what we can and should do to prepare. After Oil has aired on more than 120 radio stations around the country. You can catch it by podcast through the iTunes store at http://phobos.apple.com/WebObjects/MZStore.woa/wa/viewPodcast?id=260862117 or by listening to MP3 audio files available at the Purdue Engineering Impact Web site: http://engineering.purdue.edu/EngineeringImpact/Radio.

—LISA HUNT TALLY
Purdue and 16 of its astronaut alumni, including Neil Armstrong, dedicated the university’s Neil Armstrong Hall of Engineering on October 27, hailing the new $53.2 million building as a gateway to engineering research and education.

“Purdue engineering has long been a place for imaginations to soar,” said Purdue president France A. Córdova. “Just as alumnus Neil Armstrong’s historic walk on the moon inspired countless young people—including me—this building that bears his name will inspire a new generation to reach for the stars.”

Neil Armstrong Hall, located at Stadium and Northwestern avenues, houses the School of Aeronautics and Astronautics, School of Materials Engineering, Department of Engineering Education, and several engineering programs, including the Minority Engineering Program, Women in Engineering Program, and Engineering Projects in Community Service, or EPICS. The facility also houses the dean’s office and engineering administration.

“This building represents a physical and intellectual gateway to the College of Engineering,” said Leah Jamieson, Purdue’s John A. Edwardson Dean of Engineering. “Having materials engineering and aeronautics and astronautics under the same roof reflects engineering’s reach from the nanoscale to the galactic. As home to engineering education and the first-year engineering program, it represents the entry point to Purdue’s College of Engineering and our commitment to continually advancing knowledge about how people learn engineering. Being home to our nationally acclaimed Minority Engineering Program and Women in Engineering Program emphasizes the relationship between diversity and innovation. And as home to EPICS, it shines a light on the connections between engineering and society.”

—CLYDE HUGHES

For video of the dedication, see http://news.uns.purdue.edu/x/2007b/071027CelArmstrongDedication.html

Lunar sample lands at Purdue

Thanks to Martha Chaffee, the widow of astronaut and Purdue alumnus Roger Chaffee, a sample of the moon is on display in Armstrong Hall. Chaffee, herself a Purdue alumna, acquired the rock through NASA’s Ambassadors of Exploration program, which allows astronauts or their survivors the right to donate a piece of moon rock to an educational institution of their choice.

Roger Chaffee (BSAE ’57), who was chosen by NASA in 1966 to pilot the first flight of the initial Apollo moon program, was killed a year later in a fire during training. The Chaffee Crater, located on the far side of the moon, is named in his honor.

The sample, which weighs approximately 2 grams, is the centerpiece of a floor-to-ceiling photomural exhibit of Chaffee’s life. The mural, along with a replica of the Apollo 1 command module identical to the one in which Chaffee died, will be on display for a year. The sample will remain on long-term loan from NASA.

—TANYA BROWN WITH KRISTEN SENIOR
Students Blogging

Purdue Engineering’s Web site is offering prospective students and other visitors glimpses into the lives of a few of Purdue’s engineering students. Through blogs (Web logs), current students write about what it’s like to study abroad, participate in internships, take classes, and prepare for their futures. Here, some excerpts:

**Chemical engineering senior Allison Yates** spent half of her spring semester junior year studying in Mumbai, India, at the India Institute of Technology (IIT) and the other half working for General Electric in Bangalore.

“I’ve finally finished my finals at IIT... I packed up and moved out, wishing my fellow IITians best of luck and bon voyage. I set out for the great city of Bangalore, the silicon valley of India. I was only there long enough to leave some luggage and eat a meal or two before jet setting off to Kerala, a southern coastal state. I’m currently sitting in a little internet cafe next to Periyar Tiger Reserve, where I’m staying for the next two nights. I’m hoping to get a glimpse of an elephant or tiger tomorrow if I can get myself up in time to make it into the park before all the other tourists.”

https://engineering.purdue.edu/Blogs/AllisonYates

**Lintina Bonamico, a senior in mechanical engineering**, returned to campus this fall from Houston, Texas, where she’d participated in her third internship.

 “[At Purdue] we had our big job fair, the Industrial Roundtable. It’s the largest college job fair in the nation with more than 300 companies attending! It’s a stressful time for seniors since this is the time it really matters... If you have several good internships, you can focus your search down on careers and companies you really want, and recruiters will definitely take notice of you. I’ve done three internships, which is somewhat unusual for non-co-op students, and all the companies I talked to were highly impressed. My previous experience has really helped me sell myself.”

https://engineering.purdue.edu/Blogs/LintinaBonamico

**Paul Imel, a senior studying aerospace engineering**, participates in Purdue’s Global Engineering Alliance for Research and Education (GEARE). Through the program, Imel spent last semester studying in Karlsruhe and interning in Berlin for Pratt & Whitney Canada’s Service Center Europe.

“It seems that engineering programs in the US focus more on theoretical than the practical little details. We tend to think of an idea and try to sit down, model it, build it, and test it. Whereas, from what I’ve heard and maybe a little of what I’ve seen, German engineers tend to spend more time crunching the numbers to great detail in the beginning before moving forward. Both styles have their ups and downs and neither is better than the other. I’m not really sure how the American style of engineering studying will feel to the German students. Maybe they will find it as different as the German way did for us.”

https://engineering.purdue.edu/Blogs/PaulImel

**Clarice Smith, a sophomore, talks about the struggles she has had to overcome since starting college a year ago.**

“Coming to college was a big step for me. I didn’t know anyone and was 400 miles away from home. I never thought that I would be where I am today. I’m in a place that I love. I’ve met many people that I either associate with, are my friends, or that I can consider my family... I’m a sophomore now and I have experienced so many things; whether it was in the academics, social atmosphere, or workforce... During my time at Purdue I have met great people that have inspired me and have touching stories like me.”

https://engineering.purdue.edu/Blogs/ClariceSmith

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**Brian McNair-Williams graduates from Purdue this December with a degree in industrial engineering.**

“I want to go home after I graduate in December, and work for the Greater Erie Community Action Committee (GECAC) and for my uncle. The GECAC does good stuff for the community, and later in life, I have the intentions to start a community center to help lift the neighborhoods that I am a part of. But, in order to know how to do that and to do it well, I’m going to need some experience in that sort of field... Engineering prepares you for everything you want to do. Because essentially, what you learn in engineering is how to look at anything, and see it for what it is worth, what it is capable of, and how to think to be effective in just about any situation.”

https://engineering.purdue.edu/Blogs/BrianMcNair

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—KRISTEN SENIOR
Introducing Purdue President France Córdova

She’s studied pulsars, written award-winning fiction, helped build a space telescope, and served as chancellor of the University of California at Riverside. Now, this internationally recognized astrophysicist leads Purdue University as president. A conversation with France Córdova.

What’s been the biggest difference so far between your experience at UC-Riverside and at Purdue?

Football! We didn’t have football at UC-Riverside. It’s just so big, and so much revolves around it.

But there are more similarities than differences. Both UC-Riverside and Purdue have very high aspirations, have a land-grant mission, are research universities, and have high-quality faculty. I guess that the biggest difference is that Purdue and IU are the two research universities for the entire state of Indiana. In California we had many more. Yet Riverside had an important place, because we served a very big area with 4 million people—about two-thirds the size of Indiana. It’s just a different scale of influence that Purdue has for engagement and for opportunities to make a difference for the state.

What is your overarching goal for Purdue?

Purdue has a very, very good reputation. I would like for that reputation to be felt even more—nationally and globally. We’ll work together to become a university of distinction that is known for a few things very widely. We should be good in everything we do, but we can really only be great in a very few areas. So we should choose wisely what we want to be known for.

How would you like to see Engineering working with Science, Liberal Arts, and other disciplines at Purdue?

