Volume 49, Number 2, Fall 2008

VANDERBILT ENGINEERING

Meeting the Challenge

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

Even as the National Academy of Engineering (NAE) announced its list of the 14 grand challenges awaiting engineering answers in the 21st century, faculty members at the Vanderbilt University School of Engineering were at work on their share of solutions.

The NAE list, compiled from global surveys and finalized by a committee of technological thinkers, focuses on technologies deemed to impact the health and well being of the planet and quality of life. Challenges range from making solar energy affordable to engineering better medicines, and from improving urban infrastructure to securing cyber space.

"Vanderbilt Engineering faculty members are actively conducting research in many of these areas, with sponsorship from all federal agencies and industry, and with university partners spanning from the East Coast to the West Coast," says George Cook, associate dean for research and graduate studies. Noting that the challenges themselves are wide-ranging and complex, he says that researchers are concentrating on specific pieces of the solution areas.

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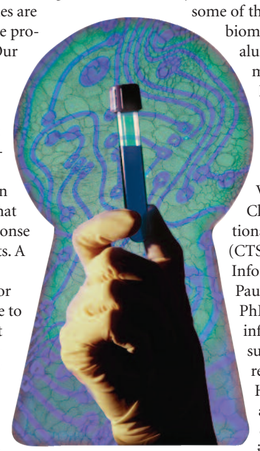
Environmental Concerns

One top challenge is making solar energy affordable. "Solar energy is the only alternative energy with the capacity to meet the world's long-term energy needs," says Kane 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 photoactive protein complex from spinach cells and assemble the 10 nanometer proteins 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 accessible to poor countries. "Unlike current expensive photovoltaics, our chief component literally grows on trees, is biodegradable and non-toxic," he notes.

Access to clean water will continue as a challenge in coming years. Currently, Gene LeBoeuf, associate professor of civil and environmental engineering, and his colleagues are working on efforts for the protection of clean water. "Our first effort involves the application of information technologies with advanced hydrodynamic and water quality modeling to produce a spill management information system," LeBoeuf says. That assists planning and response to chemical spill incidents. A second effort focuses on management strategies for water utilities in response to contamination. His latest project focused on water quality and the effects of thermal pollution from thermal electric plants.



New faculty member George Hornberger, professor of civil and environmental engineering, is an international leader in hydrology and water research. "Part of my work is looking at how microbiological processes in streambed sediments remove nitrate in the groundwater contaminated by fertilizer applied on agricultural fields," he says. One option in handling contaminated groundwater is natural attenuation—letting nature take its course. "To make sensible decisions of when explicit remedial actions are needed, as opposed to natural attenuation, we do need to know how the natural processes work," Hornberger explains.

Challenges in Health Care

Engineering better medicines includes exploring materials to replace or repair tissue. Scott Guelcher, assistant professor of chemical and biomolecular engineering, develops biomaterials for bone regeneration. These biodegradable polyurethane materials integrate delivery systems for healing infected open fractures, as well as serve as weight-bearing implants incorporating allograft 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. Guelcher says the technology may be in use very soon. "Part of our work is funded by Armed Forces Regenerative Medicine, which is committed to rapidly moving potential new therapies into the clinic," Guelcher 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 those ideas," says biomedical engineering alumnus Russ Waitman, MS'98, PhD'01, assistant professor of biomedical informatics at VUMC.

For example, VUMC Director of Clinical and Translational Science Award (CTSA) Biomedical Informatics Operations Paul Harris, MS'93, 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 Malin, 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 Janos 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

(continued on page 5)

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The Grand Challenges for Engineering in the 21st Century

(As compiled by the National Academy of Engineering)

1) Make solar energy affordable
2) Manage the nitrogen cycle
3) Advance health informatics
4) Prevent nuclear terror
5) Advance personal learning
6) Provide energy from fusion
7) Provide access to clean water
8) Engineer better medicines
9) Secure cyberspace
10) Engineer the tools of scientific discovery
11) Develop carbon sequestration methods
12) Restore and improve urban infrastructure
13) Reverse-engineering the brain
14) Enhance virtual reality

Note: The National Academy of Engineering does not rank these in order of importance. For further information about the challenges, visit *http://www.engineeringchallenges.org/*

DANIEL DUNCAN

Kenneth F. Galloway

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A Gathering Storm Grows—America's Competitiveness Erodes

Weather Report: America's advantage in the marketplace and its global preeminence in research and technology face a stormy season.

This warning—forecast three years ago in the National Academies' landmark report, *Rising Above the Gathering Storm*—was that the U.S. risks losing its position in a global economy and its leadership in research unless we take aggressive steps to foster both basic research and stronger math and science achievement by American students.

Six months ago, the Academies hosted a national convocation in the nation's capital to assess what has—and hasn't—been accomplished in the three years since *Gathering Storm's* release.

The verdict: very little has been accomplished.

Other nations have responded more swiftly to *Gathering Storm's* recommendations than has the U.S. itself, according to Norman Augustine, former CEO of Lockheed Martin Corp. and chair of the committee that prepared the report.

The consensus: America's leaders are concerned about the problem, but have weak follow-through.

American Competitiveness

Gathering Storm did help move America's competitiveness issues onto the national agenda.

The White House and Congress responded quickly. In 2006 President Bush announced the American Competitiveness Initiative (ACI) and Congress' swift bipartisan response enabled funding for ACI basic research programs starting in Fiscal Year (FY) 2007.

