How VUSE is already addressing key engineering challenges of the 21st century

Environmental Concerns

One top challenge is making solar energy affordable. “Solar energy is the only alternative energy with the capability to meet the world’s long-term energy needs,” says Kate Jennings, associate professor of chemical and biomolecular engineering. He and his collaborators are developing a solar cell inspired by nature’s solar energy conversion process—photosynthesis. “We extract a key photosynthetic protein complex from spinach cells and assemble the 10 nanometer protein into films on an electrode,” Jennings says. “When light strikes the film, electrons are transferred from one side of the protein to the other, and can then be captured and routed to a separate electrode to produce a current.” The research could lead to mass-produced solar cells that are economically scalable and could power countries. “Unlike current expensive technologies, these low-cost arrays will try to attack the systems and create a new technology,” Jennings says.

Challenges in Health Care

Engineering better medicines includes exploring materials to replace or repair tissues. Scott Goudsmit, assistant professor of chemical and biomolecular engineering, develops biomaterials for bone regeneration. These biodegradable polyurethane materials integrate delivery systems for healing infected bone fractures, as well as serve as site-specific implants incorporating alloplastic bone. Much research funding has come from the U.S. Army to assist soldiers wounded in battle, but the results are also applicable to orthopedic trauma and metastatic bone disease, where bone removed during surgery must be regenerated. Goudsmit says the technology may be in use very soon. “Part of our work is funded by the Army for Regenerative Medicine, which is committed to rapidly moving potential new therapies into the clinic,” Goudsmit says. Research in health informatics—the acquisition, management, and use and protection of information in health care—occurs in both the School of Engineering and at Vanderbilt University Medical Center (VUMC). “There are a number of efforts at Vanderbilt that are picking away at that problem, and I would say we are on the forefront of some of these ideas,” says biomedical engineering alumnus Russ Waitman, MS’88, PhD’96, assistant professor of biomedical informatics at VUMC.

For example, VUMC Director of Clinical and Translational Science Award (CTSA) Biomedical Informatics Operations Paul Harris, MS’95, PhD’96, develops informatics tools to support the medical research enterprise. Harris is research associate professor of biomedical informatics in the School of Medicine and research associate professor of biomedical engineering at VUSE. Others involved in informatics include Brad Vala, who holds appointments in the School of Engineering and the School of Medicine, and Douglas Fisher, associate professor of computer science and computer engineering, who works in data mining and machine learning.

Cyber Solutions

Information technology issues crosscut several challenges, including energy, health care, environment, and the need to secure cyberspace. More and more, embedded computers are found in everything from kitchen appliances to spacecraft, and used to monitor and control all kinds of operations in the devices, says James Sztipanovits, the E. Bronson Ingram Distinguished Professor of Engineering and director of Vanderbilt’s Institute for Software Integrated Systems (ISIS). Such cyber-physical systems rapidly increase our dependence on system technology and are already transforming industry, he says. “In many ways, the transformational effect of this will be larger than the effect of Internet technology on society,” Sztipanovits says.

Integrating cyber-physical systems into defense and civilian infrastructure exposes them to a host of new vulnerabilities. Cyber security is critical. “That vulnerability requires a new way of thinking,” says Sztipanovits, who is professor of electrical engineering, professor of computer engineering, and professor of computer science. System developers need to anticipate that intelligent adversaries will try to attack the systems and...
A Gathering Storm Grows—America’s Competitiveness Erodes

The report America’s advantage in the marketplace and its global preeminence in research and technology faces a stormy season. The report, which in some years ago was the National Academies’ landmark report, Rising Above the Gathering Storm, that warned of the nation’s low ranking in global science, technology, engineering, and math (STEM) education and research, had two goals: to estimate the nation’s endowment of intellectual capital and to warn about the possible outcomes if the nation continued on its current course.

The report’s authors, former CEOs of IBM and Microsoft, former General Electric CEO, and former chairman of the Department of Energy, warned that the nation was losing its competitive edge in science and technology and could find itself in a global race with other countries with higher investment in these areas. The report emphasized the need for increased investment in education and research, especially in STEM fields, to ensure the nation’s long-term competitiveness.

The report also warned that the nation’s relative decline in STEM education and research could have significant economic and social consequences, such as reduced innovation, lower productivity, and decreased economic growth. The authors argued that the nation needed to increase its investment in STEM education and research to ensure its continued competitiveness and economic growth.

The report was widely regarded as a call to action for policymakers, educators, and the public to address the nation’s declining competitiveness in STEM fields. It raised awareness about the importance of STEM education and research and helped to galvanize support for increased investment in these areas.

New Chairs and a New Name for Chemical Engineering

T

The new chair of the Department of Chemical and Biomolecular Engineering, Todd D. George, has been appointed to lead the School of Engineering as chair of the Department of Chemical and Biomolecular Engineering, formerly the Department of Chemical Engineering.