I hope that our strategic planning process will encourage people to think more deeply about that question. I intend to form a working group that will bring together people in the sciences and liberal arts to have a dialogue about where they might work together more effectively. That would be in the extracurricular and research domains.

As far as the curriculum itself goes, that is something that I would like to work on with the academic senate and deans, to look at the possibilities for having a more interdisciplinary curriculum to expose students to all the different threads of academe. My entire presidency will be devoted to bringing us together—so what is good about engineering will have an impact on, for instance, liberal arts, and what is good about liberal arts will have an impact on engineering.

I can see that some of the universities in this country that do this well are also universities that have strong engineering traditions, like MIT. It has a wonderful center for digital media, which brings together artists and engineers. It also has a Program for Science, Technology, and Society. There isn’t any technology—even transitioning from incandescent bulbs to fluorescents to LEDs—that doesn’t require some understanding of the social impact: how people will receive the technology and incorporate it.

“Three days in Beijing will change your worldview. Just three days! So imagine what a couple of weeks would do.”

What are the aptitudes that you’d like to see in 21st-century Purdue-educated engineers?

There are many things that we can give to today’s students: development in leadership, in entrepreneurship, and in engagement—which to me is one way of saying social responsibility; more awareness of the environmental consequences of our actions; more awareness of our energy consumption. We need to really look at our footprint on the planet and how we can be good stewards not just of our local space but of our bigger, global space. Also, [today’s students need] an appreciation of what diversity brings to excellence. I want to make sure that our engineering, science, and technology
About President Córdova

- Joined Purdue in May 2007
- Chancellor, University of California, Riverside, 2002-07
- Named one of Hispanic Business magazine’s “100 Most Influential Hispanics,” 1997
- Vice Chancellor for Research, University of California at Santa Barbara, 1996-2002
- Chief Scientist, NASA, 1993-96; received NASA’s Distinguished Service Medal in 1996
- Department Head, Astronomy & Astrophysics, Pennsylvania State University, 1989-93
- Professor of Astronomy & Astrophysics, Pennsylvania State University, 1989-96
- Deputy Group Leader, Space Astronomy & Astrophysics Group, Los Alamos National Lab, 1989
- Named one of “America’s 100 Brightest Scientists Under 40” by Science Digest, 1984
- Staff Scientist, Earth and Space Science Division, Los Alamos National Lab, 1979-89
- Won a guest editorship with Mademoiselle magazine for writing a short novel, The Women of Santo Domingo, based on her anthropologic fieldwork in a Zapotec Indian pueblo in Oaxaca, Mexico, 1969
- BA cum laude, English, Stanford University, 1969
- PhD, Physics, California Institute of Technology, 1979

What about global experiences for students?

We need to move beyond the more traditional models of education abroad, which were mostly a liberal arts model. Certainly everyone who’s had a traditional experience—and I’m one of those people—had fantastic opportunities, but we’re leaving out a lot of students who are in the sciences and engineering. We need to create a lot more opportunities for internships abroad, research experiences abroad, more-targeted, more-intense shorter programs abroad—that’s incredibly important. Three days in Beijing will change your worldview. Just three days! So imagine what a couple of weeks would do.

What are your goals for Purdue as a research institution?

This is not about my goals—it’s about the faculty’s goals; we need to have these bubble up through the strategic planning process. My aspiration is for us to be among the very top universities in the world. We are very good, but we have a ways to go in the scope and scale of what we do in research. We’ve greatly improved, so that’s the first derivative. Now we have to kick up the second derivative so that we can get to a higher point faster.

What’s on your nightstand now?

A whole pile of Chronicles of Higher Education, my alarm clock.... The most recent book that I bought is Harold Bloom’s anthology of best poetry that he’s picked [The Best Poems of the English Language: From Chaucer Through Robert Frost]. My husband and I also have been reading a collection of books about the history of Purdue, about Eli Lilly, David Ross, and George Ade. I just got my home library organized this past weekend, and there’s a growing collection of Purdue books.

—INTERVIEW BY LISA HUNT TALLY
Appointed: Gary Cheng, assistant professor of industrial engineering, as a young investigator in the Office of Naval Research for his exceptional promise for outstanding research and teaching career. Audeen Fentiman, associate dean of graduate education and interdisciplinary programs and professor of nuclear engineering, as vice president for strategy and policy for universities to the GEM Executive Committee. Shimon Nof, director of the PRISM Center and professor of industrial engineering, as president of the International Foundation for Production Research. Marshall Porterfield, associate professor of agricultural and biological engineering, horticulture and landscape architecture, and biomedical engineering, to the Board of Governors for the American Society for Gravitational and Space Biology. Karthik Ramani, professor of mechanical engineering, to the National Science Foundation’s Committee of Visitors for Industrial Innovation and Partnerships from 2007 through 2010. Kumares C. Sinha, the Olson Distinguished Professor of Civil Engineering, to the blue-ribbon panel of experts for the National Surface Transportation Policy and Revenue Commission created by Congress.

Bestowed: The National Medal of Technology, by President George W. Bush, on Leslie A. Geddes at a White House ceremony on July 27, 2007. Geddes, Purdue’s Showalter Distinguished Professor Emeritus of Biomedical Engineering, received the nation’s highest honor for technological innovation in recognition of more than 50 years of research that has spawned the development of regenerative tissue grafts, automated defibrillators, exercise pacemakers, and arm cuffs that measure blood pressure, oxygen levels, and heart rates in premature infants. In 2007, Geddes revealed a revolutionarily safer and more effective method of administering CPR. He has published more than 800 articles and has been awarded 33 patents in his lifetime.
**MILESTONES**

**Awarded:** Rakesh Agrawal, Winthrop E. Stone Distinguished Professor of Chemical Engineering, with the 2007 Industrial Research Institute Achievement Award. Jim Barany, professor of industrial engineering, with the Frank and Lillian Gilbreth Industrial Engineering Award given by the Institute of Industrial Engineers. Qingyan (Yan) Chen, professor of mechanical engineering, with the Institute of Environmental Sciences and Technology’s 2007 Willis J. Whitfield Award. Supriyo Datta, the Duncan Distinguished Professor of Electrical and Computer Engineering, with the 2008 IEEE Graduate Teaching Award. Jack Delleur, professor emeritus of civil engineering, with the 2007 Ray K. Linsley Award, presented by the American Institute of Hydrology, for his outstanding contributions in surface water hydrology. David Ebert, professor of electrical and computer engineering, with the Meritorious Service Award from the IEEE Computer Society for outstanding performance as editor-in-chief of IEEE Transactions on Visualization and Computer Graphics from 2003 to 2006. He is also the recipient of a 2007 Nvidia Faculty Fellowship. R. Edwin Garcia, assistant professor of materials engineering, with the Robert L. Coble Award for Young Scholars from the American Ceramic Society. Takashi Hibiki and Mamoru Ishii, professors of nuclear engineering, with the 2007 Engineering Achievement Award by the Thermal-hydraulic Division of the Atomic Energy Society of Japan. Leah Jamieson, John A. Edwardson Dean of Engineering and Ransburg Distinguished Professor of Electrical and Computer Engineering, with the 2007 Woman of Vision Award for Social Impact. Marshall Porterfield, associate professor of agricultural and biological engineering, horticulture and landscape architecture, and biomedical engineering, with the Halstead Young Investigator’s Award. Steve Wereley, associate professor of mechanical engineering, with the Alexander von Humboldt Foundation Research Award, as support for his 2007 sabbatical visit to the Technical University of Darmstadt, Germany.

**Featured:** Sangtae Kim, the Donald W. Feddersen Distinguished Professor, for his life’s work in the 30-minute TV documentary Cross World People, which aired on the Airirang TV network in South Korea this summer.

**Honored:** Bin Yao, associate professor of mechanical engineering, by China’s Zhejiang University as one of the overseas academic backbones for the Programme of Introducing Talents of Discipline to University on Information and Control Science.