In August 2007, the President signed into law the America COMPETES Act, which supported doubling funding for basic research programs, especially in critical areas such as alternative energy sources, supercomputing and nanotechnology. Furthermore, the House and Senate supported increased appropriations in their FY 2008 budget bills.

STEVE BARRETT

Concerned Tennessee engineering deans and graduate students traveled to Washington to discuss research funding. Pictured are, front row, left to right: Dean Kenneth F. Galloway, Vanderbilt University; student Derick Weis, Tennessee Tech University; and student Benjamin Schmidt, Vanderbilt University. Second row, left to right: Dean Lonnie Sharpe, Tennessee State University; student Jameka Johnson, Tennessee State University; Sen. Bob Corker, R-Tenn.; Dean Bruce Bomar, University of Tennessee Space Institute; and Dean David Huddleston, Tennessee Tech University.

Then support for increases in research funding fell victim to end-of-the-year politics. The FY 2008 omnibus appropriations bill led to yet another disappointing year of flat funding for key national agencies.

Congress Strips Research Funding

What members of Congress didn't count on was a firestorm that ignited when research funding was stripped from the budget.

Companies, organizations, universities and national laboratories concerned with funding for research in engineering and science, and STEM education (science, technology, engineering and mathematics) all called on Congress to restore lost funds.

The School of Engineering added its voice to the call to replace pledged science and engineering funding.

In February 2008, chemical engineering doctoral student Benjamin Schmidt and I joined other Tennessee engineering deans and graduate students in meeting with members of the Tennessee congressional delegation to urge them to push for supplemental funding. Jeff Vincent and Christina West from Vanderbilt's Washington office coordinated a poster session on Capitol Hill to highlight research in Tennessee engineering schools that supports the 'competitiveness initiatives' designated in the COMPETES Act. Our effort—and message—was well received.

Funding Is Restored—Partially

Finally, a break in the clouds.

In late June, President Bush signed a FY 2008 $162 billion supplemental spending bill. Most of this money will go to Iraq and Afghanistan, but the bill did contain $337.5 million for the National Institutes of Health, the National Science Foundation, the Department of Energy's Office of Science and NASA.

This funding is merely an attempt to restore critical competitiveness funding that was authorized by the COMPETES Act but has yet to be appropriated.

At the passage of the supplemental spending bill, the chairman of the House Science and Technology Committee, Rep. Bart Gordon (D-TN), said we need to produce the world's leading scientists and engineers, and ensure that all students have a strong grounding in math and science.

We're lucky in Tennessee—our Washington delegates get it and are true national leaders in the fight for increased science and research funding.

Despite the funding struggles, we have dedicated engineers and scientists and teachers who want to work to provide the solutions to these problems.

Improving U.S. global economic competitiveness is a huge hurdle. This back-and-forth struggle for research funding only adds to our challenges.

We have many ways to tackle competitiveness issues; cutting research funding is not one of them.

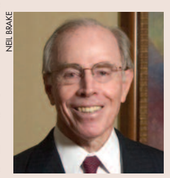
—Kenneth F. Galloway, Dean

Distinguished Alumnus Monroe Carell Jr., BE'59, Dies

Distinguished Alumnus Monroe J. Carell Jr., BE'59, renowned for his business acumen and strong volunteer leadership for Vanderbilt initiatives and Nashville charitable causes, died June 20 after a battle with cancer. He was 76.

"Monroe was a wonderful friend to Vanderbilt and a valued member of the School of Engineering's Academy of Distinguished Alumni," says Dean Kenneth F. Galloway. "He was always proud to say he was a Vanderbilt engineering graduate and we were proud to call him one of our best. His leadership and character were inspiring. The entire community will miss him."

NEIL BRAKE



Monroe Carell Jr., BE'59

Carell entered the Vanderbilt School of Engineering after serving in the Navy and graduated cum laude with a bachelor's degree in electrical engineering. He worked as chief engineer with the Duck River Electrical Membership Cooperative before agreeing to work for his father and a business partner at Central Parking in 1967. Under his leadership, Central Parking Corporation became the world's largest operator of parking facilities and a Nashville success story.

Carell said he applied engineering problem-solving principles to learn his father's business and then to grow and supervise the premier parking management firm for some 40 years. He credited the high standards expected of Vanderbilt students, including the university's honor code, as contributing to his professional success.

"I got a wonderful education at Vanderbilt," Carell said. "In addition to engineering, I got an education in life, integrity, hard work—a lot of good attributes that have served me well over time. I'll always be indebted to Vanderbilt."

Carell joined the Vanderbilt University's Board of Trust in 1991. He and his wife, Ann, supported various segments of the university, including undergraduate education, the School of Medicine, athletics, and the children's hospital, which bears his name. He was inducted into the Vanderbilt School of Engineering Academy of Distinguished Alumni in 2001. At the time of his death, Carell was leading the comprehensive, university-wide *Shape the Future* campaign.

He is survived by his wife, Julia Ann Scott Carell, BS'57 (Peabody); three children, Julia Stadler, wife of George B. Stadler, MBA'91; Edith Johnson, wife of David B. Johnson, and Kathryn Brown, wife of David H. Brown; and six grandchildren, Vanderbilt student Claire Stadler, Monroe Stadler, Carell Brown, Nicholas Brown, William Johnson and Ann Scott Johnson. He is also survived by his brother, James W. Carell.

Great Altitude—Aerospace Club Takes Off

Vanderbilt's fledgling student Aerospace Club soared high in a national contest when the students' rocket reached a height of 5,264 feet—higher than any other competitor. Vanderbilt's 14-foot rocket fell 16 feet short of the one-mile goal, but soared high enough to win the Closest to Altitude Prize in NASA's 2007-2008 University Student Launch Initiative (USLI).