George succeeds Thomas R. Harris, Emeritus Henry wearing the blue cap and gown of the 2006 distinguished professor, who retired in May after serving as the interim chair since Fall 2007, set his goals include improving the visibility and accessibility of the department; both within Vanderbilt and throughout the greater academic community; flexibly placing students for undergraduate education and chemical engineering.

VANDERBILT UNIVERSITY

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ADVISORY BOARD

Distinguished Alumni: Monroe Carell Jr., B.E.’59, D.I.

Distinguished Alumni Monroe Monroe Carell Jr., B.E.’59, D.I., received for his business career and strong volunteer leadership for Vanderbilt initiatives and charitable causes, died June 20 after a battle with cancer. He was 76.

“Monroe was a wonderful husband, father, and a valued member of the School of Engineering’s Academy of Distinguished Alumni,” says Dean Karen R. Barbe. “He was a wonderful volunteer who contributed countless hours of his time and efforts to the university and was always ready to call on him for his time. He and his leadership and chemical engineering community were greatly appreciated and will be missed.”

Dan D. George has been named as the new chair of the Department of Biomedical Engineering and of the Department of Chemical and Biomedical Engineering, formerly the Department of Chemical Engineering.

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Building Success in Construction Management

Innovation in Focus

Billy Edwards inspires businesses to look at situations through a different lens.

Chasing the Checked Flag

Recent alumni on the straightaway with future racing stars.

Business is continually stressed, ” says Sanjiv Brown & Root, Inc. (KBR), Johnson valued the Vanderbilt Law School and the Vanderbilt MBA program’s success. “When I was in the program, the focus was on team projects. We learned to work as a team and develop communication skills. The program taught us how to manage time and prioritize tasks.”

Other valuable components of the program include teaching by Vanderbilt faculty from other disciplines and a strong emphasis on health care facility construction. The practical nature of the program makes it attractive to people in the workforce who already hold bachelor degrees. Graduate students can complete a master’s degree in engineering management in as few as five years on a part-time basis.

In addition, the program offers a wealth of career development resources, including a robust alumni network, on-campus career services, and a dedicated career services office.

Learn by Doing

The program’s reputation and flexibility are key factors that draw students to the program. The program’s success is due to its strong foundation in engineering and business, as well as its ability to adapt to the needs of the students.

The program’s focus on practical, hands-on learning is evident in the student projects and the faculty’s commitment to providing a high-quality education.

In summary, the Vanderbilt Master of Engineering Management program offers a unique blend of business and engineering knowledge, which prepares students for success in the global marketplace.

The program is an excellent choice for students who want to pursue a career in the engineering management field and want to be part of a diverse and supportive community.

New opportunities in engineering management are constantly emerging, and the Vanderbilt Master of Engineering Management program is well-positioned to help students succeed in this exciting field.

Learn by Doing

Internships play a key role in the program’s success. "When I was in the program, I worked 25-30 hours a week as an intern," says Dan Lewis, BE’89, EEM’93. "I learned something in class one day and applied it the next day." Upon graduation, Lewis joined Braasch & Gorton, a Birmingham, Ala.-based firm. His job includes recruitment, and he finds School of Engineering graduates are the perfect candidates. "Because of the health care focus, they’re very analytical," he says. "If you can build a hospital, you can build anything." Interns also have worked for KBR. "The interns we’ve had here have been very qualified and employed in increased project responsibility within a short period of time," Johnson says.

For Tim Johnson, assistant professor of construction management at Vanderbilt, the program for the construction industry is in its infancy. "We need more engineers with construction management knowledge and skills," Johnson says. "Construction management is a rapidly growing field, and we need to prepare students to meet the demands of the industry." Overall, the program is an excellent choice for students who want to pursue a career in engineering management or a related field and want to be part of a diverse and supportive community.
New NSF CAREER Award Winners

Each will receive $400,000 over five years to support their research. Robinson is working on improving the reliability of integrated circuits in avionics and space applications, as well as network routers and control systems.

New Additions

The School of Engineering added three new professors in 2008. All three have significant academic and industry acclaim.

Western Reserve, is the new chair of the chemical and biomolecular engineering department (see story page 11), as well as professor of chemical and biomolecular engineering. He has won accolades for his work in fault cell mem-

University of Tennessee, he has been elected an International Director of the Institute of Transportation Engineers. He became the first Tsinghua professor selected in more than 20 years.

Schrimpf, professor of electrical engineering, Stephen Walley, academic counselor and credentials evaluator for the School, has been awarded a 2008 Judd A. Fuch-

Eminences Emeriti

Four professors have received emeriti honors. Thomas Harris is now Oynn Harry and Jamie Drummond. He is an international leader in engineering and research.

McDonald completed his doctoral studies at VUSM in May. McDonald's expertise in systems optimization under uncertainty has been an important part of the department's NASA-funded reliability analysis project.