**Participated:** Barrett Caldwell, associate professor of industrial engineering, in the National Academy of Engineering’s 13th annual U.S. Frontiers in Engineering Symposium.
Global Earnings

Have you ever wondered what the salaries are of your engineering counterparts in other countries or, for Americans, in different parts of the U.S.? How does location affect how much you earn? Here, a sampling of average salaries* for engineering directors and managers from around the States and around the globe.

—KRISTEN SENIOR

*All figures have been converted to U.S. dollars. Salaries calculated on 9/20/07 using the International Salary Expert available through the Wall Street Journal’s Executive Website, CareerJournal.com. Salary conversions into U.S. dollars performed on XE.com on 9/20/07.
Heidi Diefes-Dux chairs the Department of Engineering Education’s graduate program. The department, born in 2004 as the first of its kind in the world, seeks answers to fundamental questions about how students learn engineering: How do they gain conceptual understanding? How can they become lifelong learners? What leads to critical thinking, innovation, and creativity? But, says Diefes-Dux, there are “no books, no curriculum, no precedent.” When you’re ahead of the academic pack, you set the precedent.

Purdue’s rapidly expanding Department of Engineering Education is a research engine powering a transformation in how engineering will be taught on campus and, ultimately, around the country. The National Academy of Engineering, the U.S. Council on Competitiveness, and other national organizations are calling for reform—see NAE’s report Educating the Engineer of 2020 and the Council’s report Innovate America—citing threats to national security and to America’s economic competitiveness. Purdue civil engineering alumna Pat Galloway, CEO and chief financial officer of the Nielsen-Wurster Group and former president of the American Society of Civil Engineers, has joined the debate with The 21st Century: A Proposal for Engineering Education Reform (ASCE Press), a book painting a global picture in which megaprojects, sustainability, infrastructure security, and multicultural work teams pose challenges for which today’s engineers may be unprepared.

At Purdue, the College of Engineering is rethinking engineering education and enacting change—through original research, through curricular reform, through the innovative design of new facilities, and by emphasizing engineering experience, both within the classroom and outside it.

The goal? To educate what Leah H. Jamieson, the John A. Edwardson Dean of Engineering, calls “Purdue’s Engineer of 2020.” At the heart of the effort is a set of attributes inspired by NAE and articulated by the Purdue Engineer of 2020 Committee.
Purdue's Engineer of 2020

Vision: Purdue Engineers will be prepared for leadership roles in responding to the global technological, economic, and societal challenges of the 21st century.

Strategy: We will provide educational experiences that develop students’ knowledge areas, abilities, and qualities to enable them to identify needs and construct effective solutions in an economically, socially, and culturally relevant manner.

Abilities
- leadership
- teamwork
- communication
- decision-making
- recognize & manage change
- work effectively in diverse & multicultural environments
- work effectively in the global engineering profession
- synthesize engineering, business, and societal perspectives

Knowledge Areas
- science & math
- engineering fundamentals
- analytical skills
- open-ended design & problem solving skills
- multidisciplinarity within and beyond engineering
- integration of analytical, problem solving, and design skills

Qualities
- innovative
- strong work ethic
- ethically responsible in a global, social, intellectual, and technological context
- adaptable in a changing environment
- entrepreneurial and intrapreneurial
- curious and persistent continuous learners

The Three Pillars of the Purdue Engineering Undergraduate Education

Just who is Purdue’s Engineer of 2020? This well-rounded graduate knows engineering fundamentals and the science and math behind them. Readily solves open-ended design problems. Demonstrates flexibility. Has leadership, teamwork, and communication skills. And can work around the world and with diverse colleagues and clients. A “renaissance engineer” of sorts, Purdue’s Engineer of 2020 responds to the global technological, economic, and societal challenges of the 21st century—and leaves Purdue’s campus prepared to lead (see above).

“It’s no longer adequate to have graduates who are strong just in the engineering fundamentals,” says Jim Jones, co-chair of the Engineer of 2020 Committee and a mechanical engineering professor. “We’re moving toward more of a liberal arts education for engineering.” He points to a “dramatic shift” in survey data from Purdue mechanical engineering alumni between 1994 and 2002 on the importance of professional skills.

Identifying the attributes of Purdue’s Engineer of 2020 was a milestone, says Jamieson. “We’d never set college-wide goals before,” she notes. “And we have a bold vision. Now we’re starting to tackle the hard part: how to achieve that vision.” Rethinking the curriculum is a big part of the job.

Changing a college curriculum, it’s been said, is like moving a graveyard: you never know how many friends the dead have until you try to move them. A National Science Foundation report from 2005, The Engineering Workforce: Current State, Issues, and Recommendations, notes, “There has not been a fundamental change in engineering curricula in the United States since the shift to a more science-based engineering education in the 1960s.” But Purdue Engineering’s leadership is effecting change now; Jamieson has committed $200,000 in seed money in 2007-08 to test new ideas from faculty across the college, with plans to continue to seed innovation in future years.

To prompt faculty members to develop ideas, the college has begun sponsoring an annual Engineer of 2020 workshop focusing on three or four Purdue Engineer of 2020 attributes. On the 2007-08 schedule: entrepreneurship, multidisciplinary learning, and continuous learning. The college hosted a separate colloquium on global issues: the 10th Annual Colloquium on International Engineering Education. “The vision for change is college-wide,” says Jones, “but the implementation is by faculty at the school level.”

Supporting Purdue’s change is a push for facilities that promote teamwork and hands-on authentic learning experiences. The new Neil Armstrong Hall of Engineering, dedicated on October 27 (see page 4), does just that. Housing the Department of Engineering Education, the School of Aeronautics and Astronautics, and the School of Materials Engineering—along with Engineering Projects in Community Service, the Women in Engineering Program, the Minority Engineering Program, and the college’s administrative offices—Armstrong Hall is a tangible expression of how the College of Engineering intends to educate tomorrow’s engineers.

Take Engineering Education’s new “Ideas to Innovation Learning Laboratory,” for instance. It’s a space where stu-
This past summer, undergraduate students from around the world converged at Purdue to pursue hands-on research projects. Their goals? To study new ways to transform coal into liquid fuels. To develop instructional technology in first-year physics education. To increase the efficiency of solar cells. To design and test radio-frequency antennas. And more.

Through Purdue’s Summer Undergraduate Research Fellowship program (SURF), 56 students from universities in Australia, Austria, India, Ireland, Serbia, Switzerland, and Turkey joined some 130 Purdue students in working directly with Purdue professors and researchers, employing tools used on the cutting edge of science, engineering, and technology. Participants spend the summer on campus, earning a $1,000-per-month stipend. The experience enhances students’ classroom learning, involves them in real problem solving, and sparks interest for research careers in science and engineering. “Most undergraduate students don’t have the opportunity to do this type of research,” says Jay Gore, Purdue’s Vincent P. Reilly Professor in Mechanical Engineering and founder of SURF, which got its start in 2003. “The goal is to introduce undergraduate students to the concept of graduate and post-graduate research projects and have the opportunity to be mentored by university professors and researchers.”

SURF, which got its start in 2003. “The goal is to introduce undergraduate students to the concept of graduate and post-graduate research projects and have the opportunity to be mentored by university professors and researchers.”

Purdue students who want an off-campus experience: the Research at Federal Labs Program. And beginning in 2008, SURF will offer a year-round research program for students at Purdue.

—L.H.T.
on the colloquies and details of those research areas were published in the Journal of Engineering Education last year.

“This was a tremendous accomplishment,” says Haghighi, “since it was the first major collective attempt of the engineering education research community to develop a cohesive and comprehensive national research agenda that will serve as a guide and framework, particularly at a time that this community is establishing engineering education as a serious and scholarly discipline.”