Eleven university teams competed in the year-long USLI project, which was won by Utah State University. The contest was sponsored by Alliant Techsystems and managed by NASA's Marshall Space Flight Center.

BARRETT GIVEN, NASA/MSFC

From left, Aerospace Club members Thomas Folk, Chris McMenamin, Will Runge, Andrew Gould, Nathan Grady and Greg Todd carry the team's rocket to the launch pad.

"It was an intense scene, with rockets going off at 30 minute intervals," said senior Glen Bartley. "I was just thinking 'please take off, please take off…' when it took off beautifully and hit our desired altitude within 16 feet. The entire team was elated. A year's worth of rocket engineering climaxed at that point."

The project required all competitors to build a rocket that would carry and launch a scientific/technical payload to an altitude of one mile (5,280 feet). Vanderbilt's entry placed an unmanned aerial vehicle (UAV) in the rocket and released it midair. The altitude reached was several hundred feet higher than that of other teams.

"The students came up with several innovative designs, including the UAV, which was packaged inside the rocket and deployed at a pre-set altitude," said A.V. Anilkumar, club advisor and professor of mechanical engineering, who coached the team. He added that the club's design of the rocket-deployed UAV also earned second place honors in the Team Design category at the American Institute of Aeronautics and Astronautics (AIAA) Southeastern regional competition.

In addition to Bartley, Vanderbilt's team included mechanical engineering seniors Thomas Folk, Andrew Gould, Nathan Grady, Chris McMenamin, Brandon Reed, Alex Sobey, Greg Todd, and junior Will Runge. Electronics technician Robin Midgett served as safety officer. Rocketry enthusiast Russ Bruner, BE'86, MS'87, and EMT Rodney McMillan were on site to assist the team.

A Soaring Win

Other competing universities were Alabama A&M University, Auburn University, College of Menominee Nation, Fisk University, Harding University, Mississippi State University, Missouri University of Science and Technology, University of Alabama in Huntsville, University of North Dakota, and Utah State University.

"This program has provided our students with amazing technical and real-life challenges and I am very proud that they handled them so well," Anilkumar said. "Most of the seniors on the team have leveraged their experiences to get excellent career offers."

VISAGE Summer Session

Leeches, weeds and trees were part of the service learning component for Professor Gene LeBoeuf's Vanderbilt Initiative for Scholarship and Global Engagement (VISAGE) summer session participants in Melbourne, Australia. While learning hands-on about Australia's water sustainability issues, students tested water quality, identified organisms in water, weeded invasive species from wetlands, planted trees, and built a rainwater collection tank for irrigation. They also learned to tuck pants into socks to prevent leeches from attaching to their legs while measuring trees in the rainforest. From left, Shelley McFarlan, site director and activities coordinator for academic affairs, Vanderbilt International Office; Jessie Newton, senior, civil engineering; John Jacobi, senior, civil engineering; Hanum Jumastapha, senior, mechanical engineering; Laura Harper, sophomore, arts and science; Francis Simpson, sophomore, biomedical engineering; Moriah Lutz-Tveite, sophomore, arts and science; Grant Bouchillon, senior, civil engineering; Russell Nour, senior, civil engineering; and Gene LeBoeuf, professor of civil and environmental engineering.

New Chairs and a New Name for Chemical Engineering

Todd D. Giorgio has been named the new chair of the Department of Biomedical Engineering and Peter N. Pintauro has joined the School of Engineering as chair of the Department of Chemical and Biomolecular Engineering, formerly the Department of Chemical Engineering.

JOHN RUSSELL

Todd D. Giorgio

Giorgio succeeds Thomas R. Harris, Orrin Henry Ingram Distinguished Professor, who retired in May. Giorgio, who served as interim chair since fall 2007, says his goals include promoting the visibility and accomplishments of the department both within Vanderbilt and throughout the greater academic community. His plans include expanding the faculty roster, adding additional areas of research, attracting greater numbers of promising undergraduate and graduate students, strengthening undergraduate education and developing research ideas as incubators for small businesses.

"We have a special opportunity, through a combination of expansion and retirements, to hire a substantial number of new faculty members over the next five years," Giorgio says. "We have the resources to strengthen our current areas of expertise and to establish new areas of research in cooperation with medicine and biological sciences."

A member of the VUSE faculty since 1987, Giorgio is professor of biomedical engineering and chemical engineering. He is a researcher at the Vanderbilt-Ingram Cancer Center and serves on the executive committee of the Vanderbilt Institute for Nanoscale Science and Engineering (VINSE). Giorgio earned his bachelor of science degree from Lehigh University and his Ph.D. in chemical engineering from Rice University.

Leader in Research and Teaching

Following a year-long national search, Peter N. Pintauro has been appointed the new head of the recently renamed Department of Chemical and Biomolecular Engineering. Before assuming his new post from outgoing chair Douglas LeVan, Pintauro was the Kent Hale Smith Professor of Engineering and chair of the chemical engineering department at Case Western Reserve University. He earned a bachelor of science degree from the University of Pennsylvania and a Ph.D. at the University of California, Los Angeles. His primary areas of research focus are fuel cell membranes and electrochemical engineering. In addition to his duties as department chair, Pintauro will teach both undergraduate and graduate level classes.

JOHN RUSSELL

Peter N. Pintauro

"I know that Vanderbilt has a well-deserved reputation for excellence in undergraduate education," Pintauro says. "I am committed to maintaining that goal, and I'm excited about continuing to build on the department's graduate education and research strengths."

