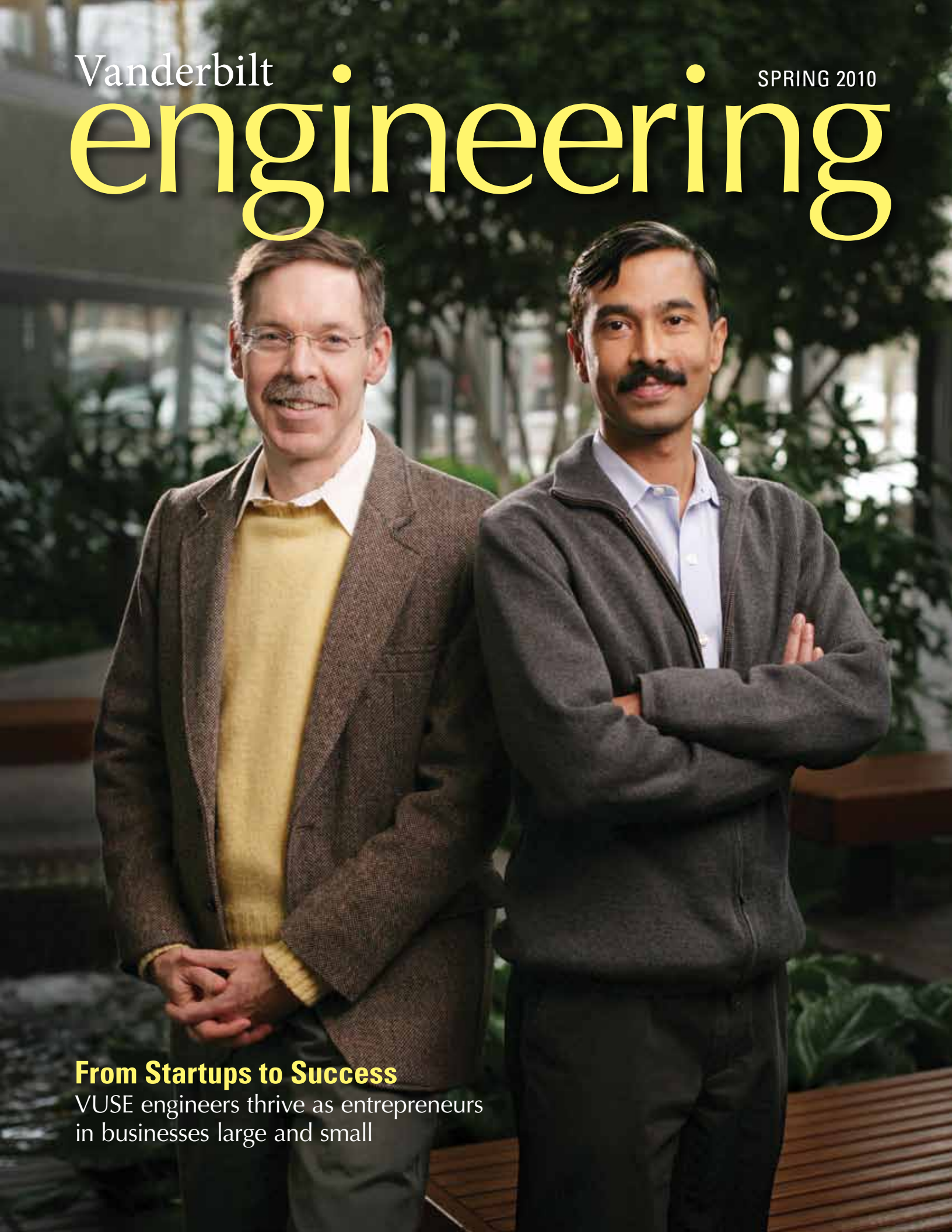
Vanderbilt

engineering

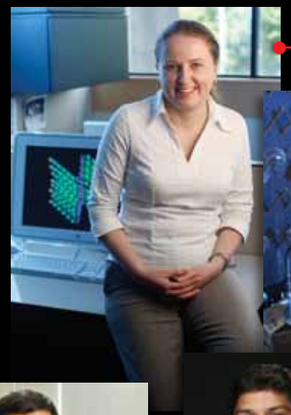
SPRING 2010

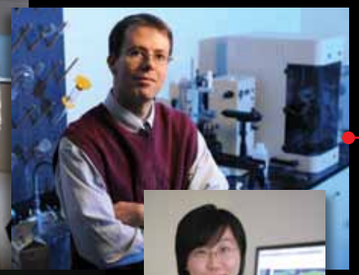


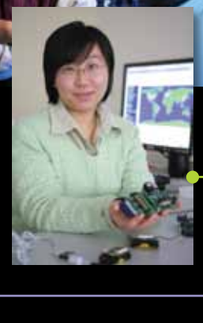
From Startups to Success

VUSE engineers thrive as entrepreneurs in businesses large and small

honors and awards







Julie Adams, assistant professor of computer science and computer engineering, has been awarded a Department of Defense program grant to support her work in the area of human and robotic teams.

Gautam Biswas, professor of computer science and computer engineering, has received a National Science Foundation award for research regarding intelligent learning environments.

Benoit Dawant, professor of electrical engineering and biomedical engineering, has been named an IEEE Fellow by the board of directors of the Institute of Electrical and Electronics Engineers. The IEEE board honored Dawant for his contributions to biomedical image analysis and image-guided medical interventions.

W. Wesley Eckenfelder, Distinguished Professor of Environmental and Water Resources Engineering, emeritus, has published WWE *(W. Wesley Eckenfelder/Wastewater Extraordinaire)–The Life of an Environmental Pioneer.* The memoir follows Eckenfelder from his student days to his more than 20 years at Vanderbilt and up to the present day.

The NSF has awarded **Aniruddha Gokhale,** assistant professor of computer science and computer engineering, a nearly half-million dollar award for his work with distributed real-time embedded systems. This is in addition to his CAREER award announced in 2009.

Xenofon Koutsoukos, associate professor of computer science and computer engineering, participated in the National Academy of Engineering's first Frontiers of Engineering Education symposium. He was chosen from a highly competitive pool of applicants nominated by fellow engineers or deans.

The Department of Chemical and Biomolecular Engineering has been awarded a U.S. Department of Education grant to fund graduate fellowships in the area of advanced materials. The grant is part of the Graduate Assistance in Areas of National Need (GAANN) program, and will be directed by Associate Professors **Clare McCabe** and **G. Kane Jennings.**

Assistant Professor of Computer Engineering and Computer Science **Yuan Xue** has been awarded a Department of Defense program grant regarding the science of integration for networked systems.

Vanderbilt
engineering

INSIGHT ◦ INNOVATION ◦ IMPACT℠

Volume 51, Number 1, **spring 2010**

2 from the dean

6 cover story
From Startups to Success: VUSE Engineers Thrive as Entrepreneurs in Businesses Large and Small

12 on campus
Student Developer Draws Sales with iPhone Apps

14 next
Pushing to Improve

18 in the field
Quest for Knowledge Spurs Nanotechnology Entrepreneur Karen Buechler

20 feature
Calculating Risk, Increasing Reliability

26 feature
A Changed Life

3 just the facts
4 digest
11 unforgettable
22 ask an engineer
24 impact
28 celebrating alumni

On the cover: Alumni Robert Tryon, PhD'96, and Animesh Dey, MS'94, PhD'96, of VEXTEC, named America's most promising company by *Forbes*

Editor
Nancy Wise

Designer
Chris Collins

Assistant Art Director
Michael Smeltzer

Art Director
Donna Pritchett

Contributors
Joanne L. Beckham (BA'62), Brenda Ellis, Mardy Fones, Becky Green, David Kosson, Laura Miller, Sandy Smith, Fiona Soltes, Susan Starcher, Mary Ellen Crowley Ternes (BE'84), Jennifer Zehnder

Photography
Neil Brake, Tom Cherrey, Kerry Dahlen, Daniel Dubois, Steve Green, Peyton Hoge, Jenny Mandeville, John Russell, Zach Goodyear Photography

Web Edition Design and Development
Lacy Tite

Visit the School of Engineering on the web at *www.engineering.vanderbilt.edu*

Vanderbilt Engineering, the Vanderbilt University School Of Engineering magazine, is published twice yearly in cooperation with the Office of Development and Alumni Relations Communications for alumni, parents of current students, faculty and other friends of the School of Engineering. Editorial offices are located in the Loews Vanderbilt Office Complex, 2100 West End Ave., Suite 820, Nashville, TN 37203.

Visit Vanderbilt's alumni publications on the web at *www.vanderbilt.edu/alumni/magazines*

Please send news items and changes of address to the editor at: PMB 407703, 2301 Vanderbilt Place, Nashville, TN 37240-7703.

Entrepreneurial Engineers

DANIEL DUBOIS

Dean Galloway

It is widely believed that, to strengthen our economy, we need new ventures, new enterprises, new businesses and new industries. What, then, is an appropriate role for schools of engineering and engineering educators? Can you teach entrepreneurship? Or are some individuals just born entrepreneurs? Are engineers entrepreneurial?

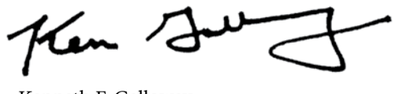
A number of the key entrepreneurial personality traits mirror engineering competencies necessary for a 21st century career. At the Vanderbilt University School of Engineering, we are fortunate in having successful entrepreneurs among our graduates, students and faculty.