Purdue ENE faculty members like Ruth Streveler are digging deep to answer such questions as, What important engineering science concepts do students find difficult? How can you design learning environments that help students better understand these concepts?

“Our research shows that as many as 25 percent or more of advanced engineering students have a faulty understanding of fundamental concepts in their field,” says Streveler. For instance, many chemical engineering students confuse equilibrium and steady state, electrical engineering students may understand voltage to be a property of a particular single location, and mechanical engineering majors may think of force as the property of a body. These flawed views hinder a student’s ability to understand engineering problems deeply.

Streveler is currently refining a thermal and transport concept inventory, which measures student understanding of fundamental concepts in fluid mechanics, heat transfer, and thermodynamics. She also plans to begin research on why certain engineering concepts are difficult—in hopes of providing insights into how to design learning environments that truly transform students’ educational experience.

Such abstract insights should find their way into concrete practice at Purdue, says Jamieson. The College of Engineering will become ENE’s testbed for ideas, with Purdue students the beneficiaries. ENE’s reach extends to younger students as well: the department’s INSPIRE program (see box at right) connects with P–6th grade teachers to expand their view of engineering and, in turn, excite youngsters about the field. (Similarly, EPICS High is working with high school teachers to bring community-based engineering design into high schools.)

From this kind of seminal research to cutting-edge facilities to innovative learning opportunities, when you take a look at Purdue Engineering’s educational initiatives, you see a paradigm shifting. At this moment in the history of how we educate engineers, to remain static is to become obsolete. The push is on to educate Purdue’s Engineer of 2020. Stay tuned as Purdue Engineering educators, researchers, and leadership rethink, refine, and remake engineering education to equip that engineer to thrive.

The Institute for P-12 Engineering Research and Learning

Founded in 2006, INSPIRE conducts basic multidisciplinary research in human cognition and concept development in engineering education.

The institute, a centerpiece of Purdue’s Department of Engineering Education, aims to inform, at the national level, the design of engineering curriculum, student learning environments, and teacher education—all to motivate new generations of pre-college students to embrace engineering. To ensure broad impact, INSPIRE is initiating and leading an advocacy effort at state and national levels to influence policymaking that will increase the United States’ commitment to P-12 engineering education. And to engage teachers, the institute’s Summer Academy program offers P–6th grade teachers a week of intensive hands-on training and assistance in developing personalized engineering lesson plans.

“I learned two very important facts by 8:30 a.m. the first day of training,” says Summer Academy participant Sandy McMahon. “[First], that I knew absolutely nothing about engineering, and [second], that engineers and teachers don’t think alike.” It wasn’t easy introducing her to the world of engineering, she adds: “I have been challenged every minute of every day,... [but] the staff at Purdue has been phenomenal.”

—REBECCA GOLDENBERG
**Global Engineering Program**

Engineer your global career. That’s the directive to students from Purdue’s Global Engineering Program (GEP), which puts the academic and career development of students at the heart of international experiences.

“Companies tell us that they need global engineers, and that’s what we’re working toward,” says Becky Hull, who promotes GEP work- and study-abroad opportunities to students in her position as Civil Engineering’s study-abroad liaison. Interim director Dan Hirleman (head of Purdue’s School of Mechanical Engineering) and assistant director Yating Chang head the program.

GEP equips students to engineer global careers through a variety of programs, including spring break, Maymester, and summer programs; engineering internships and co-op assignments at international locations; semester or academic-year student exchanges or study abroad with partner universities; and Purdue’s GEARE program.

GEARE, the Global Engineering Alliance for Research and Education, works in partnership with prestigious universities in Germany, China, India, and Mexico to provide undergraduates a domestic corporate internship, a later international internship at the same company, one semester of study abroad, and a two-semester co-located global design team project. (A graduate-level version offers six months of mentored research experience at a GEARE partner university.)

“When [our] students are hired, they have an edge over those who have not gone abroad,” says Hull. Mechanical engineering junior and GEP participant Kim Dietz attests to that: “Now I have a better understanding of how to prepare myself for an international career.”

—R.G.

**EPICS**

**Engineering Projects in Community Service**

Purdue’s EPICS program, a nationally acclaimed initiative now in its 12th year, puts multidisciplinary teams of students to work, for academic credit, on the technological needs of local community service agencies, schools, and other nonprofits. Undergraduates from 30 different departments within and beyond Purdue’s College of Engineering form teams of eight to 20 students to research, design, prototype, and implement engineering solutions.

Purdue EPICS enrolls more than 500 undergraduates each year; teams have already delivered more than 200 projects to their community partners. All projects fall into one of four categories: human services, access and abilities, education and outreach, and the environment.

The national program, headquartered at Purdue, operates at 18 universities all over the country (including Puerto Rico) and in New Zealand. Today, peer teams at multiple EPICS sites are collaborating to address community needs on the national level. A growing international interest in EPICS provides opportunities for EPICS students to address local community needs in their own native countries as well as collaborating on projects across universities and even participating in student exchanges that provide global service-learning experiences. The 2006-07 year alone saw some 1,500 students delivering more than 300 projects across the EPICS programs.

Building on EPICS’ overwhelming success, Purdue and partnering EPICS universities are reaching out to create a high school model called EPICS High, which launched this past spring in 28 schools across five states. “I wasn’t thinking of engineering at all but wanted to do the project,” says one Bedford (Indiana) North Lawrence High School girl who’s participated in the program. “After I got into it, I found electrical engineering fun.”

—R.G.
The 19th-century Purdue engineer's plan of study:

The program of study you see here harks back to 1874, when two- and three-cent coins were in circulation, public schools were segregated, only 0.7% of women ever studied within the halls of a university, and the Republican elephant was born.

Following this program of study, the Purdue engineering student took set courses for the first three years before choosing one of four majors in the senior year: civil engineering, mechanical engineering, mining engineering, or architecture. Today's mechanical engineering students need only 128 credits to graduate, but back then it was a whopping 220. Jim Jones, associate head of the School of Mechanical Engineering, speculates that classes may not have assigned as much work to make up for the sheer number of credits taken each semester.

But French and German? Political economy and logic? Botany and moral science?

“The program of study was tied to the industries of the day and what was crucial and important in the late 1800s,” Jones says. “I think at Purdue we’re coming full circle in a lot of ways. In my viewpoint, industries are looking for a much broader set of skills. It’s no longer adequate to just have good solid technical skills. Technical skills are necessary but not sufficient for being a good engineer. [Employers] want all these other skill sets like being innovative, entrepreneurial, having a global perspective, leadership, and other skills that aren’t explicitly technical.”

—R.G.
Doctoral Distinctions
Two PhD students receive the prestigious Chorafas Foundation Award.

Two Purdue engineering students won the Dimitris N. Chorafas Foundation doctoral dissertation award, which was established to encourage the development of promising graduate researchers in engineering.

Tengfei Zhang, of Jiangxi, China, and Arijit Raychowdhury, of Calcutta, India, were selected for the monetary prize. The prize money is intended as co-funding for the students’ advanced studies and/or research, says Jay P. Gore, the Vincent P. Reilly Professor of Mechanical Engineering.

Zhang’s dissertation, titled “Detection and Mitigation of Contaminant Transport in Commercial Aircraft Cabins,” is sponsored by the U.S. Federal Aviation Administration to improve airliner cabin security and environment. The research aims to develop defense technologies that protect passengers and crew on airplanes by detecting and mitigating possible air contamination. The core of the dissertation is to develop an inverse model that can tell when, where, and how chemical or biological agents have been released by terrorists.

Raychowdhury’s research centers on the development of circuit and architectural techniques for nanotechnology and their implications for the high-performance and low-power computational needs of the future.