Pintauro joins the department as it undergoes a change in name. As of July 1, 2008, what was formerly the Department of Chemical Engineering is now the Department of Chemical and Biomolecular Engineering. Although the change was decided upon before he agreed to come to VUSE, Pintauro agrees with the new nomenclature.

"The new name better reflects the teaching and research efforts of the department, as well as its planned direction and aspirations," Pintauro says.

—Laurie A. Parker

Innovation in Focus

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

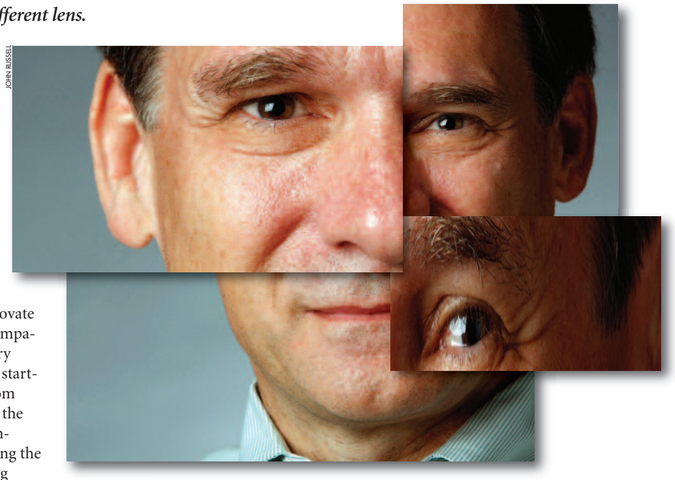
As a founder of consulting firm Kitchen Table Partners, LLC, Billy Edwards is on a mission to change the way businesses think about creativity, innovation and risk.

"As companies grow, they typically become more risk adverse," says Edwards, BE'79, GS'81, PhD'85. "After a while, they forget what they went through to reach their current success. You can think of that success as creating antibodies to protect the business. These antibodies attack and reject innovation for consuming resources that (existing) business units should get. Innovation, on the other hand, is a random walk, the antithesis of day-to-day operations.

The Austin, Texas, resident knows what he's talking about. He's worked for large corporations, start-ups and companies in-between. His career has taken him from chief innovation officer for Advanced Micro Devices (AMD) to CEO of Hesson Labs, a fabless semiconductor start-up. He was an executive at Motorola, in both its corporate and its semiconductor operations, and honed his skills at biomedical companies. In addition to being a consultant, Edwards is currently a founder of Rational Semiconductors, which does specialized microprocessor design. Edwards says of his career path, "It's wonderful for me. I love to try new things. To me, new and different is fun."

Billy Edwards, BE'79, GS'81, PhD'85

He uses that passion for innovation and creativity to inspire businesses and help them succeed. Edwards says that to innovate and outthink the competition, companies must create multi-disciplinary teams that operate and think like start-ups, have unwavering support from senior management, and provide the latitude to reach beyond tradition-bound corporate practices. "During the 2000-2006 era of the long running AMD/Intel saga, we used their weight and way of doing things against them. We knew they wouldn't look far afield," Edwards says. "In essence, we faked left and went right. We knew they'd do everything they could not to go that way. We used their style and mass against them and it worked well."



JOHN RUSSELL

Trained to Solve Problems

Edwards, who earned a bachelor of engineering in biomedical engineering and material science; a master of science in material science; and a doctorate in material science from Vanderbilt, credits the School of Engineering with encouraging innovation through problem solving. "In class, we were given complex, ambiguous problems to sort through. That's powerful training because most business problems don't fit into a formula of 'Here are the three inputs. What's the output?'" says Edwards, who describes the more typical business problem-solving strategy as "try small, safe tweaks so nothing breaks."

He likens the approach he learned at Vanderbilt to learning how and when to use a zoom lens. "When you're trying something different, you need to be able to pull back and assess how it fits in the big picture as well as zoom in to understand the crucial details," he explains. "That ability to move back and forth to answer key questions is something I first experienced at Vanderbilt. We were free to think and fit a problem into the larger context. As long as we did a task correctly, we could try new approaches to understanding the broader context."

Along with the zoom lens, he says curiosity, an innate comfort with ambiguity and a taste for risk are key foundations for innovation. "Equally important is knowing how to work with people and teams. Understanding how to manage people and work within organizational dynamics, how to negotiate and sell, and understanding the value of individuals are keys," he says. "These come into play almost daily and I first started learning and experiencing them while I was at Vanderbilt."

—Mardy Fones

Building Success in Construction Management

Theory is good. Experience is better. That's the strategy behind the School of Engineering's Graduate Program in Construction Management (CMP), where coursework combines with internships to provide experience.

Launched in 2003, the master's program has become highly successful with employers and students alike. "We have 100 percent placement of graduates, with starting salaries ranging from $55,000-$75,000 per year," says Sanjiv Gokhale, professor of civil engineering and CMP director and creator.

Built on the fundamentals of civil engineering, the construction management program combines engineering, construction technologies, design and management to prepare graduates to meet challenges on the job. "Throughout the program, the inter-relationship between planning, design and construction is continually stressed," Gokhale says.

The program's reputation and flexibility cause demand for CMP slots and graduates to grow annually, he says. Case studies and guest speakers from industry make the curriculum timely and relevant. Classes are scheduled in late afternoon to accommodate those working or doing internships.