Many of our alumni mix a strong technical skill set with mastery of time management and organizational skills, understanding team and leadership dynamics, ambitious professional goals, and an alert eye for opportunity.

Our faculty members encourage students to ask challenging questions, prepare them to work well under pressure, help them to communicate their ideas, and nurture a resilient attitude to failure and setbacks. Some of the key principles of entrepreneurship are instilled by the classes we teach, the research we do, and the professional networks we have created—as evidenced by students, alumni and faculty who start their own ventures.

In this issue of *Vanderbilt Engineering*, you will read about just a few of our engineering graduates who have launched successful businesses. They credit their Vanderbilt engineering education for laying the groundwork for entrepreneurship—from honing creative problem-solving skills to rigorous multidisciplinary design projects to courses in engineering management. These entrepreneurs will tell you career success, while often dependent on technical expertise, also depends on your ability to sell an idea and to manage your time, yourself and others.

Ken Morse, the former head of MIT's Entrepreneurship Center, thinks entrepreneurs are made, not born. Thus in addition to providing a solid technical base, engineering educators have a responsibility to teach principles of product development and project management, to encourage creative problem solving and to nurture innovative thinking. To that end, a Vanderbilt engineering education has and will continue to launch entrepreneurial career paths.



Kenneth F. Galloway
Dean

Patented Success

If it doesn't exist or it needs improvement, invent and innovate. These are just a few Vanderbilt University School of Engineering alumni who did just that.

PHOTOS COURTESY OF THE ALUMNUS, UNLESS OTHERWISE NOTED.

CORNING INC. AND WORLD KITCHEN, LLC

William H. Armistead, BE'37, MS'38, PhD'41
As an inventor and leader of R&D for Corning Inc., Armistead was responsible for more than 50 patented glass innovations. He launched Corning into the eyeglass market (think Photogray lenses that change in response to UV rays) and television glass. He helped develop Corning's popular glass product, Corelle, and later became Corning's vice chairman.

DUPONT ™/NOMEX®

W. Robert Clay, BE'54
Transformers, generators, computers, photocopiers and even microwave ovens use Bob Clay's work. Clay spent 10 years developing and marketing paper made with DuPont's Nomex aramid fiber (he holds one of the earliest patents for the paper). The electrical insulation product keeps motors, generators and transformers running even under extreme heat.

ISTOCKPHOTO.COM/SUSAN MCGINTY

Charles M. Krutchen, BE'56
Krutchen has more than 33 process patents registered with the U.S. Patent and Trademark Office. The chemical engineer worked for Mobil as a plastics engineer and developed several systems for polymer and polystyrene resin foam extrusions. His work shows up in insulation, shipping materials, foam cups, meat trays and snack food containers.

INTEL CORP.

Moenes Zaher Iskarous, MS'92, PhD'95
Iskarous works at Intel Corp., where he participates in research and developed several patented computer and electrical engineering projects. He holds three patents and has three more in progress. An early patent provided an efficient method to retrieve video images stored in computer RAM. Where would computers be without him?

WASHINGTON UNIVERSITY OF ST. LOUIS MAGAZINE

NASA

Michael E. Polites, PhD'86
One of NASA's most decorated engineers, Polites holds four patents that make possible low-power, reaction-less scanning of experiments in air and space. Because of their importance, he was selected NASA– Marshall Space Flight Center Inventor of the Year and received the NASA Research and Technology Award. Polites was a key designer of the pointing systems for a number of successful NASA spacecraft, including the Hubble Space Telescope.

Fleetwood Honored With Olin Henry Landreth Chair in Engineering

Daniel M. Fleetwood, professor of electrical engineering, has been named the Olin Henry Landreth Chair in Engineering by Vanderbilt University and the School of Engineering.


DANIEL DUBOIS

Daniel Fleetwood

This is a new chair within the school, made possible by a gift from an anonymous donor. Landreth was Vanderbilt's first professor of engineering and its first dean of engineering.

Fleetwood chairs the electrical engineering and computer science department. He has authored more than 335 publications on radiation effects in microelectronics, 10 of which have been recognized with outstanding paper awards. These papers have been cited more than 5,900 times.

"Dan is a highly valued colleague who has served his department, the school and Vanderbilt University with distinction," says Dean Kenneth F. Galloway. "He has made significant contributions to a positive national perception of engineering at Vanderbilt."

Fleetwood, who is also professor of physics, is a fellow of both the Institute for Electrical and Electronics Engineers and the American Physical Society, and a member of Phi Beta Kappa and Sigma Pi Sigma. In 2009, he received the IEEE Nuclear and Plasma Sciences Society's Merit Award.

He earned bachelor's, master's and doctorate degrees from Purdue University and joined Vanderbilt's School of Engineering in 1999.

Parker Participates in Peace and Science Conference at the Vatican


DANIEL DUBOIS

Frank Parker

Frank Parker, Distinguished Professor of Environmental and Water Resources Engineering, traveled to the Vatican late in 2009 to discuss the role of science in furthering world peace.

Parker, an internationally recognized expert in remediation of radioactively contaminated soil and water and a member of the National Academy of Engineering, spoke at an exclusive meeting at the Pontifical Academy of Sciences. In his talk, he discussed the benefits of expanding commercial nuclear power by extracting uranium from oceans.

"One of the ways we can improve the chances for peace is by providing almost limitless energy," Parker said, noting that control of resources such as water and oil is widely recognized as a major cause of war. "There are an estimated 4.5 billion tons of uranium dissolved in the world's oceans that could be extracted to provide a virtually inexhaustible supply of fuel for nuclear reactors."

The conference was jointly sponsored by the academy, Ettore Majorana Foundation and Centre for Scientific Culture, and World Federation of Scientists.

Students Work for Clean Water

From left, first-year mechanical engineering student **Bailie Borchers**, junior civil engineering majors **Leslie Labruto** and **Jessica Canfora** and senior mechanical engineering major **John Barrere** participated in an Engineers Without Borders project in Llanchama, Peru, over winter break. The students educated the villagers on the importance of clean water treatment and worked to survey and set up a new water pump.

More Than 45 Years of Doing It Right

Mary Jean Morris isn't predicting how long it'll take her to clean out her office. After all, she had a long time to settle into it.

Morris retired from her position as research associate with the Department of Civil and Environmental Engineering on December 31, 2009, after just over 45 years at Vanderbilt—41 of those with environmental engineering.

She started at Vanderbilt on July 6, 1964, soon after earning her master's from Tennessee Technological University. At VUSE, Morris worked in research, as a laboratory assistant and taught laboratory classes. Most recently, she served as laboratory manager and safety officer for civil and environmental engineering.


STEVE GREEN

Mary Jean Morris

Over the years, Morris has been acknowledged in countless student dissertations for generously providing her time and for her consummate knowledge of laboratory proceedings.

"Mary Jean has an amazing talent for understanding and teaching laboratory protocol," says colleague Lewis Saettel, manager of electrical engineering and computer science. "Her expertise is in the field of 'how to do it right'."

Morris' institutional memory and stern, yet wry manner enthralled students and colleagues alike. "Students who took her lab courses wrote on their evaluations that they were well-informed and fortunate to have her as a safety manager," says Senior Research Scientist Rossane DeLapp. "However, I think one of her greatest contributions to our department is her role as guardian of its colorful history."

Associate Professor of Civil Engineering Bob Stammer, BE'72, says the department will miss her dependability and sense of humor. "Future students will miss getting to know a Vanderbilt legend. I do not want to imply that she had been here a long time," he says, "but she was here when I was an undergraduate CE student … and I have been on the Vanderbilt payroll for 29 years now."

Professor Outlines Defense, Software Challenges in Capitol Hill Briefing

Douglas C. Schmidt, professor of computer science and associate chair of computer science and engineering, was one of three researchers invited to speak at a Capitol Hill briefing sponsored by the congressional R&D Caucus in Washington, D.C. Schmidt, also a senior research scientist at Vanderbilt's Institute for Software Integrated Systems, discussed the complex issues involved in integrating multiple and diverse software-intensive systems in national defense operations. "There are very serious technical challenges, some obvious and some to be discovered, and the challenge of too many vendors, too many technologies and too many systems," Schmidt reported. The briefing, Defense Basic Research: Critical to National Security and Economic Security, was held in conjunction with the Coalition for National Security Research.


DANIEL DUBOIS

Doug Schmidt

Interdisciplinary Team Earns Gates Foundation Award

Professor of Biomedical Engineering **Rick Haselton** and Associate Professor of Chemistry **David Wright** have received a $100,000 Grand Challenges Explorations grant from the Bill & Melinda Gates Foundation to research the development of a simple, low-cost diagnostic test for malaria. Haselton and Wright propose using nanoparticles and chemistry to develop a malaria infection test suitable for locations that lack electricity, refrigeration and highly trained technicians. The project is one of 76 grants announced by the Gates Foundation in the third funding round of Grand Challenges Explorations, a highly competitive initiative to help scientists around the world explore bold and largely unproven ways to improve health in developing countries.

From Startups to SUCCESS

VUSE engineers thrive as entrepreneurs in businesses large and small

by Mardy Fones

A solar company president who introduced President Barack Obama at the Denver Museum of Nature and Science, showcasing how the sun powers the museum's environmental system.

Two engineers who lead what *Forbes* magazine named the most promising company in America.

A president and CEO whose company saves money for commercial building owners through modular-based energy efficient heating and cooling recovery systems.

A spine surgeon who created health beverages.