The Chorafas Foundation was created in 1992, and prizes are awarded to students at more than 20 universities around the world for exceptional doctoral research projects and to help stimulate research among young doctoral candidates. Candidates must be planning to graduate between May 2007 and August 2008. Their research should be in the advanced stages, according to the foundation’s rules.

Dimitris N. Chorafas is an internationally recognized consultant who has advised financial institutions and industrial corporations on strategic planning, risk management, computer and communication systems, and internal controls since 1961.

—CLYDE HUGHES

The College of Engineering recognized nine other students with cash prizes and certificates for their dissertation proposals selected from nominations for the Chorafas competition. Shown here at the presentation: Back row: Nathaniel Pettis (Electrical and Computer Engineering); Yu-Sung Wu (Electrical and Computer Engineering); Jay Gore, then-associate dean for research and entrepreneurship; James C. Sisco (Top Dissertation Award recipient, Aeronautics and Astronautics); Silas Leavelsley (Biomedical Engineering); Front row: Alok Joshi (Mechanical Engineering); Arijit Raychowdhury (Chorafas Award winner, Electrical and Computer Engineering); Tengfei Zhang (Chorafas Award winner, Mechanical Engineering); and Watcharapol Chayaprasert (Agricultural and Biological Engineering). Awardees not shown: Baratunde Cola (Mechanical Engineering); Jung Eun Oh (Civil Engineering); and Mahidhar Rayasam (Mechanical Engineering).
Engineers Deserve a Liberal Education

As much or more than for any other career, engineers need the benefits of a liberal bachelor’s education. Other professions have recognized this need for many years. It is time for engineering to change to the master’s as the professional degree. Bachelor’s education should then be modeled after pre-medical education—a set of generally required courses within the context of a liberal arts bachelor’s degree, with a wide choice of majors.

Some of the drivers for this change are:

- Engineers need the flexibility to move among careers, to management, public service, or out of the engineering profession altogether.
- Engineers must interact effectively with people of different backgrounds and with the public on issues such as environment, energy, food supply, water, and national security.
- With instant broadband communication and access to information, “the world is flat.” Straightforward engineering jobs are going overseas, leaving U.S. engineers with more complex, interactive jobs and the need to understand and work closely with other cultures.
- There is simply more to be had from life if one has a broader background and interests.

All these factors call for a broader engineer, with more understanding of society and the human nature and condition.

Engineering is the only major profession with the bachelor’s degree as the first professional degree and accreditation primarily at that level. Other professions, such as medicine, law, business, architecture, planning, journalism, and public health, build upon a liberal arts bachelor’s degree.

To its credit, ABET [the Accreditation Board for Engineering and Technology] has recently sought more breadth in undergraduate engineering education. But the problem is that a nominally four-year bachelor’s degree is just too small a box in which to package both a professional engineering education and an adequate liberal education.

Some will say that fewer students would enter engineering because of the prospects of longer time and more cost. But the change will also enable students to make a much more informed choice as the end of the bachelor’s degree approaches. Breadth and the opportunity for a delayed commitment should bring more students to consider engineering seriously, especially women and minorities. The community college transfer route will be much more attractive and workable. The added time and cost are excellent investments for a future career, and the time is offset by the fact that most engineering students now take well over four years to complete their degree. The change to model pre-medical education may actually increase the number and diversity of engineering students.

Some pre-engineering bachelor’s graduates will not proceed onward to the professional master’s. They will still have good options, including other professional degrees and jobs linking engineering with other functions. They will contribute toward the goal of a technologically literate population.

Some will observe that there is a strong industrial demand for bachelor’s engineers. But here the interests of corporations and individuals diverge. Corporations will gladly hire engineers for entry-level functions when the openings are there. Individual engineers need to enhance their flexibility and opportunities for moving to different functions as their career develops and/or as the economic cycle turns downward.

Still others will observe that it will be difficult to make this change. But medicine and law did it in the early parts of the last century. Surely engineering—the problemsolving profession—can find the way to do make the change.

My class at Yale had its 50th reunion this year. In the reflective 50-year class book, one of our number observed and regretted that he had “missed his Yale education” because of having majored in engineering. With the change that I am urging, he would have had that education.

C. Judson King is provost and senior vice president emeritus of the University of California system and professor emeritus of chemical engineering on the Berkeley campus. He currently directs the Center for Studies in Higher Education at Berkeley. This article will also appear in the Winter 2008 issue of Chemical Engineering Education.
Construction Countdown

A freshman engineering class gets an up-close look at the new Colts home on the rise.

You want to talk about looming deadlines? Suppose your office had a giant digital clock in the conference room, counting down the days, hours, minutes, and seconds of a project-due date. And just so

visitors could take note, too, an identical clock clicks off the seconds in the reception area. So tick the timepieces in the downtown Indianapolis construction offices of the Hunt Construction Group, builders of the rising Lucas Oil Stadium—323 days, 16 hours, 9 minutes, 22.8 seconds, and counting.

But there was little pressure on 24 freshman engineering students, simply here for a tour of the new Colts stadium. The quiet group entered the stadium with the brick exterior walls already in place. They saw: on a dirt-covered field—still long before Peyton Manning can hit Marvin Harrison in perfect stride crossing over the middle—giant cranes which have helped place three of five steel trusses that form the peak of a retractable roof.

They walked through the Colts locker room, looking more like an unfinished basement at this point, got a view of the soon-to-be 50-yard line from one of the 140 suites, and spied what

Colts fans will see when a north-side window opens up like a sliding glass door: the Indianapolis skyline.

Pretty tasty as far as field trips go. The class, Engineering 103, also known as “Civil Engineering in Action,” is taught by Bryan Hubbard, director of industrial relations. Hubbard’s two-fold mission: to increase the number of freshmen making the leap to the School of Civil Engineering and introduce them to the possibilities of a civil engineering career. “It’s difficult in the classroom to explain the size and scale of a project like this,” Hubbard says. “Even the ‘Building Big’–type shows can’t match what you see in person.”

For the management team from Hunt, assisted by the Indianapolis-based firms Smoot Construction and Mezzetta Construction, the massive undertaking is a familiar enterprise. The number-one builder of sports facilities, according to Engineering-News Record magazine, Hunt has built retractable roof baseball stadiums in Phoenix.
(Chase Field), Seattle (Safeco Field), and Milwaukee (Miller Park). In addition to Lucas Oil Stadium, they’re also building a new multipurpose facility and home for the Arizona Cardinals of the National Football League (NFL).

Familiarity, however, doesn’t necessarily make for a build without problems. Chad Hobson (BSCT ’90), the project manager overseeing all the outdoor and indoor civil work, says they experienced problems as soon as they started digging a big hole in the ground. “We ran into a lot of unforeseen conditions in the excavation,” Hobson says. “We had about a half a million cubic yards of dirt that we hauled out of the hole.” The ground, in turn, turned up remnants of materials that had been on the site for hundreds of years—everything from old railroad stations to gas manufacturing plants to coal mining facilities.

The stadium is also being designed to sit on top of Pogue’s Run, a waterway 40 feet wide and 15 feet tall that runs under downtown on its way to the White River. Rather than relocate or build around the run, designers decided to build over it, Hobson says, saving millions of dollars and much precious time.

And if everything comes in on time, Lucas Oil Stadium should pay off handsomely for the city of Indianapolis. In addition to football, NCAA basketball, conventions, trade shows, monster truck extravaganzas, and more will come to the multipurpose facility. The Colts have outgrown the RCA Dome, currently one of the smallest venues in the NFL, and the size and numbers of the new seven-level stadium are impressive. Up to 63,000 football fans will have access to larger entrances and public concourses, 14 escalators, and 11 passenger elevators, wider seats with more space between rows, 148 concessions stands, and 1,400 toilets.

Who knows what lurked in the minds of the students on the site? Wrestling with decisions on what majors to choose and miles to go before they work, the freshman bunch stood mostly silent when tour leaders called for questions.