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 in eighteen months on average. Undergraduate students in the program spend five years earning both a bachelor's degree in civil engineering and a master's degree in engineering.

DANIEL DUBOIS

Sanjiv Gokhale

"The curriculum was designed to meet the design and construction industry's needs," says Jim A. Johnson, BE'63, PhD'72, co-chair of the CMP's Industry Advisory Board. Director of program management for the Houston-based construction firm of Kellogg Brown & Root, Inc. (KBR), Johnson values the training and knowledge the program provides. "The collaboration of this program with the Owen Graduate School of Management on project finance and the Vanderbilt Law School on contract law is particularly valuable."

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 Dave Livingston, BE'03, ME'04. "I'd learn something in class one night and apply it the next day."

Upon graduation, Livingston joined Brassfield & Gorrie, a Birmingham, Ala. firm. His job includes recruitment, and he finds School of Engineering graduates to be strong candidates. "Because of the health care focus, they're versatile," he says. "If you can build a hospital, you can build anything."

Interns have also worked for KBR. "The interns we've had have been well prepared and able to assume increased project responsibility within a short period of time," Johnson says.

For Tom Harrell, ME'05, an engineer on Turner Construction's monumental new Yankee Stadium project, the emphasis on pragmatics such as contracts and schedule reduction methods set the construction management program apart. "It's one thing to build a hypothetical cost estimate. It's another to ask an owner for an additional $10,000 because your estimate didn't include the correct door security," Harrell says. "I use some element of my education every day."

Geeta Ghiassi, ME'07, adds that learning to work as a team with the many different people and trades on a construction job was an invaluable aspect of the program. Ghiassi, civil project manager for the Sydney Airport Corp. in Sydney, Australia, says "Team work is one of the main aspects of civil engineering and construction."

—Mardy Fones

Chasing the Checkered Flag

Recent alumnus on the straightaway with racing future

ROSS ADGERIL

The roar of the crowds, smell of burning rubber and grinding whine of cars ripping up the racetrack are the antithesis of the quiet beauty of the Vanderbilt campus. But for Brad Jaeger, BE'07, the two intertwine, part of a lifelong passion for motor sports and a career built around the question, "How much faster can it go?"

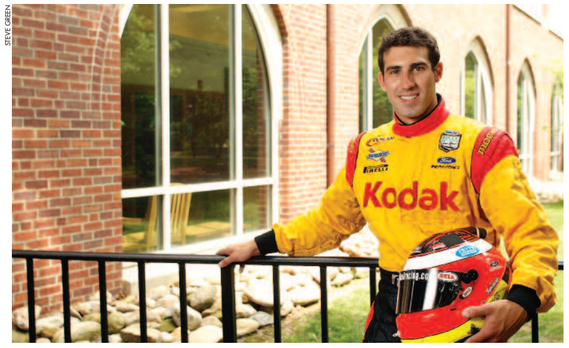
A year out of Vanderbilt, Jaeger races professionally for the Doran Racing team in the 2008 Rolex Sports Car Series, the most competitive professional road racing championship in North America. The Cincinnati native drives the No. 77 Kodak Ford Doran/Dallara car, which can reach speeds of up to 195 miles an hour.

Jaeger, 23, was introduced to racing in childhood. "My dad raced and collected cars—Corvettes and Ferraris and old Indy cars," says Jaeger, who started with racing go-karts. "These aren't the go-karts most people think of. They can go from zero to 100 mph and back to zero in 10 seconds." By 14, he was winning big in go-karting; by 16, he was on his way up.

"I was good," says Jaeger, with a self-effacing smile. "I'm a quick learner, and in the first year, I qualified first nine times and won seven of nine races. I loved it." That love spilled over into his Vanderbilt years when he lived the dual existence of a successful race car driver and mechanical engineering major.

"As a student, I had to be organized, disciplined," Jaeger says. "I'd be at the track all weekend, snag a red-eye back, and do my homework on the plane. Then a cab would drop me behind the engineering building and I'd go straight to class."

Jaeger was a member of the School of Engineering's Formula Society of Automotive Engineers (SAE) team. The team designs and fabricates open-wheel race cars and competes against other universities on research, development and vehicle performance. He says the experience was integral to his preparation for a life axle-deep in car design and construction and racing.



STEVE GREEN

Brad Jaeger, BE'07

Rising Star

As a driver, he has frequently finished in the top three, placed second in the Sport 2000 National Championship, won the Pacific Formula 2000 Championship, competed several times in the Rolex 24 at Daytona, and had four top 10 finishes last year in the Indy Pro Series.

Jaeger's success is no surprise to Joe Dorris, BE'65. "Brad's technical knowledge (gained) from his experience with the School of Engineering's SAE team provides him with a knowledge base for communicating to the team and particularly the engineers. He can talk their language," says Dorris, the former CEO of Futaba Corporation of America, a long-time motor sports sponsor. "In racing, chemistry—how team members work together—is of paramount importance. Being a Vanderbilt graduate gives Brad the confidence and background to work effectively with all levels of his team, from the owners to the tire changer."

Jaeger's rise through the complex ranks of motor sports also netted him an engineer slot with Doran Racing. "I've done everything from hands-on wrenching as a mechanic to design work as an engineer, working to convert a Ford GT into a race car," he says.