What do they have in common? They're all Vanderbilt engineers who launched successful businesses. Their methods? Creativity and collaboration, a focus on giving people what they want, plus access to capital, savvy management and a singular passion for making great ideas reality.

Blake Jones, BE'96 (left), discusses solar energy with Vice President Joseph Biden and President Barack Obama.

OFFICIAL WHITE HOUSE PHOTO / PETE SOUZA

Opportunity is Everything

Blake Jones, BE'96, says opportunities are everywhere for entrepreneurs who are motivated and willing to learn. His Boulder, Colo.-based company, Namasté Solar, emerged from his 10 years as a civil engineer and project manager in the U.S. and Egypt for an oil services company. Later, he was engineering and service manager for a renewable energy company in Nepal. His return to the United States in 2004 coincided with Colorado's passage of legislation mandating that a portion of the state's power come from renewable resources.

"I realized that everything I'd been doing had led me to this point," says Jones, who credits his Vanderbilt engineering education with turning him on to the potential of solar energy. He says that Colorado's abundant sunshine—along with Boulder's educated, affluent residents—reinforced the choice of location for Namasté Solar.

In February 2009, Jones introduced President Obama at the signing of the American Recovery and Reinvestment Act in Denver. Since clean energy and the creation of green jobs were a large part of the president's stimulus package, the connection was natural.

Presidential connection aside, Namasté Solar still faces the challenges of being an entrepreneurial startup. Jones advises rising entrepreneurs to do work they love, to network continuously with other professionals and in their community to find new opportunities, and more important, "never be too proud to ask for ideas and help."

Chris McKinney, director of the Vanderbilt's Office of Technology Transfer and Enterprise Development (OTTED) and adjunct professor of engineering management, says that is good advice. "Entrepreneurship is a team sport. The best entrepreneurs look for the best people to complement their skills. It's about leveraging your assets and finding others to help with the rest."

OTTED is Vanderbilt's own entrepreneurial link. It protects the intellectual property assets of Vanderbilt, licenses technology developed by Vanderbilt inventors and innovators, and assists in the startup of companies that commercialize Vanderbilt technology.

McKinney says the myth of overnight success falls flat under close examination. "An entrepreneur is willing to knock his head against the wall. Try. Fail. Try. Fail," he says, adding that he believes VUSE students are predisposed to entrepreneurship through the depth and breadth of their education, work with entrepreneurial faculty, and ability to manage and communicate.

Spirit of Entrepreneurship

Management was one of the elements that recently led *Forbes* magazine to name VEXTEC (see sidebar) the most promising company in America. The pioneering company founded and led by Bob Tryon, PhD'96, chief technology officer; Animesh Dey, MS'94, PhD'96, chief product development officer; and Loren Nasser, CEO, beat out thousands of other companies for the *Forbes* honor. *Forbes* selected VEXTEC for the quality of its management, technology and opportunity, stating that the

STEVE PETERSON 2009

Blake Jones, BE'96, introduces President Obama at the signing of the American Recovery and Reinvestment Act.

Brentwood, Tenn., company represented the very spirit of entrepreneurship in America.

VEXTEC uses computer modeling and materials science to predict the reliability of a product or product component. One of its greatest assets is the way its technology and leadership bring together the resources and people across an organization. "Each market sector has its own challenges," Dey says. "Success for us comes from recognizing that the objective is the same—understanding when something is going to break and helping the client translate that to improved reliability."

Hot and Cold

Mark Platt, BE'87, has grown his company, Multistack, 700 percent since 2002.

There's a lot of wasted energy in the cooling of commercial buildings. To take advantage of this issue, Mark Platt, BE'87, used his own money, plus funds he raised, to buy and expand Multistack, a modular chiller and cooling products manufacturer. Focused on innovative air conditioning technology, the company has grown 700 percent since 2002; its compact equipment has been installed in facilities such as manufacturing plants, blood banks and even the notoriously cold Ed Sullivan Theater in New York City, where *The Late Show With David Letterman* is taped.

Recently, Platt and Multistack were finalists for Ernst & Young's Entrepreneur of the Year award. "Multistack's success comes from our ability to recognize new, disruptive technology and leverage it into products that save customers money," Platt says.

He confesses Multistack's maturation has been a learn-as-you-go enterprise, one in which he raised $3 million of seed capital. "It's amazing what you can accomplish when you don't know it's impossible," he quips.

He credits close relationships with customers and employees with fostering a home run. "We're always looking for the next big idea. We fight the drag of our success. Our philosophy is do the right thing for customers quicker, rather than later," the company's president and CEO explains. "Life is relationships. Everything else is noise."

In the Classroom

The groundwork for entrepreneurship, say Vanderbilt University School of Engineering faculty, is laid in the classroom and occurs on many levels; the multidisciplinary senior design project course brings it all into focus.

"This required class is a launching pad and an opportunity for students to go through the normal design frustrations, where they spark off each other's ideas and learn teamwork," says Paul King, professor of mechanical and biomedical engineering, emeritus, who has taught the yearlong class since 1991. "Teams learn to work inside and outside the box, to solve real problems, to follow a structured approach and how to brainstorm."

For those who want an edge and more of the tools entrepreneurs need, VUSE also offers an engineering management minor. The interdisciplinary program teaches business management as it relates to engineering, with a special emphasis on issues involving technology development and innovation.


OUILLARD INC.

Hughes

"The challenge is learning to manage implementation of their creative ideas so they'll generate positive cash flow quickly," says David Berezov, adjunct professor of engineering management. That, in turn, attracts capital and growth. "It's eye-opening for students to see firsthand how an idea, its financing and operation come together, and to see the relationship between technologies and the underlying financial profit."

Dr. Alex Hughes, BE'99, MD'03, agrees. A spine surgeon who developed a line of health drinks under the brand name Function Drinks, he puts it this way. "You need to be realistic, know what the market opportunity is, and have accounted for the

Dr. Alex Hughes, BE'99, combined his engineering and medical knowledge to create Function Drinks, a line of health drinks.

Predicting Failure Leads to Success on *Forbes*' Most Promising Company List

Things break. *Forbes* magazine says breakage costs American manufacturers $30 billion a year in warranty payments. If manufacturers could predict breakage and adjust warranties, they could save more than double that amount—not to mention the other benefits they'd reap from improved reliability, performance and quality.

Anticipating breakage on everything from jet engines and health care devices to energy technology is the entrepreneurial niche that gave birth to VEXTEC. Founded by Bob Tryon, PhD'96, chief technology officer, and Animesh Dey, MS'94, PhD'96, chief product development officer, along with CEO Loren Nasser, VEXTEC is a front-runner in using a computational framework for simulating and predicting the breakdown of manufactured products—and the potential impact on a company's finances.

"Like the DNA of any living cell, every material has a microstructure that determines its behavior. This is the key to predicting how and when failure will happen," says Tryon, a material science engineer who previously worked at General Motors and Ford. At the core of VEXTEC's success is a patented system that simulates the life expectancy of a part, an engine or an entire product fleet. The system then combines that information with data from other components in a product to predict the product's overall reliability. Clients range from manufacturers to oil and gas, aerospace and electronics companies.

In 2009, *Forbes* lauded VEXTEC as America's most promising company, predicting its Virtual Life Management (VLM) product for forecasting failure will hasten the pace of innovation in its market niche.

Entrepreneurs in Reliability

"It's hard to be an entrepreneur at GM," shrugs Tryon, who worked first in the gas turbine division at GM. Concerned about product reliability, GM sent him to Vanderbilt for a doctorate in engineering and to study under Thomas A. Cruse, then H. Fort Flowers Professor of Mechanical Engineering and the guru of probabilistic structural analysis methods. At VUSE, Tryon met fellow doctoral candidate and computational reliability modeling expert Dey, studying under Professor Sankaran Mahadevan. Under Cruse and Mahadevan's tutelage, Tryon and Dey saw a future ripe with possibilities.

When Tryon and Dey graduated in 1996, the sale of the GM division in which Tryon had worked made him a free agent. Initially, he and Dey honed their chops as consultants. Their first customer? Chrysler.

Their work took two paths: material science experts focused on developing a virtual material simulation tool, while computational experts focused on correlating the simulation from material behavior to predicting fleet performance and business impacts. In 2000, the two joined with Loren Nasser to found VEXTEC. Nasser husbanded the management and infrastructure of the self-funded firm while Tryon and Dey focused on refining the VLM product. Today, the three still own 100 percent of the company, which has 28 employees and posted $3 million in sales in 2008.


PHOTOS BY DANIEL DUBOIS

Robert Tryon, PhD'96, (top) holds scaled-down aircraft turbine disks before and after testing by VEXTEC. Animesh Dey, MS'94, PhD'06, (bottom) shows a mini-aircraft engine used to test for structural failure of the disks.

Custom-tailored Sales and Service

In providing the only accurate and efficient computational framework for simulating and then predicting product behavior, VEXTEC's VLM has the potential of eliminating the need for trial-and-error product testing. It also provides insight about products and how to make them better.

Dey says listening to individual customers is critical in helping those customers improve their products. "Don't tell customers what you know," he says. "Tailor your message to what they need and want to know." Dey customizes VLM to meet the exact needs of each client and industry. The challenge is to focus, identify need and create a solution in ways that positively affect clients' operations and bottom line.

Although their pioneering technology, management team and huge market potential led to the *Forbes* honor, Dey and Tryon say that the personalized approach is key to the company's success. It's not enough to have a great product—VEXTEC must meet customers' needs to grow.

"Fundamentally, to be successful, your product has to make someone's day-to-day life easier," Tryon says.