Hubbard, however, couldn’t resist—after it was all said and done—asking one young man what he thought, if he had fun. Straight-faced, the freshman replied, “It was the experience of a lifetime.”

An educational experience, Hubbard hopes, to be repeated in the coming years by many from the class in paid internships and big builds throughout construction careers.

—WILLIAM MEINERS
Inspiration Unveiled

Husband-and-wife donors grace the Purdue campus with a sculpture of Neil Armstrong.

On October 26, one day before Purdue dedicated Neil Armstrong Hall as the flagship building of the College of Engineering (see page 4), President France Córdova joined engineering dean Leah Jamieson and others to unveil what is destined to become a classic landmark on the university’s campus: a bronze sculpture of the first astronaut to walk on the moon. The statue, accompanied by a trail of sculpted moon boot impressions and other symbolic features, stands in front of the new building, located at Stadium and Northwestern avenues.

Artist Chas Fagan, of Charlotte, North Carolina, created the work. The sculpture of Armstrong, depicted as an undergraduate student in the 1950s, sits on a stone plinth in front of the building. Armstrong gazes over his left shoulder in the general direction of the lunar moon boot impressions.

“The statue represents a voice from the past speaking to the future, Armstrong’s likeness seems to be saying, ‘I was a student once at Purdue, just as you are now. I went on to achieve things I didn’t dare dream about, and you, too, can do amazing things,’” says Córdova. “I hope it will inspire our students and others to reach for the stars.”

Mary Jo Kirk and her husband, Bob Kirk (BSME ’52), of Washington, D.C., donated the money for the sculpture. In recognition, the area in which it is located has been named Kirk Plaza.

The bronze statue, an 8-foot-tall, 133-percent-scale likeness of Armstrong, recreates the image of a clean-cut college student wearing a windbreaker, button-down Oxford shirt, cuffed khaki pants, and penny loafers. His right hand rests on a small stack of books, and his slide rule is removed from its case as though ready for action.

An elliptical stone arc resembling a spacecraft trajectory is embedded flush with the ground in Kirk Plaza next to the statue. An inscription in the arc reads: “One small step for a man, one giant leap for mankind.”

The arc leads toward the lunar footprints, which were modeled after an actual moon boot from the Smithsonian Air and Space Museum. The 21 boot impressions trail away from the sculpture toward the building, running parallel to a walkway and spaced far apart to replicate the
bounding gait of an Apollo astronaut. A few of the lunar prints are spaced farther apart than others, as though created by a leaping moon walker.

The sculpture presented several challenges, according to Fagan. “The moon boot prints were definitely an unusual touch,” says the sculptor, an internationally known artist who has painted portraits of all U.S. presidents, some of which are hanging in the White House.

The boot impressions are made of “cast stone” that matches the base on which Armstrong sits and also the floor of Kirk Plaza. Fagan used a special foam to make forms from the moon boot that he was permitted to access at the Smithsonian. The foam, the same material used by podiatrists to size feet, was safe to use on the valuable Apollo relic.

“Then we used a laser scanner to take images of the foam impressions we made from the single boot,” Fagan says. “We had only a right boot, so we made a mirror image for a left foot. Then we created a master cut to create molds for the final impressions.”

Fagan consulted with Armstrong to ensure that he was on the right track before creating the sculpture’s final design.

“I met with him privately so that I could quiz him and get his perspective of what he was like as an engineering student at Purdue,” says Fagan. “He reviewed details and made suggestions, and the design was approved by committee.”

Fagan also had to meet with his subject to solve a key missing ingredient: He needed to know what Armstrong’s profile looked like. “Without knowing someone’s profile, you are just guessing, based on shadows you see in photographs, as to how the person looks in real life,” Fagan says. “The age difference did not really matter because bone structure and basic features don’t change.”

Armstrong earned a bachelor’s degree from Purdue’s School of Aeronautics and Astronautics in 1955. He was selected for astronaut training in 1962, and, in 1969, commanded NASA’s Apollo 11 mission, which landed the first humans on the moon.

—EMIL VENERE
On June 30, 2007, Purdue announced that more than $1.7 billion had been raised from nearly 184,000 donors at the conclusion of the seven-year Campaign for Purdue, surpassing the $1.5 billion university-wide goal. The news was good for the College of Engineering as well: Purdue Engineering exceeded its campaign goal of $472M by 4%, raising $491M, or 28% of the university total.

The Campaign for Purdue, begun in 2000 and publicly announced in 2002, was part of an overall strategic plan adopted for the university in 2001. The plan’s goal: to make Purdue a preeminent university by advancing quality in all areas, including basic and applied sciences and engineering, and contributing to societal progress, especially in Indiana. In parallel, the College of Engineering developed a strategic plan in 2002 whose timeline concluded this past summer.

At the college level, campaign dollars have supplemented state and federal funds to support Engineering’s strategic goals: facilities and equipment, student support, faculty support, programs, and unrestricted uses. New cutting-edge facilities have sprung up across campus, faculty size has grown substantially, and student scholarships have blossomed.

"The generosity of our alumni and friends continues to amaze me," says Amy Noah, director of advancement for the College of Engineering. "This campaign has been an overwhelming success that has allowed the College of Engineering to accomplish the goals that were spelled out in our strategic plan. Our friends, alumni, and corporate partners should feel proud of what they have helped make happen in the College of Engineering."

Below, a college-wide and school-by-school look at Purdue Engineering’s strategic-plan successes, bolstered by the generosity of Purdue Engineering donors.

### College of Engineering

- Faculty size grew from 277 to 343, with a total of 136 new faculty hired in nine multidisciplinary signature areas.
- Total of 24 National Science Foundation (NSF) Career Award recipients; 123% growth in named and distinguished professors; eight new National Academy of Engineering (NAE) members since 2001.
- Established a named professorship through the Goodwin Challenge.
- In the past three years of the strategic plan, 17% of new faculty hires were underrepresented minorities and 24% were women; for the past two years, *Hispanic Business* magazine named the College of Engineering #2 in the country for Hispanic graduate students.
• Significant new space added with the completion of Civil’s Bowen Lab, Chemical Engineering’s Forney Hall addition, Biomedical Engineering’s Jischke Hall, the Birck Nanotechnology Center, and Neil Armstrong Hall. Funds raised for Electrical and Computer Engineering’s Seng-Wang Hall and Mechanical Engineering’s Gatewood Wing.
• Growth in large-scale research projects:
  • $21M and $17M NSF Engineering Research Centers for Compact and Efficient Fluid Power and Structured Organic Composites, respectively.
  • $13M U.S. Department of Transportation NEXTRANS Integrated Solutions for Mobility, Safety and Infrastructure Renewal Center.
  • $18.5M renewal of the NSF Network for Computational Nanotechnology.

Aeronautics and Astronautics
• Faculty grew by 28%, with a fivefold increase in distinguished and named professors.
• Doubled research expenditures in five years.
• Created new Aerospace Systems area and Astrodynamics and Space Applications area.
• Addition of new educational and research capabilities in Armstrong Hall.
• Granted more aerospace-related degrees to women than any of its peers.

Agricultural and Biological Engineering
• Increased faculty from 19 to 26.
• Increased breadth and depth of learning and discovery opportunities in biological engineering (e.g., sensor technology development for biosciences application and to improve fundamental understanding of biological systems).
• Grew the graduate program from approximately 55 to 75 graduate students.
• Increased interdisciplinary research with significant faculty involvement in Discovery Park research complex (70% of ABE faculty involved with one or more Discovery Park centers).
• Greatly expanded expertise and research capacity in fluid power (two new faculty; new 8,000-square-foot laboratory).
• More than doubled research grants and contracts.

Weldon School of Biomedical Engineering
• Father and son alumni Norm and
Tom Weldon named the school.