While the shop work is satisfying, his focus now is exclusively driving. "You can't do both well," says Jaeger, explaining that the driver who is thinking about a car's engineering while driving isn't truly "up on the wheel"—motor sports talk for being 100 percent in the race. His commitment includes regular triathlon-style training to focus his mind and to build the physical and mental stamina for the rigors of racing. To relax, he plays the guitar and mandolin, and blogs on his Web site, *www.bradjaeger.com.*

With a string of top 10 finishes and one top five finish in the 2008 season, Jaeger's long-term vision is to keep driving and keep winning. "When I do hang up my helmet, I'd like to get a master's in aerospace or mechanical engineering, then design cars," he says. "That would be the perfect life."

—Mardy Fones

Meeting the Challenge *from page 1*

plan accordingly. ISIS is involved with partners at other major universities, including the University of California at Berkeley, Stanford, Carnegie Mellon and Cornell, to understand the implications of cyber security in engineering design.

In another cyber initiative, Doug Schmidt, professor of computer science and computer engineering and associate chair for computer science and engineering is helping develop a system to link U.S. military personnel seamlessly to the Global Information Grid regardless of the connection device or available bandwidth. Key to the system is that soldiers need to be able to use the information on any available device, whether cell phones, satellites, land lines, or the Internet.

Infrastructure and Virtual Reality

An urban society will continue to be challenged by infrastructure needs. Florence Sanchez, assistant professor of civil and environmental engineering, infuses nanoparticles and nanofibers into traditional concrete, thus developing cement-based materials that are stronger, lighter and less prone to degradation. "Nanomodification of cement is an emerging area of research that is in its infancy and will take some time to work its way into applications," Sanchez says. It could lead to bridges and other structures with a range of novel properties including low electrical resistivity, self-sensing capabilities, self-cleaning and self-control of cracks.

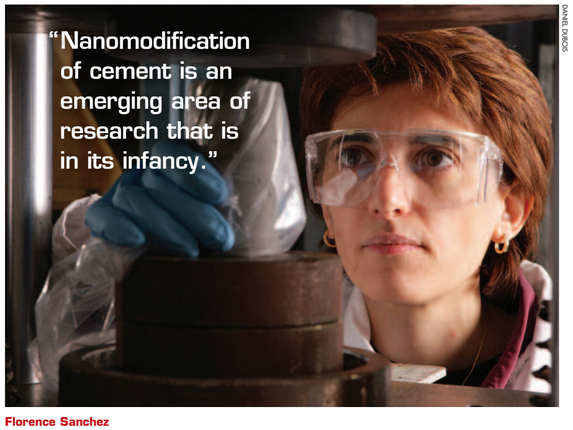
Bobby Bodenheimer, associate professor of computer science and computer engineering, concentrates on virtual reality issues. "What my colleagues and I are trying to create are better interfaces between the computer and a person to let people experience places, situations and activities that, for reasons of cost, time or distance, cannot easily be experienced in the real world," Bodenheimer says. Current research focuses on ways to allow people to move about their virtual environment without bumping into walls and furniture of their real world confines. "The challenge of creating virtual environments and methods of interacting with them so that people can meaningfully learn, train and perform in them is both novel and exciting," he says. "Novel in that it involves collaboration with psychologists and other fields of engineering, and exciting because, although we see the vision, the roadmap to get there isn't yet clear to us. Getting there is going to be fun."

Key to the Solutions

Unmentioned in the NAE list is the need to recruit and educate the next generation of engineers. Stacy Klein, associate dean for outreach, has developed the Vanderbilt Instruction in Biomedical Engineering for Secondary Science (VIBES) curriculum that seeks to stimulate high school students' interest in science through hands-on projects and real-world problem solving. "I found teaching certain subjects like electrical fields kind of boring," the former high school physics teacher says. "I figured that if I was bored, my students were, too." In contrast, with VIBES, students learn electrical fields by taking and studying their own ECGs. "That's a lot more interesting," she says.

The students Klein refers to will be charged with some of these, and other engineering challenges. "New challenges will emerge as the century progresses," Klein says. "Many of the problems faced by those who live—and will live—in the 21st century require the kinds of solutions that only engineering can provide."

—Dwayne O'Brien, MA'05



DANIEL DUBOIS

Florence Sanchez

New NSF CAREER Award Winners

Two Vanderbilt engineering professors have received prestigious National Science Foundation Faculty Early Career Development (CAREER) Program awards, bringing 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. (See related article at *http://www.vanderbilt.edu/alumni/publications/en/engvufall07.pdf.*)

William H. Robinson, assistant professor of electrical engineering and computer engineering, and Sharon M. Weiss, assistant professor of electrical engineering and physics, are the newest recipients of the highly competitive grants.

NEIL BRAKE

Sharon M. Weiss

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

"One of today's most challenging design issues is the threat of radiation-induced soft errors in CMOS digital systems," Robinson says. "By identifying the fundamental characteristics of soft errors, we can develop design principles to improve the starting point for reliability of all types of integrated circuits." CMOS refers to complementary metal oxide semiconductor, a technology used to fabricate integrated circuits like microprocessors.

The NSF grant will also support Robinson's efforts to recruit and retain students in science and engineering from traditionally underrepresented groups. He participates in the Tennessee Louis Stokes Alliance for Minority Participation program at Vanderbilt and coordinates the Alfred P. 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 multicore computer architectures, field-programmable gate arrays (FPGAs), and hardware design for secure and reliable computing platforms.

Weiss is investigating methods to achieve faster and more accurate detection of biological and chemical materials by using portable porous silicon waveguides. This work has impact in medical diagnostics, environmental monitoring and homeland security.

Weiss' research involves using a sensor made from porous silicon, a material with billions of tiny nanometer-sized holes (1,000 times smaller than the thickness of a human hair) to achieve more sensitive detection of biomolecules in less time.