—Mardy Fones

back-of-the-envelope costs," the biomedical engineering graduate advises. "Look at the trends and the potential legal issues and do due diligence with competitors. Sure you have an end vision but also know it's not religion—that you have to approach it like science." Function Drinks, available in stores such as Target and Whole Foods, was named the best new product of 2007 by BevNet, a leading beverage industry authority.

Serial Entrepreneurs

An entrepreneur who now works in consulting services, Gary York, BE'81, has been involved in launching several successful software companies. "Ten people see the same problem you see but seven won't do anything about it. Three will and they'll be your competitors, so you have to execute it better," says York, who advises less experienced entrepreneurs and who has been described as a serial entrepreneur. Key in launching a new product, he says, is partnering with a paying customer whose business serves as both a proving ground and validation for investors (and the market) that your product has potential.

Limp

David Limp, BS'88, a Silicon Valley veteran associated with multiple entrepreneurial successes including PalmSource, says it all comes down to two things. "You've got to articulate and execute an idea that captures the imagination of customers," says Limp, who has worked both on the development and financing side of entrepreneurial ventures (see sidebar). "If you can do that, you can find someone to write you a check."

But that check, he warns, isn't technological or creative carte blanche. "Your inclination as an engineer may be to solve a problem in the most creative way, to strive for perfection," he cautions. "You have to understand that what the customer wants and needs may not be the perfect way of solving a problem, but it is the right way. To be successful, engineer/entrepreneurs must learn to balance those dynamics."

Entrepreneurial ventures often occur when engineers combine interests with a challenge. Chikai Ohazama, BE'94, developed the product that became Google Earth by combining interests in 3-D graphics, medical imaging and geospatial data. Sunil Paul, BE'87, co-founded two successful Internet firms and today is a venture capitalist with interests in clean energy technology. His wife's frustration with spam emails sparked Paul's development of Brightmail Inc., an anti-spam computer software firm later purchased by Symantec.

Jordan Eisenberg, BS'04, pursues similar success and personal interests. Eisenberg has developed and licensed a medical device concept to a major manufacturer, authored and applied for two patents, and launched a company to market and distribute his products. He credits his widespread entrepreneurism with the problem-solving skills he learned at Vanderbilt. "Would you rather have several small businesses that are profitable or one large one that isn't?" he says pragmatically.

Adventures of an Entrepreneurial Engineer

David Limp has the entrepreneurial bug

"I love being involved in fast-paced, high-risk, high-reward startups," says Limp, BS'88, a successful entrepreneur and chief operating officer of BrightKite, a social networking Web site. Limp, who earned his degree in computer science from the School of Engineering, specializes in ventures in the high-tech arena.

Good entrepreneurial ideas abound, he says. The tricky part is crossing the space between an idea and getting to market with a product no one else has, one that customers need. "To be a successful engineer/entrepreneur you have to have experience in all parts of business," the Silicon Valley veteran advises, as well as a willingness to stake your name and reputation on a product.

No Shortcuts

Limp has made a career of such experiences. Just out of VUSE, he spent eight years at Apple Computing. Then he was at Liberate Technologies, serving as vice president of marketing, later chief strategy officer. Next he was vice president of business development for PalmSource and then a venture partner with Azure Capital Partners, which backs entrepreneurs, including BrightKite.

"Having a holistic view of what it takes to run a business is fundamental. That's where my Vanderbilt engineering education is an asset. It's provided a balance between theoretical and practical," Limp says. "The practicality of the curriculum has paid dividends countless times as I apply core problem-solving skills to startups that are changing dramatically daily."

Taking Risks

Currently, Limp is also collaborating on a Web site called Education.com, which provides a consolidated reputable resource for parents about educating children in the same way WebMD consolidates medical information. "It's averaging 2 million hits a month," he says. "Advertisers love it because they can get to customers they want—moms and dads interested in saving time."

But Limp says not every hit is a home run. He helped develop a palm-sized computer that fell flat. "It was a brilliant piece of electrical engineering. It failed because consumers went to lower price points with bigger keyboards," he says philosophically. "In the end, we sold the assets. Yet I wouldn't trade time there for anything."

The hallmarks of the engineer/entrepreneur are a combination of courage and unrelenting focus, he notes. "Don't chase the next shiny penny," he advises. "Sure, the next idea is out there, but its success is predicated on doing everything you can to make the current one a success."

—Mardy Fones

Unforgettable

Karl B. Schnelle Jr.

Professor of Chemical and Environmental Engineering, Emeritus

by Mary Ellen Crowley Ternes, BE'84

PEYTON HOGE

Among his accomplishments, Karl Schnelle Jr. was

- elected a Fellow by the American Institute of Chemical Engineers (AIChE) in 1981
- named the Lyman A. Ripperton Environmental Educator in 2006 by the Air and Waste Management Association
- recently honored with the 2009 Environmental Division Service Award from AIChE
- honored as the 1995 Vanderbilt Alexander Heard Distinguished Service Professor

Even though I did great on my ACTs and had already taken calculus, I really wasn't prepared for my freshman year at Vanderbilt. After skating through my small rural high school, the Vanderbilt School of Engineering was going to make me work.

Working hard was the easy part. The one thing that really held me back was having no self-confidence. None. While Vanderbilt isn't a big school, I had gone to school with the same small group of kids virtually my entire life. I was so shy, I was actually afraid to go to class.

It's nice to have outgrown all that, but back then, it represented a wall I almost couldn't see over. The idea of asking for help never occurred to me. But fortunately, Professor Karl Schnelle has always had a way of ignoring walls like that and helping students get past them, too. While other professors pretty much scared me to death, with his gravelly voice and candid expression, Professor Schnelle was always warm, grounded and easy-going with a great sense of humor. One of my fondest memories is Professor Schnelle's distillation survey course—he had various ethyl alcohols that had to be tasted by us students. That was the first course I had with him—who knew that chemical engineering could also be fun?

While I eventually learned to get out of my own way and enjoy chemical engineering as a discipline, I really couldn't see myself working in a chemical plant. After my junior year, I needed help seeing how I could use my degree. Again, Professor Schnelle provided the key. He has always been passionate about separation processes and applications in pollution control. I decided to focus in that area.

After graduation, I went to the U.S. Environmental Protection Agency and worked to clean up Superfund sites. After becoming interested in on-site incineration as a Superfund remedy, I began writing permits for hazardous waste incinerators. At about that time, I saw that Professor Schnelle was teaching courses on air pollution control. It occurred to me that I should take my incinerator pollution control and combustion process experience and focus on air pollution control and compliance with Clean Air Act regulations. Shortly after that, I went to law school and become a Clean Air Act lawyer.

I love this work. I even co-wrote a chapter of the American Bar Association's *Clean Air Act Handbook*. (Again Professor Schnelle served as a model—he co-wrote a whole textbook, the *Air Pollution Control Technology Handbook*.)

Air law is technical enough that I still feel right at home at AIChE meetings and conferences. There I get to see Professor Schnelle and talk about a subject that makes most people's eyes' glaze over. Professor Schnelle is one of the few people who, like me, still think all of this is fun.

When I started at the School of Engineering, I figured out pretty quickly how much work it would take to get my chemical engineering degree. What I couldn't have known was how much fun I'd end up having with it or how critically it would factor into a career I love so much. But Professor Schnelle did. There are professors who love their subjects and who are truly inspirational teachers. And there are professors who show you the way, who give you direction and instill a sense of creativity, fun and passion for learning that never dies.

Professor Schnelle is all of those, and more.

Mary Ellen Crowley Ternes, BE'84, is a shareholder and member of the environmental practice group of McAfee & Taft, Oklahoma's largest law firm. She's a fellow of the American College of Environmental Lawyers, active in AIChE, and frequently writes and speaks on environmental issues.

Student Developer Draws Sales with iPhone Apps

by Laura Miller, MA'95

One of the hottest new electronic mediums for visual artists comes from a Vanderbilt University School of Engineering student who says he has no artistic skills himself.

Ben Gotow, a senior computer engineering major, develops applications (apps) for the iPhone. Two of his artistic drawing apps, Layers and NetSketch, have become so admired by users that online galleries have been dedicated to each app as a thematic medium. The applications are also a source of income for the student—he has earned more than $70,000 in sales of three apps through Apple's online store.

Cell phones increasingly are adapting the functions of computers. More advanced cell phones, known as smart phones, can serve as phone, MP3 player, camera, laptop, game arcade, video player and more. In addition to basic functions, smart phones can also be outfitted for additional uses through downloadable applications purchased online. That creates new opportunities for computer engineers.

Gotow was initially drawn to iPhone development by Apple's iPhone SDK, which allows apps to be written in the same high-level language used for desktop applications. "All of a sudden, developing a mobile app became a lot more like developing a desktop app," he says. Writing applications for the iPhone is a relatively new arena—Apple, which owns the iPhone, only began allowing outside developers to create and sell applications for the iPhone in June 2008. Since then, more than two billion apps have been downloaded from Apple's App Store; sales for the iPhone and iPod Touch total more than 50 million units.

The Virginia native says he first conceived the idea for NetSketch while in a computer engineering class. More than 350 work hours later, he submitted his proposed app to Apple to review. NetSketch was accepted by Apple and available for downloads starting in July 2008. His other two applications, Layers and Mathomatic, soon followed.

Advancing Human-Computer Interaction

Gotow says he likes to focus on the interaction between users and technology. "I'm interested in human interfaces: When the user picks up the phone for the first time, what's the first thing they try to do?" Gotow says. "I try to create interfaces that just work. The iPhone is a great platform because the multitouch screen allows for some really intuitive methods of interaction."