- Completed and occupied new building, Martin C. Jischke Hall of Biomedical Engineering.
- Graduated the inaugural BME undergraduate class in May 2007.
- Secured a $100M endowment from the Mann Foundation to create the Alfred Mann Institute for Biomedical Development.
- Established the Leslie A. Geddes Professorship in Biomedical Engineering through a gift from Cook Inc., utilizing the Goodwin Challenge.

Chemical Engineering

- Hired three NAE members and saw one faculty member elected.
- Enhanced faculty diversity, adding three female faculty and two underrepresented faculty.
- Eight faculty have received NSF Career and Presidential Young Investigator Awards since 2001.
- New and renovated facilities, with the addition of the $20M Forney Hall and the ongoing $12.8M renovations of the existing building.
- Near doubling of research expenditures.

Civil Engineering

- Through the Goodwin Challenge, established the Bowen Engineering Head of Civil Engineering, Concrete Paving Industry Professorship in Concrete Pavement and Materials Science, the Jack and Kay Hockema Professorship, and the Charles Pankow Professorship.
- Constructed the Bowen Laboratory, one of the nation’s premier large-scale structural testing labs.
- Created two new research laboratories and new community-building space.
- Doubled the size of the incoming 2007 sophomore class.

Electrical and Computer Engineering

- Pioneered innovations in education, including NanoHub, a new model for ubiquitous education; Vertically Integrated Projects (VIP), an initiative to expand undergraduate research and experiential learning opportunities; and a new undergraduate curriculum in parallel processing.
- Increased diversity in graduate student population (19% of domestic students are underrepresented minorities) and participated in diversity initiatives.
- Established seven new professorships, including the Hewlett-Packard Professorship of Electrical and Computer Engineering through the Goodwin Challenge.
- Raised $17.5 million toward the construction of Wang Hall, which will include 30 laboratories for fields and optics, energy sources and systems, VLSI and circuit design, and computation electronics.
- Constructed a new MRI research facility in Purdue’s Research Park, in partnership with InnerVision.
Hosted first regional leadership conference of HKN honor society.

Engineering Education
- Created the world’s first Department of Engineering Education and started the world’s first graduate-degree program in engineering education; first doctoral degree awarded in 2006.
- Established the Institute for P-12 Engineering Research and Learning (INSPIRE), creating new models for engagement in pre-university education.
- Grew research awards by 700% in 2006-07, to more than $3.2M per year.
- Within the First-Year Engineering Program, enhanced experiential learning opportunities, global experiences, advising services, and percentage of students entering professional schools.

Materials Engineering
- Increased faculty from 11 to 22, increasing diversity and faculty breadth into new research areas such as computational materials science, polymers, and biological and soft materials.

Industrial Engineering
- Raised funds for three chaired professorships.
- Raised funds for graduate and undergraduate student support.
- Grew strong partnerships in China, India, and Latin America.
- Revamped doctoral program and a new BSIE/MBA program.
- Realigned the school for future leadership in areas like service engineering, RFID (radio-frequency identification), and healthcare engineering.

Mechanical Engineering
- Raised $26M for faculty support, surpassing advancement goal of $23.5M; added nine endowed chairs, including the Cummins Professor of Mechanical Engineering through the Goodwin Challenge.
- Established the Graduate Engineering Alliance for Research and Education (GEARE), now expanded to include students from other engineering disciplines, and created GEARE university partnerships in Germany, India, China, and Mexico.
- Increased study-abroad participation fivefold.
- Doubled research funding; established an NSF-funded Engineering Research Center for Compact and Efficient Fluid Power.
- Raised more than $12M for scholarships and fellowships (original goal: $11.5M).
- Raised funds for the Roger B. Gatewood Wing.

Nuclear Engineering
- Established the Paul Wattelet Chair in Nuclear Engineering through the Goodwin Challenge.
- Hired three new faculty members and increased faculty diversity.
- Doubled undergraduate enrollment and saw a 25% increase in graduate students.

—Lisa Hunt Tally with Kim Medaris and Carolyn Percifield
Engineering’s 2007 Honorary Doctorates

Meet four remarkable individuals, each of whom received a doctorate honoris causa at Purdue’s May 2007 graduation.

**MASTER BUILDER**

Robert L. Bowen (BSCE ’62)

An alumnus of Purdue’s School of Civil Engineering, Bob Bowen has distinguished himself in the construction industry as the founder and owner of Bowen Engineering Corporation, a multimarket company specializing in water and wastewater treatment plants and energy utility construction. Based in the Indianapolis area, the company works in 15 states in the midwest and southeastern U.S. Bowen, an authority on preplanning and leadership practices in construction, is also a founder and instructor of the Associated General Contractors (AGC) Project Manager Institute. Bowen Engineering has received four AGC Build America Awards—the Oscar of the construction industry—including one for the $57 million Lafayette Wastewater Treatment Plant Addition (in Indiana) in 2004.

Along with his wife, Terry, Bowen established the Bowen Foundation 13 years ago to provide scholarships to minority students in Indianapolis to help them pursue an education past high school. About 300 students have received more than $750,000 in scholarships through this foundation.

In 2002 the Bowens joined with then Purdue president Martin Jischke (see below) to found Science Bound, a program that mentors students from the Indianapolis public schools (eighth grade through high school) and encourages them to pursue careers in science and technical fields—offering opportunities to earn full-tuition scholarships to Purdue.

The Bowens also provided financial support for Purdue’s Robert L. and Terry L. Bowen High-Scale Performance Civil Engineering Laboratory, an $11 million research facility (opened in 2003) that allows engineers to test structures such as bridges and buildings while focusing on making construction materials safer, more durable, and earthquake-resistant.

In 2005 the Bowens received the Outstanding Philanthropist Award from the Indiana chapter of the Association of Fundraising Professionals for their generous financial support of education.

**VISIONARY LEADER**

Martin C. Jischke

As Purdue’s 10th president, Martin Jischke led the institution through a strategic plan that has guided Purdue toward preeminence and a fundraising campaign that raised more than $1.7 billion.

Born and raised in Chicago, Jischke received his bachelor’s degree in physics from the Illinois Institute of Technology and earned master’s and doctoral degrees in aeronautics and astronautics from MIT. Before coming to Purdue, he served as faculty member, director, dean, and interim president at the University of Oklahoma; chancellor of the University of Missouri-Rolla; and president of Iowa State University.

Jischke joined Purdue in 2000, placing a high priority on improving the institution’s ability to support economic development in Indiana. He regularly visited communities throughout the state to meet with business and government leaders in order to find ways to improve Purdue’s ability to cooperate with local and regional efforts.

In addition, the Jischke presidency brought the most intense period of new construction in the history of the West Lafayette campus. Since August 2000, more than $780 million in new facilities have been completed or initiated or are being planned. The centerpiece of these efforts is Discovery Park, a $300 million research and teaching complex designed to focus on interdisciplinary projects and to bring new ideas to the marketplace as efficiently as possible.

In 2006, Jischke was appointed by President George W. Bush to the President’s Council of Advisors on Science and Technology. He has also served as president of the Global Consortium of Higher Education and Research for Agriculture; as a member of the board of directors of the National Association of State Universities and Land Grant Colleges, Campus Compact, and the Association of American Universities; and as a council member of the National Academies Government University Industry Roundtable.
FIELD-DEFINING RESEARCHER
Raymond Viskanta
(MSME '56, PhD '60)

Over the course of 50 years, Raymond Viskanta’s research as a Purdue faculty member in mechanical engineering encompassed a wide range of topics in convection and radiation heat transfer, contributing significantly to Purdue’s position as a leader in the field.

Viskanta lives in West Lafayette, Indiana, but his journey to Purdue was challenging. Born in Lithuania, he moved with his family in 1944 as the front lines of the Soviet-German conflict approached the family home. Settling in Germany, the family moved to displaced-persons camps in West Germany after the war ended and emigrated to the U.S. in 1949.