"Accurate and reliable detection of biological and chemical materials is essential for improved medical diagnostics, environmental monitoring and homeland security," she says. "The extremely large surface area of porous silicon allows for more biomolecules to be captured. By evaluating how light interacts with the silicon, it is possible to detect the presence of trace amounts of biological material. Porous silicon sensors, made in our photonic crystals laboratory, have been used to identify specific DNA sequences and will be designed to detect various toxins and viruses in the near future."

DANIEL DUBOIS

William H. Robinson

The NSF grant will also support Weiss' outreach initiatives for K-12 students and enable her to offer additional research experiences for undergraduate students.

Weiss joined the Vanderbilt faculty in 2005. She holds one patent and has two more pending. Her research interests include photonics, biosensing, optical properties of materials and optoelectronic devices.

— Joanne Lamphere Beckham

Faculty Changes Include Honors, Tenure and New Faces

VUSE's commitment to the recruitment and development of exceptional faculty has resulted in the addition of outstanding new faculty members, the awarding of tenure to others, and the honoring of long-time professors with emeritus status.

New Additions

New civil and environmental engineering faculty are George M. Hornberger and Mark McDonald. Hornberger comes to VUSE from the University of Virginia, where he was the Ernest H. Ern Professor of Environmental Sciences. A member of the prestigious National Academy of Engineering, he is an international leader in hydrology and water research.

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

Peter N. Pintauro, formerly of Case Western Reserve, is the new chair of the renamed chemical and biomolecular engineering department (see story page 3), as well as professor of chemical and biomolecular engineering. He has won accolades for his work in fuel cell membranes and electrochemical engineering.

Jamey Young has also joined the chemical and biomolecular engineering department. After earning a Ph.D. in chemical engineering at Purdue, Young was the Kirschstein NRSA Postdoctoral Fellow at MIT. His research focuses on metabolic flux analysis.

Newly Tenured Talent

The four faculty members receiving tenure are Mark Does, Duco Jansen, Michael Miga and Greg Walker.

Does, the director of the Center for Small Animal Imaging, became associate professor of biomedical engineering. Jansen, who works in the field of biomedical optics using the Free Electron Laser, became professor of biomedical engineering. Director of the Biomedical Modeling Laboratory, Miga became associate professor of biomedical engineering. Walker became associate professor of mechanical engineering; he directs the Thermal Engineering Laboratory.

Eminences Emeriti

Four professors have received emeriti honors. Thomas Harris is now Orrin Henry Ingram Distinguished Professor of Engineering, Emeritus, as well as professor of biomedical engineering, emeritus; professor of chemical engineering, emeritus; and professor of medicine, emeritus. Paul H. King is now professor of biomedical engineering, emeritus and professor of mechanical engineering, emeritus. Karl B. Schnelle Jr. has become professor of chemical and environmental engineering, emeritus, and Richard G. Shiavi is now professor of biomedical engineering, emeritus and professor of electrical engineering, emeritus.

—Laurie A. Parker

Faculty Notes

Operational Risk Management: A Case Study Approach to Effective Planning and Response by **Mark D. Abkowitz**, professor of civil and environmental engineering, was published by John Wiley & Sons.

James H. Clarke, professor of civil and environmental engineering, received the Distinguished Service Recognition award from the Nuclear Regulatory Commission for his service on the NRC's Advisory Committee on Nuclear Waste and Materials (ACNW&M).

J. Michael Fitzpatrick, professor of computer engineering and computer science, was named a Fellow of the Society by SPIE. Fellows are members of distinction who have made significant scientific and technical contributions in the multidisciplinary fields of optics, photonics and imaging. Fitzpatrick was recognized for specific achievements in image registration in medical imaging.

J. Michael Fitzpatrick

Design of Biomedical Devices and Systems, by **Paul H. King**, professor of biomedical engineering, emeritus, and professor of mechanical engineering, emeritus, and Richard C. Fries, has been translated into Korean. A second edition was published in August.

Robert E. Stammer Jr., associate professor of civil engineering, was elected an International Director of the Institute of Transportation Engineers. He became the first Tennessean elected in more than 20 years.

VUSE honored faculty and staff with three awards in May 2008. The Edward J. White Engineering Faculty Award for Excellence in Service was presented to biomedical engineering professor **Richard Shiavi**. The School of Engineering Award for Excellence in Teaching was presented to **Ronald Schrimpf**, professor of electrical engineering. **Stephen Wadley**, academic counselor and credentials evaluator for the School, received the 2008 Judith A. Pachtman Endowed Staff Service Award for exceptional service to the faculty and staff.

Artistic Endeavors

Two young engineers launch art careers.

Leonardo da Vinci would be proud. In the tradition of the multi-creative artist, engineer and scientist, two recent School of Engineering graduates are winning acclaim for artistic achievements as well as engineering skills.

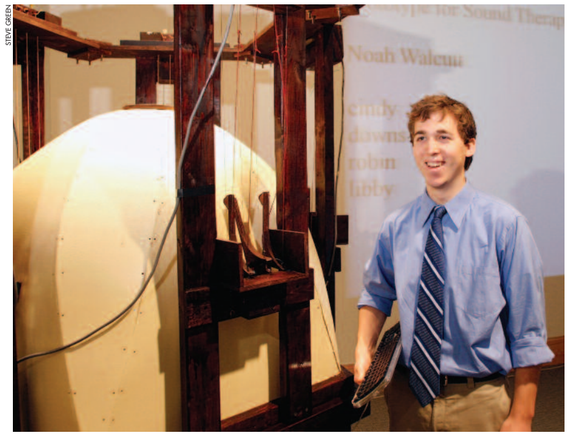
Noah Walcutt, BE'08, a mechanical engineering graduate, won Vanderbilt's 2008 Margaret Wooldridge Hamblet Award in Studio Art, and will spend the next year traveling and exploring the intersection of art, engineering and music.