JOHN RUSSELL

Senior computer engineering major Ben Gotow is already a successful developer of applications for the iPhone.

Gotow has been writing computer programs since childhood. He says his father, software designer Jon Gotow of St. Clair Software, fostered his love of programming and problem solving from a young age. "His help and expertise allowed me to tackle design issues ranging from networking and threading to UI [user interface] design and has helped make NetSketch a solid and efficient application," the student says.

Gotow gets inspiration for new apps by looking beyond the limitations of his previous work. "You do something once and then realize you could go back and do something better," he says. "Layers was inspired by the comments, suggestions and requests by users of NetSketch. I tried to expand the app to meet their needs, but I realized pretty quickly that what was being created required more than just an update—I needed something entirely new."

> "I'm interested in human interfaces: When the user picks up the phone for the first time, what's the first thing they try to do?"
>
> —Ben Gotow

Even though he professes to have no artistic skill of his own, Gotow says he loves creating apps for artists because art applications are an area in which high quality tools are appreciated and he knows his work will be put to the best use.

JOHN RUSSELL

Layers, one of Ben Gotow's iPhone apps, helps artists create anywhere.

Building Smart Phone Technology

In addition to creating the applications, Gotow is one of more than 25 students in an innovative yearlong class launched by the School of Engineering. Developed and taught by Research Assistant Professor of Computer Science Jules White, MS'06, PhD'08, the course applies existing computer theory to new real-world models of networking and focuses on the creation of smart phone technology.

Gotow is developing a version of Layers for the iPad, Apple's newest product. He is also working with White on an independent study project to create an augmented reality library for the iPhone based on global positioning technology. Gotow hopes to develop an app that would allow users to point their phones at a building anywhere on Vanderbilt's campus and receive information about what is going on inside as well as the building's history.

Gotow is also working on a project with Dr. Brian Rothman, assistant professor of anesthesiology. They're developing an iPhone app for the Vanderbilt Perioperative Information Management System at Vanderbilt University Medical Center. After graduation, Gotow plans to go to graduate school and has applied to several programs that emphasize human/computer interaction.

Pushing to Improve

Bob Webster creates mechanical devices to make things better for patients

by Sandy Smith

Smaller. Less invasive. More flexible. Those aren't just directives from physicians regarding medical devices—they're the goals that Assistant Professor of Mechanical Engineering Robert Webster III has set for his research and lab.

"The thing that drives me to continue to work really hard is the end product medically," he says. "Will it do something that doctors can't do today? Will it be less invasive? Will it make things better for the patient? If it's just academic and I can't see how it's going to help, I'm not as interested."

Webster's patented development of several types of steerable medical needles already provides safer, less invasive and more accurate ways for physicians to deliver treatments to patients. Despite initial successes, however, he is continually pushing to improve, working toward swallowable robots, image-guided cochlear implants, and less invasive and more dexterous laparoscopic instruments.

A Commitment To Collaboration

The connection between mechanical engineering and medicine is at the core of Webster's work. In fact, it was the collaborative atmosphere between medical center and university that made Vanderbilt stand out when Webster sought his first faculty position after earning his doctorate from Johns Hopkins University in 2007. Today the assistant professor is involved in a variety of projects with Vanderbilt University Medical Center. He frequently makes the short walk from the School of Engineering to the Medical Center. "Just being close to one another physically—you can't underestimate how important that is," Webster says of his collaborations with VUMC doctors and researchers.

Webster's commitment to collaboration set him apart early on, says Allison Okamura, Webster's graduate advisor at Johns Hopkins and professor of mechanical engineering there.

"He's always willing to talk to people about his research and his ideas and seek out help from all kinds of people, whether it's an engineer with a different specialty or a medical professional," Okamura says.

Webster believes engineers and doctors enhance each other, although their thought processes are different. "Doctors can sometimes be too close to the problem to think outside the box. Ideas generated solely by doctors without engineering input can often, with some exceptions, of course, be small tweaks on existing tools," he says. "Engineers tend to have the opposite problem. Many of the 'breakthroughs' that we would come up with on our own don't work at all clinically. It takes just the right partnership to have a doctor who is willing to think outside the box and an engineer willing to take the time to understand the real-world challenges doctors face every day."

Webster has that kind of partnership with a number of Vanderbilt's leading researchers, including Dr. Robert Labadie, associate professor in the Medical Center's Department of Otolaryngology, and J. Michael Fitzpatrick, professor of computer science, computer engineering and electrical engineering. They are working on a procedure to make cochlear implants—devices implanted inside the ear to help those with profound hearing loss—less invasive.

This rigid platform allows a drill to be lined up precisely for cochlear implant surgery. The slim rod demonstrates the path the drill would take.

Previously, implantation required the removal of a large amount of bone to reach the cochlea inside the ear. To avoid removing the bone, the team developed a rigid individualized platform to allow a drill to be lined up more precisely, missing nerves that control facial functions and the tongue. Their platform should go into clinical trials this year. Even so, the team is still working on improvements, investigating whether robotics could be used for the drill's guidance, eliminating the need to manufacture the customized platforms.

Webster "has a surgical mentality, meaning that he is very goal-oriented and doesn't get bogged down in extraneous issues," says Labadie, who also holds a doctorate in bioengineering.

PHOTOS BY JOHN RUSSELL

"Research between engineers and doctors is a team effort, but the reality is that clinical constraints, such as office hours and operating room time, restrict the available time of doctors. Bob is very respectful of this and works to make things work."

Building The Future

In Webster's Medical & Electromechanical Design (MED) lab, more than half a dozen student researchers work on a variety of projects. One project involves improvements to a swallowable medical robot Webster first worked on during graduate school. The next phase, Webster believes, is capsule robots that do more than provide a view inside the body.

"The best path forward is having the capsule do a clinical intervention," Webster says. "You have a spot that's bleeding and you apply a clip to it or a powder that causes it to clot. Or you have the capsule find the tumor and clip it off or just take a biopsy sample. That's where I see it going."

Critical to making that happen is solving a power-supply issue. "DC motors and batteries don't scale down well. We need more power density," Webster says. He's tapped into the work of the Center for Compact and Efficient Fluid Power, a National Science Foundation-funded center in which Vanderbilt is a partner university, to help accomplish that.

> "Will it do something that doctors can't do today? Will it be less invasive? Will it make things better for the patient?"
>
> —Robert Webster III

Volunteer Work Plants Seeds

Webster saw early on how engineering could help make things better for patients. His father was a civil engineer who specialized in hospital construction and expansion. "He'd design the building and get the construction underway," Webster says. The Webster family moved every few years, mostly around New York and Pennsylvania. Because young Bob was homeschooled from kindergarten through high school, he was able to focus on the math and science courses that he loved. He volunteered in a biomedical engineering department at a local veteran's medical center. "I got

Webster and his team continue to refine steerable surgical needles. This one consists of a series of telescoping precurved tubes that are flexible and can rotate inside each other.

to see medical equipment, how hospitals work from the inside out. Maybe that planted some seeds," he says.

A passion for lasers led to an undergraduate degree in electrical engineering at Clemson University. He used co-ops and internships to define his career path methodically. A nuclear power plant was "all paperwork," he discovered. The pace in a government lab was too slow. A rapidly growing corporate technology firm was somewhat appealing, but by his senior year, robotics had his attention. As an undergraduate visiting researcher at University of Newcastle, Australia, he quickly learned that he could control the robots and do the electronics, but that he was limited by what mechanical engineers built for him.

Refusing to let someone else determine his limits, Webster pursued graduate studies in mechanical engineering at Johns Hopkins. He spent the first year in the machine shop, learning to build.

"He was not afraid to get his hands dirty," says Okamura, who also directs Johns Hopkins' prestigious Haptics Laboratory. "Prototyping is such an important part of the design process. His enthusiasm for doing that is a key part of his success."

For his doctoral thesis, Webster built on Okamura's work with steerable needles. Okamura had noted that a straight needle began to bend as it penetrated the body. She and Webster launched a study to determine ways to control or use the natural bend, which has since become a major research area for Johns Hopkins; Okamura and Webster jointly hold a patent on the initial phase. Flexible needles that can be steered from outside the body could improve medical procedures, including chemotherapy, biopsies and tumor removal, with minimal trauma to the patient. Still, Webster wasn't satisfied. Webster built a new steerable needle from a series of telescoping precurved tubes that are flexible and can rotate inside each other. This enables control of shaft shape that was not possible with the first design, which controlled only the forward trajectory of the tip. That development is also patented by Webster and Okamura.