Viskanta earned his bachelor’s degree from the University of Illinois and then started graduate work at Purdue in heat transfer, earning his master’s degree in 1956. He started his mechanical engineering career at Argonne National Lab and, thanks to a U.S. Atomic Energy Commission Fellowship, returned to Purdue to work on his doctoral degree, which he completed in 1960.

Viskanta joined Purdue’s faculty as an associate professor of mechanical engineering in 1962, becoming the W.F.M. Goss Distinguished Professor of Engineering in 1986. He has received recognition over his career not only because of the unusual quality and productivity of his research but also because of its expansive breadth. He is published in more than 50 journals in the U.S., Europe, and Japan.

TECHNOLOGY INNOVATOR
Vern W. Weekman Jr.
(BSChE '53, PhD '63)

Vern Weekman has distinguished himself as a leader in the energy industry, having developed key technologies, guided a new commercial venture, managed research for a major corporation at every level, and taken national leadership in his profession.

Although most of his career was spent in Mobil Oil Corporation, Weekman most recently has served as a faculty industrial fellow and visiting lecturer at Princeton University. He earned his bachelor’s degree in chemical engineering from Purdue in 1953 and a master’s in chemical engineering from the University of Michigan the following year.

Weekman started his career with Mobil in 1954, served in the U.S. Air Force from 1955 to 1957, and returned to Mobil for 40 years, earning his doctorate from Purdue along the way in 1963.

His work in the early years of his career is credited with establishing Mobil Oil’s international leadership position in the catalytic reforming of petroleum. Models he published during that period are still cited today as examples of how to treat complex systems. While at Mobil, he published 33 papers and received 11 patents. He was elected to the National Academy of Engineering in 1985.

Weekman spent five years as the first president of Mobil Solar Energy Corporation, leading the venture to bring brand-new technology to the marketplace, a mission that required not only a dramatic change in technology and science but also a new intimacy with entrepreneurship. His success at Mobil was balanced with his effective service as president of the American Institute of Chemical Engineers in 1998.

Named a Distinguished Engineering Alumnus by Purdue, Weekman also served as a founding member of the New Directions Industrial Advisory Council of Purdue’s School of Chemical Engineering from 1990 to 1997.

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U.S.-educated engineers have long enjoyed an assured competitive edge in career opportunities, prestigious posts, and stature in their fields. But as universities across the globe expand and enhance their engineering curricula and the numbers of students entering engineering grows, that advantage could erode.

**Can U.S.-educated engineers retain their competitive advantage?**

Answer: Maybe, but it will take change and work.

If U.S.-educated engineers are to retain a competitive advantage, we must not only improve but score reasonably well in each of five areas: U.S. demand for engineers, international admission and residency policies, emphasis on creativity and innovation in our education, accelerated quality of our education, and research funding allocations.

- **Demand for engineers**—in job opportunities and good salaries—drives the number who pursue engineering. Without demand and good salaries, top students will choose other disciplines.

- **International admissions**: A decade ago, nearly all international students stayed in the U.S. As the world’s economies improve, more return home, so we need to increase the number admitted and allowed to stay after their education to retain similar or greater numbers than in the past.

- **Innovation**: We must move in educating beyond content knowledge to helping students develop their creative potential by giving them the objective rather than telling them how to do it.

- **Educational quality**: It’s no secret that universities around the world are emulating U.S. education, improving on it, and catching up with us. I started the department of industrial engineering at Tsinghua University in China in 2001. Within five years, National Academy of Engineering members ranked it in the top 20 in the world. Hence, we need to move impact of education to the next level.

- **Research funding**: Much of the money currently supports research projects, student fellowships, and post-docs. Innovations could include funding outstanding professors with designations such as National Institutes of Health professor or National Science Foundation professor, and the money could be continuous for all their research activities. Also, when people write research proposals, it’s a predictive model. Instead, why not pay for outstanding, completed research? After all, descriptive models are always more accurate than predictive models. Without advancements in every one of these areas, we certainly could lose. With change, improvement, and high scores in all five, we can keep and even improve our competitive advantage.

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**Gavriel Salvendy**

> Professor of Industrial Engineering, Purdue University
> Chair Professor and Head, Department of Industrial Engineering, Tsinghua University, Beijing, China
Answer: It depends on whether our engineering schools transform their curricula.

Gone are the days when engineering advancements are achieved by working in isolated disciplines. Today’s problems are more interdisciplinary, and thus engineers are involved in challenges that go beyond the historical disciplines of civil, mechanical, and electrical engineering. To stay competitive, U.S. engineering education must similarly evolve to offer much more cross-disciplinary education and hands-on training.

Today’s engineers no longer face just an electrical engineering problem or a chemical engineering problem. They must be flexible, able to work across multiple disciplines, be more of a renaissance engineer with integrative skills. They must adapt to new technologies throughout their lifelong journey.

At IBM, for example, our research used to be internally and technically focused. Today, it’s the opposite. Research starts with real-world problems clients haven’t been able to solve. This requires our engineers to be much more customer-oriented with strong listening, project management, leadership, and even financial skills.

There’s no question that engineering education outside the U.S. is making great strides along these lines. Some institutions, particularly in India and China, aren’t just playing catch-up. They are leapfrogging us.

U.S. engineering schools, therefore, must evolve by driving greater collaboration across the traditional disciplines. This will challenge them to significantly re-evaluate their approach to recruiting, curricula, and research.

Change of this magnitude will require forceful leadership by U.S. engineering schools. However, I am cautiously optimistic that they are up to this challenge as they have been so many times over the past 150 years.

Answer: Only if we move to higher-level functions and are willing to work abroad.

Right now, U.S.-educated engineers have a competitive edge in creativity, innovation, and location. Design work is usually done in the U.S. because a lot of companies are headquartered here. But that is changing.

Because of the Internet, videoconferencing, and other communications, we are slowly losing the location advantage. And more companies are operating plants outside the U.S., taking advantage of cheaper labor abroad and hiring process engineers and other engineers at those locations. We cannot bank on location anymore as an advantage.

We must move to higher-level functions in engineering so our skills are in demand. And we must globalize ourselves, be willing to work internationally.

If we don’t, we will lose our position as one of the high-tech leaders in the world. China and India are right behind the U.S., and they have much larger populations to draw from. The top 1 percent in China is a much larger pool, for example, than the top 1 percent in the U.S.

When I studied at the Indian Institute of Technology in Bombay, I saw first-hand the kind of training their engineers are getting, and it’s impressive, somewhat beyond ours. Their fundamentals are much stronger, their math and science understanding so much better. And their students are not satisfied to stop at a bachelor’s. They go for the master’s, the MBA, the PhD. There’s a stronger push in their society to do something at that level if they have the opportunity. And they are more determined to better themselves.

I also know I must be willing to work abroad, to work with international people, and to adjust to this new environment. Even with higher-level skills, working internationally will be part of my job.

—INTERVIEWS BY KATHY MAYER
Quantum what?

See lower right (rotate page).

Image by Wei Qiao, David Ebert, Maker Korkusinski, Gerhard Klimeck
This is an image of a quantum dot produced by a simulation using the nanoHUB, a Web site created by the Purdue-based Network for Computational Nanotechnology. The nanoHUB is used by more than 3,000 national and international researchers and educators each month. This image shows a computed second excited electron state of a quantum dot nanodevice in which electrons resonate and emit bright light. Quantum dots are the basis of the new, energy-efficient, long-lasting, ultrabright light-emitting diodes (LEDs) that are becoming widely used in highway traffic signals.
An iconic American structure, the Golden Gate Bridge links San Francisco to Marin County, California, spanning the treacherous Golden Gate. The spectacular suspension bridge owes its design to Purdue civil engineering professor Charles Ellis.