New Faculty Changes Include Honors, Tenure and New Faces

Joanne Lamphere Beckham, professor of computer engineering, and Sharon M. Weiss, assistant professor of electrical engineering and physics, are the newest recipients of highly competitive grants.

no Vanderbilt engineering professors have received prestigious National Science Foundation Faculty Early Career Development (CAREER) Program awards, outpacing the number of VUSE recipients to seven in 24 months. That achievement puts the School of Engineering among the NSF’s top award recipients nationally.

WILLIAM H. ROBINSON, professor of computer engineering, has been named an International Director of the Institute of Transportation Engineers.

The NSF grant will also support Wolcott’s efforts to recruit and retain students in science and engineering from traditionally underrepresented groups. He participates in the Tennesseee Louis Stokes Alliance for Minority Participation program at Vanderbilt and coordinates the Alfred Sloan Foundation Minority Ph.D. Program in the Department of Electrical Engineering and Computer Science.

Robinson joined the Vanderbilt engineering faculty in August 2003. His research interests include multivariate computer architectures, field-programmable gate arrays (FPGAs), and hard-
tone design for secure and reliable computing applications.

Wolcott is interested in designing methods to detect false positives and accurate detection of biological and chemical materi-

New Additions

Henderson has been honored by receiving the highest degree of excellence in his field even as his first music single, “I Don’t Know”, was climbing the national Adult Contemporary radio charts.

Outlet for Creativity

Walcott says he is looking for a cre-

Artistic Endeavors

Two young engineers launch art careers.

Lorenzo de Vicii would be proud. In the tradition of the multi-talented artist, engineer, and scientist, two

VESE is an endowed staff award for career distinction who have the opportunity to achieve the same level of success that Bob did.

For more information, please contact Katie Jackson in Vanderbilt’s Office of Planned Giving at 615-343-8358 or at 615-784-1699 or katie.jackson@vanderbilt.edu.

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To Protect and Serve…and Teach

Ken Pence’s office is cluttered with student projects from his engineering management classes, ranging from a guitar with frets that light up to teach players chords to a magnetic-induction powered device to measure an individual’s risk of being killed or robbed, depending on lifestyle or situations. Between 1995–98, the site where the tests are posted had more than 1 million hits (www.rateyourrisk.com). “Most people are disappointed to find out that they’re not at risk at all,” he says wryly.

As a professor, Pence is never disappointed in his students. “One favorite student project is a bicycle equipped with a lithium battery and an electric motor controller,” says Pence. “I sometimes ride it the six miles to school. I tell people I see this old guy coasting uphill at 20 miles an hour. People realize there’s something different when they see him.”

Pence is a man distinguished to do things the ordinary way. Entering Vanderbilt School of Engineering in 1969 as a freshman, lack of money forced him to drop out during his senior year. Instead of an engineering degree, he became a police officer, SWAT team leader and then a police captain.

**Atypical Career Path**

In the next 30 years, he graduated from the FBI National Academy, secured millions in technology grants for Metro police, led training on terrorism for police and the military. He became a fifth degree black belt in Taekwondo and an instrument-rated pilot, built a geodesic dome house in rural Davidson County, and helped develop a pocket language translator that enables police officers and soldiers to communicate with non-English speakers. He also returned to Vanderbilt, completing his bachelor’s, master’s and doctorate degrees.

While a police officer, Pence developed tests to measure an individual’s risk of being killed or robbed, depending on lifestyle or situations. Between 1995–98, the site where the tests are posted had more than 1 million hits (www.rateyourrisk.com). “Most people are disappointed to find out that they’re not at risk at all,” he says wryly.

As a professor, Pence is never disappointed in his students. “My favorite moments are when students’ confidence grows and their eyes light up as they talk about projects. “My closest student is really bright,” he reports. “I love teaching.” In addition to engineering management, Pence also teaches project management, engineering economics and applied behavioral science. Outside the classroom, Pence applies his passion for teaching by instructing others on gun use. “Every-one should know how to shoot,” he says. “You never need a gun until you need one, really, really badly. I think everyone armed should be trained.”

(Science fiction writer) Robert Heinlein said, “An armed society is a polite society.”

Pence had extra time recently for reading science fiction, his genre of choice, as he recovered from knee replacement surgery, a byproduct of 40 years of Tae Kwon Do, and surgery, chemotherapy and radiation for throat cancer.

“Has it all changed me? Sure. For one thing, I don’t stand in the shower and pray to lose weight,” he quips. “Because of my years on the police force, I never took life for granted, but now when I pray, I say, ‘Thank you for what I don’t know about today—the problems and threats beyond my awareness.’”

And Pence has more projects on the horizon. “I aspire to make a portable MRI and magnetic levitation device over the next few years. The application of knowledge excites me,” he says.

—Mardy Fones