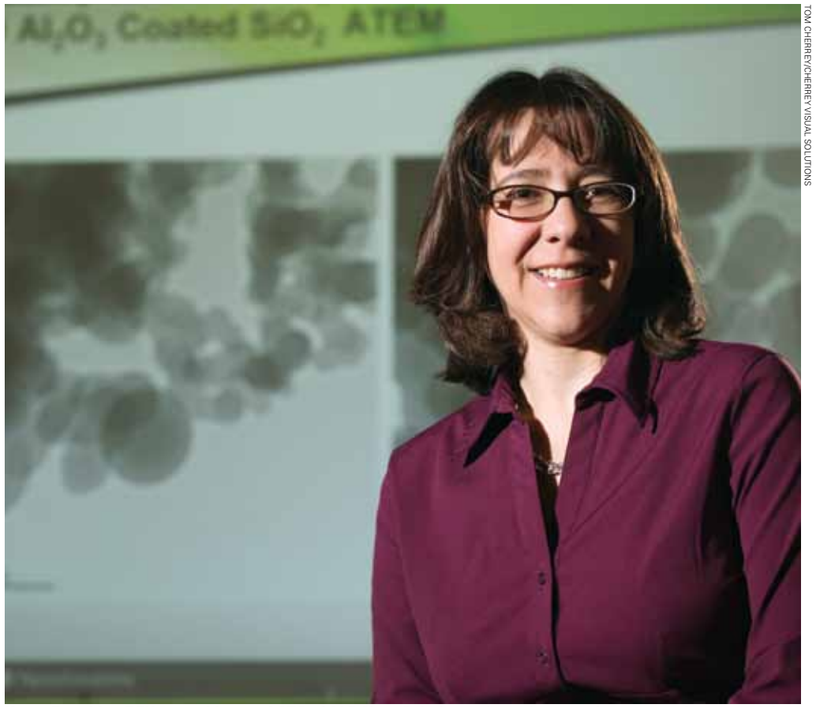
Today, Webster works with Acoustic MedSystems, a small company based in Champaign, Ill., on a thermal treatment of liver tumors using the steerable needles. Human trials are still a few years away and work continues in the MED lab. Intuitive Surgical, a corporation that manufactures robotic surgical systems, has also licensed the patent and is developing additional initiatives in its own facilities.

The steering technology has other applications, as Robert Galloway, professor of biomedical engineering, discovered. Galloway pioneered the field of interactive image-guided surgery. Soon after arriving at Vanderbilt, Webster joined in the research, attempting to develop a laparoscopic method for image scanning before surgery; the work allows surgeons to have a three-dimensional image prior to incision.

"Prior to having Bob's expertise, any flex in any of our objects constituted a targeting error," Galloway says. "He brings an important piece to the next step. He understands the incredible challenges with working in engineering development for the purposes of making people better. We have a world-class team of people here who do that and so we have a high bar for acceptance of anyone new. Bob has stepped right in."

Quest for Knowledge Spurs Nanotechnology Entrepreneur Karen Buechler

by Becky Green



TOM CHERREY/CHERREY VISUAL SOLUTIONS

Karen Buechler, BE'94, president and CTO of ALD NanoSolutions, shows images of nanocoated nanoparticles.

Curiosity has served Karen Raska Buechler, BE'94, well. It was curiosity that led her to Vanderbilt University School of Engineering for a bachelor's degree in chemical engineering and on to graduate school in Colorado for her master's and doctorate. In the Rocky Mountains, curiosity combined with an entrepreneurial spirit and supportive family helped Buechler become the co-founder, president and chief technology officer of an innovative nanotechnology company, ALD NanoSolutions.

"Life takes you to interesting, intriguing places," Buechler says. "Fifteen years ago I would have never anticipated that I would be sitting in a boardroom with *Fortune* 50 executives and other industry leaders."

ALD NanoSolutions began when Buechler, P. Michael Masterson and two professors, Steven George and Alan Weimer, met at the University of Colorado in Boulder. Using licensed research and intellectual property developed in the George/Weimer laboratories at the university, the four set out to use atomic layer deposition (ALD) technology to apply ultrathin nanocoatings on nanoparticle surfaces. The technology has the potential to solve materials problems in a wide variety of industries.

Commercializing Nanotechnology

Buechler describes nanotechnology as a challenging field with new material development. "The material development world is quite interesting. You have both long-term applications where changes are revolutionary, as well as short-term applications where significant improvements to the end product can provide a drop-in solution for the customer," she says. "We are currently working on both types of projects and they both have their own unique challenges."

Her company works with strategic partners to design materials primarily for the aerospace, electronics and automotive industries. Buechler leads the product development efforts, explaining that she develops virtually any applications that are technically possible and economically viable. She also guides research execution and project management, works with client partners to fulfill their needs, and helps develop the brand of the company.

ALD NanoSolutions focuses on commercializing its patented nanocoating processes, called Particle ALD and Polymer ALD, and targets collaborative research agreements with other partners for the discovery and validation of innovative composite materials. Funded predominately by grants from agencies such as the National Science Foundation, Department of Defense and Department of Energy, the firm's projects typically involve materials technology related to the ALD nanocoating of fine particles as well as of flat or particle polymer surfaces.

The company currently has protective coating materials being tested on the International Space Station as part of NASA's Materials International Space Station Experiment (MISSE). The MISSE program tests the long-term effects on materials exposed to the space environment. "These materials are plastics with a protective coating to keep them from degrading in the extreme ultraviolet radiation and hyperthermal oxygen that are in the near-Earth orbit," Buechler says. "The coating is a multilayer of two or three different ceramics that are hundreds of nanometers thick."

> "Fifteen years ago I would have never anticipated that I would be sitting in a boardroom with *Fortune* 50 executives and other industry leaders."
>
> —Karen Buechler

Lifelong Passion for Knowledge

Buechler's interest in chemical engineering began with her parents. Her father was an electrical engineer and her mother held a chemistry degree. At an early age, Buechler was hungry for knowledge and relished every opportunity to solve basic and complex problems. She says that she and her siblings were encouraged to pursue and actualize whatever they desired. "Their support and confidence enabled me to flourish as a woman in engineering," Buechler reflects.

"At 18, I was drawn to Vanderbilt largely due to the reputation of the university and the quality of credible research," Buechler says. "The amount of one-on-one attention and the close-knit learning environment are testaments to the quality of education you receive at Vanderbilt's School of Engineering."

While an undergraduate, Buechler took classes from Eva Sevick, professor of chemical engineering. Sevick had recently completed her dissertation and challenged Buechler to experience independent study. Buechler's enthusiasm and focus were also prompted by Professor of Chemical and Environmental Engineering Karl Schnelle Jr. and his accomplishments. Describing the faculty at Vanderbilt, Buechler says, "I was always impressed by the wonderful mixture of experiences and drive that helped guide me to where I am today."

When she was considering her next steps, Tomlinson Fort, then-chair of the chemical engineering department, suggested Buechler employ her ever-unfolding curiosity and apply to graduate school. Following his recommendation, Buechler completed her doctorate in chemical engineering at the University of Colorado at Boulder in 1999.

It was there, as a postdoctoral research associate in the Department of Chemical Engineering, that Buechler was instrumental in developing and patenting the technology that led to ALD NanoSolutions.

"Getting my education opened a lot of doors for me and created a wealth of opportunities," Buechler says. Although she didn't set out to be a company president only 15 years after graduation from VUSE, Buechler says that flexibility and openness to different paths were critical in what she's achieved so far. She also credits her husband, Ken, for his support and patience.

"When you go to build a company from scratch, you often find yourself working for no take-home pay for some time. This can be an enormous burden to a family," Buechler says. She and Ken married when Buechler was a junior at Vanderbilt ("A pretty unusual step," she admits). "If it weren't for my husband's extreme patience and his flexibility in life/vision this never would have been possible for me."

Looking toward the future, the nanotechnology guru believes there is still much to achieve. On this note, she encourages young engineers not to limit themselves too early. "Don't wait for an opportunity," she advises. "Create it for yourself."

DANIEL DUBOIS

Calculating Risk, Increasing Reliability

by Joanne Lamphere Beckham, BA'62

When you take a plane trip, drive across a bridge or ride the commuter train to work, you trust that those structures and systems are safe. Likewise, pilots flying combat missions depend on their planes and astronauts hurtling into space depend on the rockets propelling them.

Sankaran Mahadevan, professor of civil and environmental engineering, works on ways to increase the reliability and decrease the risks of those and other complex structures and systems. His research regarding railroad wheels, spacecraft, dams, bridges and even nuclear waste dumps has the potential to save human lives and millions of dollars.

In the past, engineers had to test multiple samples of something to see how many failed. They would then add more material and components than needed to increase the reliability of their designs. That approach doesn't work with today's large structures and complex systems.

"Skyscrapers and bridges can't be put through full-scale testing as can small mechanical and electrical devices," Mahadevan says. "You can't test the reliability of large systems like space shuttles and warplanes by waiting to see what fails. No matter what the system, we have to be concerned about how reliable it is."

Mahadevan and his colleagues in the Structural Reliability Research Group are developing computer models that can predict with a high degree of confidence whether a system will fail, when failure is likely to occur and how to prevent such failure.

Computer Programs Take the Risk

Dr. Maha, as he is known to his students, also directs the Vanderbilt Risk and Reliability Engineering and Management doctoral program, the largest and most prestigious of its kind in the world. "It began in 2001 as an Integrative Graduate Education and Research Traineeship (IGERT) grant from the National Science Foundation," he explains. "That focused on studying and developing multidisciplinary computational and experimental methods for assessing and managing risk and reliability."

© ISTOCKPHOTO.COM/JEAN FROOMS

Today, the program is self-sustaining, with governmental and private partners that include the Transportation Technology Center, Sandia National Laboratories, Federal Aviation Administration, NASA, U.S. Air Force, U.S. Department of Energy, Boeing Co., Bell Helicopter Textron and Union Pacific. Those organizations and others provide about $1 million in funding each year for research projects on structural reliability and durability, optimization and decision making under uncertainty, structural health monitoring, and reliability and risk engineering and management.

Mahadevan is currently applying his expertise to NASA spacecraft. His team is working on calculating risk and uncertainty in such large systems by incorporating multiple disciplines like structures, aerodynamics, propulsion, mass and geometry into the computer programs. An acceptable risk for spacecraft is typically about one in 10,000.