Fellow graduate Will Hedgecock, BE'08, received Vanderbilt's Computer Engineering Program award for achieving 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

Walcutt says he was looking for a creative outlet when he signed up for a sculpture course. Initially, Walcutt wanted to expand upon the idea of creating an "escape pod," a place people could use to retreat in the modern world. He melded his engineering skills with sculpture, using carpentry and principles for sound to develop the Hamblet award-winning piece. The award's $25,000 prize underwrites travel and independent art activity for the recipient for one year, culminating in an exhibition.

STEVE GREEN



Noah Walcutt, BE'08, and his award-winning sculpture

Walcutt's 8-to-10-foot-tall prize-winning piece is topped by a dome that acts as a soundboard for 20 strings, attached tangentially to the surface. Striking a computer keyboard from inside the dome activates hammers, similar to those found inside a piano, that strike the strings and resonate along the A-minor harmonic scale. Sitting inside the dome creates a multi-sensory experience where people can create, hear and feel the chords. Walcutt envisions the piece as a prototype for sound therapy. "Engaging in the typing to create the music is like play," he says.

Standards of Excellence

Creating music is something Hedgecock has been doing since he was young. Born and raised in Pensacola, Fla., he joined the Pensacola Children's Chorus at nine and toured with the group for 10 years throughout the U.S. and abroad. He met Grammy award-winning music producer Larry Butler after a performance of the chorus and began working on a CD with him. Butler, the only Nashville producer to win the Producer of the Year Grammy Award, helped shape the careers of superstars Kenny Rogers, Johnny Cash, John Denver and others.

Will Hedgecock, BE'08, can be heard on the pop music charts.

Hedgecock's CD, *Reflections*, was released for sale just three days before Hedgecock graduated from Vanderbilt. Hedgecock has also received awareness from his music videos, which can be seen on television and the Internet, including on YouTube and MySpace; five tracks from *Reflections*, a mix of original songs with pop, R&B and adult contemporary standards, have received play on radio stations featuring the Adult Standards format.

"I am very proud of the work that I have accomplished—both with computers and music," the computer science engineer says, but admits his lifelong passion is to have a successful music career.

Walcutt, on the other hand, is still somewhat bemused by the attention his artwork has earned. "I don't consider myself to be an artist, but I'm getting used to that idea," Walcutt says.

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 radio. It also sports statues of a SWAT officer and a British bobby, nods to the 30-plus years the assistant professor of engineering management spent with the Metro Nashville Police Department.

While his law enforcement life is always in the background, the pride he takes in the work of his students is front and center. "One favorite student project is a bicycle equipped with a lithium battery and an electric motor controller," says Pence, BS'77, MS'03, PhD'05. "I sometimes ride it the six miles to school. People realize there's something different when they see this old guy coasting uphill at 20 miles an hour."

STEVE GREEN

Ken Pence, BS'77, MS'03, PhD'05

Pence is a man disinclined 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 engineer, 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, and led training on terrorism for police and the military. He became a fifth degree black belt in Tae Kwon Do 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. His favorite moments are when students' confidence grows and their eyes light up as they talk about projects. "My slowest 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. "Everyone 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.'"

Ken Pence (center) in gear with SWAT team colleagues.

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

A LOOK BACK

COURTESY OF VANDERBILT UNIVERSITY SPECIAL COLLECTIONS AND UNIVERSITY ARCHIVES

Vera Jane Jones Mackey, the first woman to graduate from Vanderbilt University School of Engineering. She graduated in 1945 with a chemical engineering degree.

Gas was 11 cents a gallon, Glenn Miller was king and World War II was ramping up in 1940 when Vera Jane Jones Mackey, BA'44, BE'45, enrolled at Vanderbilt.

Math, science, logic and problem solving were her passions, so she went after a chemistry degree supplemented with engineering classes. "The A&S dean didn't like it," Mackey recalls from her home in Georgia. "He asked me how (School of Engineering) Dean Lewis felt about it. I told him 'Dean Lewis said I could take anything I wanted.'"

During the war years, the School of Engineering was small, which Mackey says helped her develop relationships with faculty. She finished a bachelor's degree in chemistry in 1944. Only a few courses short of a chemical engineering degree, she continued on, and in 1945, became the first woman to graduate from Vanderbilt University School of Engineering.

The Nashville native joined Tennessee Valley Authority (TVA) in fertilizer testing and development and was TVA's first woman engineer. After marrying co-worker James S. Mackey in 1956, nepotism rules forced her out. When those rules were rescinded in 1976, Mackey returned to serve as editor of a soils and fertilizer abstract journal, retiring in 1992.

Despite her work record, being a woman had its challenges. One boss tried to block her promotion. Another told her she'd be useful if she'd just augment her engineering and chemistry degrees with secretarial courses.

Clerical work was never part of Mackey's plan. "I worked for Dean Sarratt and took advanced math classes from him," says Mackey, who credits mentors such as Sarratt and other faculty with encouraging and preparing her to compete in male-dominated field. "When I graduated, Dean Sarratt told me, 'You ought to have been Phi Beta Kappa, but you took all the hard courses.'"

—Mardy Fones

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