"The question then becomes how good are our models?" Mahadevan says, noting that there are many assumptions and very little data on which to base such predictions. "It has been shown that different models will yield very different predictions. So we're developing rigorous methods to verify and validate our computer models."

"We are also monitoring the health of large systems by placing sensors on the vehicle that will detect real-time damage, diagnose the problem, and offer a prognosis as to how long the vehicle can be used before repair or grounding," he continues. "One research question is to determine how many sensors are needed and where they should be installed." Another concerns the reliability of the sensor itself.

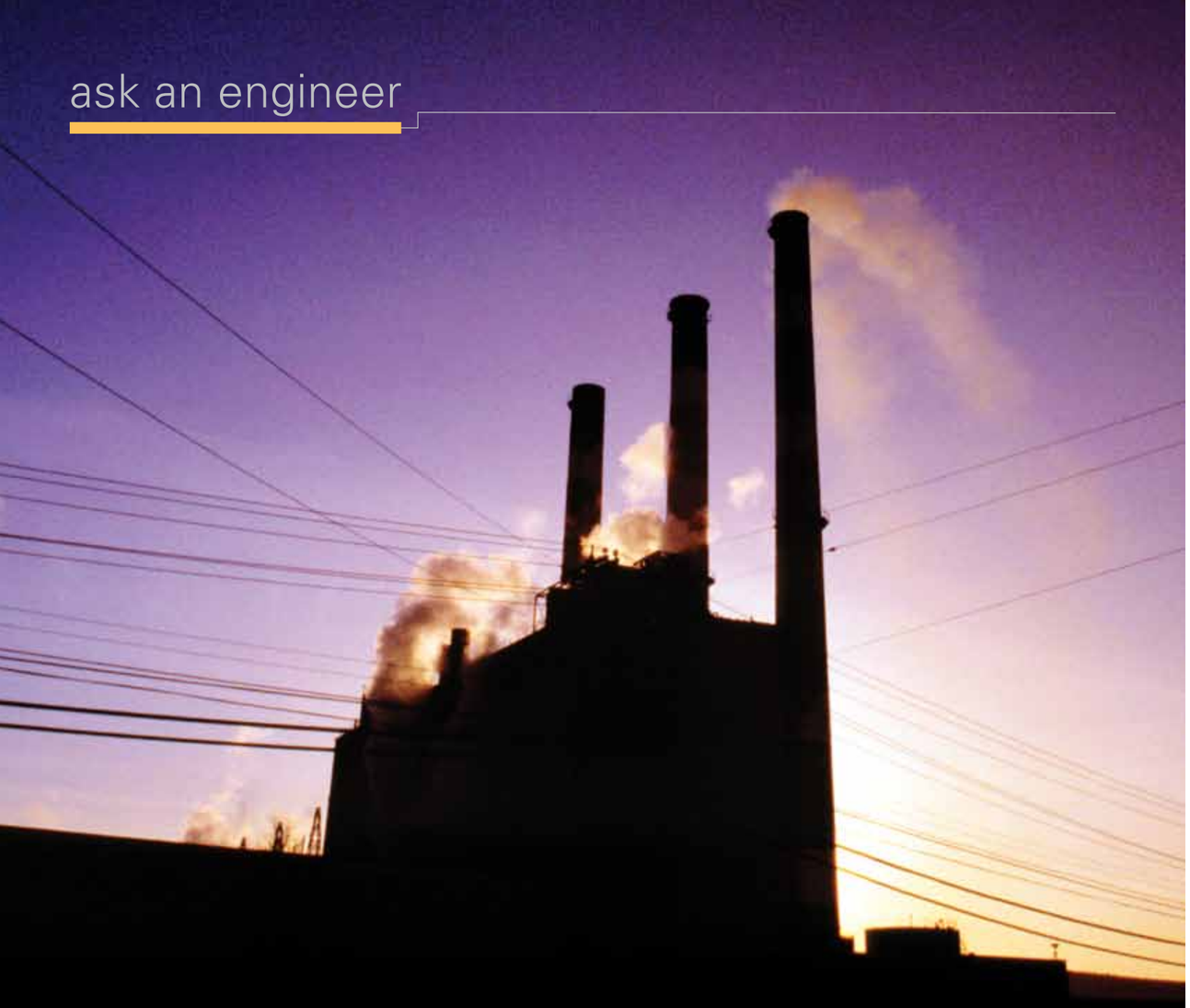
Planes, Trains and Nuclear Waste

Mahadevan's reliability methods can be used in the design, manufacture, operation and maintenance of equipment and systems in many fields. Engineers and scientists call that life-cycle risk management. His research for the Federal Highway Administration, for example, identified which 2,000 bridges throughout the country should carry advanced structural health monitoring instrumentation. The team also developed a cost-effective way to inspect train wheels that demonstrated a 400 percent return on investment for partner Union Pacific.

Current research includes a U.S. Air Force Research Laboratory project to develop rapid diagnosis and prognosis methods for warplanes. The group is also working on applying risk and reliability management to large complex systems like homeland security and transportation. Through a consortium of universities known as the CRESP project, the Department of Energy funds an effort to model the durability and uncertainty of concrete storage facilities for low-level nuclear waste. The team also has received a five-year, $1.2 million award from the FAA to develop advanced methods to predict fatigue and fracture, and the related uncertainty, in helicopter rotor components.

> "You can't test the reliability of large systems like space shuttles by waiting to see what fails."
>
> —Sankaran Mahadevan

Mahadevan joined the Vanderbilt engineering faculty in 1988, after earning his Ph.D. from Georgia Tech. His work has been recognized with numerous awards, including the Distinguished Probabilistic Methods Educator Award from the Society of Automotive Engineers and the Outstanding Professional Service Award from the American Society of Civil Engineers. In 2006, he received Vanderbilt's Joe B. Wyatt Distinguished University Professor Award for his achievements in developing significant new knowledge from multidisciplinary research.



© ISTOCKPHOTO.COM/JASON VERSCHOOR

What is Coal Ash?

The term "coal ash" has been in the media a lot in the past year. *Vanderbilt Engineering* asked a School of Engineering research team to explain the term and tell us why it is important. The team consists of Professors David S. Kosson, Florence Sanchez and Andrew Garrabrants, all of the Department of Civil and Environmental Engineering, along with collaborators Peter Kariher (Arcadis Inc.); Hans van der Sloot and Paul Seignette (Energy Research Centre of the Netherlands); and Susan Thorneloe (project director for the Environmental Protection Agency's Office of Research and Development).

Where does coal ash come from?

Coal combustion for energy use results in the formation of several types of residuals, collectively referred to as coal combustion residues (CCRs). Coal ash refers to both bottom ash, the material remaining within the boiler chamber after coal combustion (which is continuously removed), and fly ash, the fine material suspended in the combustion gases that is typically separated in the first stage of air pollution control.

Why is it in the news?

A large quantity of fly ash was stored wet in a diked landfill operated by the Tennessee Valley Authority in Kingston, Tenn. The dike failed in December 2008, resulting in several hundred acres, including several homes, water bodies and transportation routes, being inundated with fly ash sludge. This also focused attention on the broader issues of coal combustion, including design of containment facilities for CCRs, potential environmental impacts from the disposal or use of CCRs, and the role of coal fired power plants in air pollution and climate change.

Is it toxic? Is it environmentally dangerous?

The presence of specific environmental contaminants in CCRs has been of ongoing public and environmental concern. These contaminants include mercury, aluminum, antimony, arsenic, barium, boron, cadmium, chromium, cobalt, lead, molybdenum, selenium and thallium.

Leaching, the extraction of contaminants from solids by contacting water, followed by transport and contamination of water resources, is a primary path to potential impact on human health and the environment. So how CCRs are managed is of great interest.

And how are CCRs managed?

Current management practices include disposal as either wet or dry/moist materials in landfills, collection in wet impoundments, and use in cement, concrete, wallboard, highway base layers and other applications. In the United States, approximately 44 percent (or approximately 61 million tons of the 136 million tons produced annually) of all CCRs produced are reused in commercial and engineering applications.

What more can be done?

The key is to test CCRs and to use or dispose of CCRs in contexts that are protective of human health and the environment. Many CCRs can be used safely in a range of applications. Many current disposal conditions are safe. Many also have been identified as being of potential concern. Some disposal and use applications for CCRs also have resulted in adverse environmental impacts. It is important to have a flexible decision structure that guides utilities and environmental regulators to make decisions that are protective and economic. When done safely, use of CCRs in construction applications also reduces the demand for other materials (e.g., Portland cement, fine aggregate) and the environmental consequences of their production and use.

STEVE GREEN

Team members Andrew Garrabrants, David Kosson and Florence Sanchez

How does your work come into this topic?

Vanderbilt School of Engineering's contributions in this area—working in collaboration with our partners—have been the development of robust methodologies for leaching assessment and the characterization of more than 70 CCRs. This provides a detailed understanding of the effects of coal type and facility configuration on those CCR characteristics important to assessing potential environmental impacts. The EPA and Department of Energy have been key sponsors and collaborators. Additional collaborators include The Energy Research Centre of The Netherlands (ECN) and Arcadis Inc. Another contribution is LeachXS, software developed by Vanderbilt, ECN and DHI to facilitate data evaluation from leaching tests and assessment of potential environmental impacts. A simplified version, LeachXS Lite, is being made available through the EPA to facilitate distribution and use of the data developed as part of this program.

For more information, email david.kosson@vanderbilt.edu. *The report,* Characterization of Coal Combustion Residues from Electric Utilities—Leaching and Characterization Data, *EPA-600/R-09/151 (Dec. 2009), authored by D. Kosson, F. Sanchez, P. Kariher, L.H. Turner, R. Delapp and P. Seignette, is available from* www.epa.gov.

Champions for the Pursuit of Dreams

by Brenda Ellis

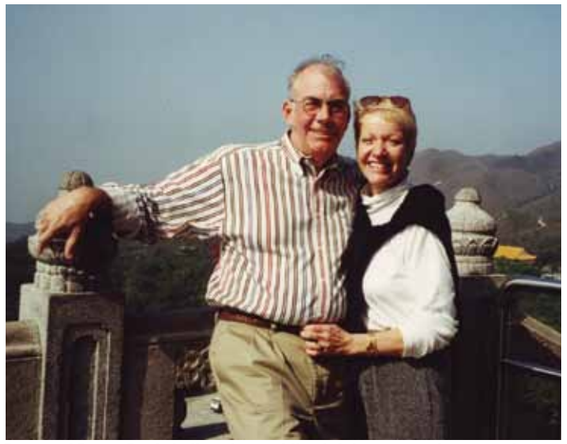
Doug Davis says he felt he was already a rich man when he left the School of Engineering in 1965 with a bachelor's degree in civil engineering and a job at the Mare Island Naval Shipyard near San Francisco, Calif.

"When I graduated from Vanderbilt, I had a wonderful education and no money, but I didn't owe anyone any money," says Davis, BE'65, and now CEO and owner of Atlanta's Diversified Metal Fabricators. "In retrospect, I was very rich."

Davis and his wife, Penny, hope to offer future engineers the same bright start.

"Being debt-free [at graduation] probably wasn't that uncommon then; it is rare today," Davis says, noting his first semester tuition in 1961 was $350. Today, a semester's tuition is more than 50 times that amount.

The Davises have long supported the School of Engineering through its building fund and with endowed scholarships. In 2005 they set up the Doug and Penny Davis Scholarship for engineering students, adding to it each year, and are now participating in the university's campaign to raise funds for students through the Opportunity Vanderbilt initiative. Strong proponents for education, the Davises support the university's recent move to replace all need-based undergraduate student loans with scholarships and grant assistance through the expanded financial aid program.



Doug and Penny Davis believe in providing bright starts to future engineers.

> "When I graduated from Vanderbilt, I had a wonderful education and no money, but I didn't owe anyone any money. In retrospect, I was very rich."
>
> —Doug Davis

"Today, tuition has a serious impact on most families' budgets as well as leaving graduates in debt up to their eyeballs," Davis says. "They have to spend the next 10 years not pursuing dreams but paying off debt."

Diverse Dreams

Pursuing dreams after graduation led Davis first to California where he was part of a team of project engineers that designed Trieste III, the third generation of the bathyscape (two-person "deep boat") Trieste, which reached a record-breaking depth of some seven miles in the Pacific Ocean's Mariana Trench. His team also designed the Deep Submersible Rescue Vehicle to conduct rescue missions for sunken submarines.

He then moved to Florida and opened a gourmet restaurant. Two years later, he moved to Atlanta to work for Bankhead Enterprises, at the time the largest manufacturer of car haulers in the United States. In 1978 he founded Diversified Metal Fabricators, which has become the leading manufacturer and supplier of high-rail equipment used in building and maintaining railroads. Davis now is semiretired and the couple divides their time between Georgia and Florida.

Davis Scholars

Davis strongly believes that he wouldn't have had those opportunities or his diverse career without the School of Engineering. The students benefiting from Davis' support feel the same way.

Senior Randy Lee Smith says his Davis scholarship "means the world to me." The mechanical engineering major fell in love with both Nashville and Vanderbilt during a campus visit and knew he wanted to learn here. "The Davises' generous donation has enabled me, and several others, to attend Vanderbilt's School of Engineering," he says. He was able to tell them of his appreciation when he met the couple during a campus visit in 2008. "They are extremely courteous and genuine," he says. "We've kept in touch and I look forward to meeting them again soon."

Twins and first-year engineering students Alec and Taylor Coston say their parents frequently reminded them of the burden of student loans as the two began their school searches. "I know that without help, my parents would not be able to afford to send us both to school at Vanderbilt," Taylor says. His brother agrees. "Vanderbilt would have been a very slim possibility without financial aid," Alec says. When the Costons received Davis scholarships through Opportunity Vanderbilt, Alec says they were overjoyed.

The Costons like problem solving, the elegance of math and the ideas behind concepts. The Atlanta natives say they were drawn to Vanderbilt engineering because they'll get a great engineering education and exposure to strong liberal arts programs. Being well-rounded students, Davis notes, is the Vanderbilt experience, and one he thinks is unique.

"The World Will Be a Better Place"

"It's difficult to convey to an outsider the sense of it," he says. "One convert is Penny, who has become a cheerleader for the School of Engineering and for Vanderbilt. She always encouraged my support of the university, but a Vanderbilt event a few years ago made a huge impression on her."

Recalling the occasion, Penny Davis concurs. "A group of freshman engineering students just blew me away," she says. "I could imagine these students after four years at Vanderbilt. The world will be a better place. I'm Vandy through and through."

A former teacher, Penny matches her husband's commitment to education. She says that although their two sons and daughter didn't attend Vanderbilt, she hopes all five grandchildren will.

The Davises aren't sitting back, waiting for the time their grandchildren are here, however. They're involved with their students right now.

"I hope these students will leave Vanderbilt after four years, with diplomas in hand, as rich as I was in 1965," Davis says.

A Changed Life

Alumna Fran Presley overcame hardship and heartache to be an engineer

by Fiona Soltes

Back when Fran Schwaiger Presley, BS'79, was a small-town Alabama girl, a full scholarship to the Vanderbilt University School of Engineering did more than crack a door to opportunity—it threw open the gates of resoluteness.

"Everyone has a story," Presley says easily. But most stories don't begin with a highly unsupportive parent, a time of sleeping in the car, and a traumatic freshman year that led Presley to drop out and then beg her way back. Even if they do, they don't usually end with the kind of success that has allowed Presley to bring it full circle, bequeathing a multimillion dollar scholarship to the school that gave her a start.

"I love the fact that people think I'm that amazing," says Presley, a longtime project engineer with FedEx Express nearing retirement. "I just did what I felt like I had to do."

KERRY DAHLEN

Fran Presley, BS'79, near her home on Alki Beach in West Seattle.

Packing In the Middle of the Night

Presley's construction-worker father never made more than $100 a week. Her mother suffered heart problems and a stroke that left her paralyzed and insecure. Fran's older sister was mentally unstable and eventually committed suicide. Presley knew that there had to be more.

"I loved school, and I knew I could do a lot," she says. A guidance counselor agreed. The counselor introduced the teen to the idea of the Vanderbilt School of Engineering. News of a scholarship thrilled Fran's father, who had already offered everything he could: $200 a year toward the then-$5,000 tuition. Fran's mother, however, presented her daughter with a choice: She could go away to college or she could be part of the family.

"At the time, I was devastated," Presley admits. "She thought I was being highfalutin, that I was denying my humble beginnings. But I was going. I had to pack in the middle of the night. Looking back, I have no idea where I found that strength, courage and persistence at 17, but it was there."

The challenges were far from over. Unable to afford the $50 dorm fee, Presley was placed in a communal lounge with five other students and no privacy.

She discovered a love for engineering almost immediately—she had originally planned on computer science—and that major led her to a work/study position in the dean's office. Pressure continued from home, however, and she cried daily. Fran's 8-year-old sister thought she abandoned her by going away to college. Her mother told her not to call or come home for the holidays because she didn't want to be reminded of Presley's existence. It was too much. By the end of her first year, Presley headed back to Alabama to try to work things out.

Though Presley's mother preferred her daughter work at a local bank, she allowed Presley to continue courses at a nearby school. Then, at some point during the first semester of her sophomore year, Presley says, revelation struck.

"If there is such a thing as a higher power telling you something, that's what happened," she says. "And it told me, 'This is your life. You've got to live it.'"

> "I always felt like if I could go to Vanderbilt and do what I did there, I could handle anything."
>
> —Fran Presley

The Defining Point

At VUSE, Presley had found allies in Assistant Dean Roger Webb and Registrar Eleanor T. (Totty) Hughes, both of whom knew she had major family issues; they had wished her well as she headed home, but secretly hoped she would return.

When Presley called Webb that day, he was ready. She confessed she had made a mistake. Webb, in turn, admitted that the school had held her enrollment open. But there was a catch: She'd missed a semester, so the scholarship money would now only cover three and a half years total.

"I said, 'I'll be there tomorrow.' I never looked back. It was a defining point in my life," she says.

Lacking money for a hotel, Presley camped in her car in Centennial Park until the dorms opened. Thanks to heavy class loads and summer school, she graduated on time summa cum laude with a degree in engineering science. Her dad came to Commencement; her mother did not. Hughes stood in for her at the ceremonies. Presley says she and her mother made peace before her mother's death in 1996, but even so, Presley was in her 30s before thoughts of her didn't bring tears.

Giving Back

Presley worked for several companies before landing at FedEx more than 27 years ago. When she arrived for her interview, she asked to speak to another female engineer at the company and was told there wasn't one. It wasn't the first time; a previous job positioned her as the only woman working with 100 tradesmen.

"But I always felt like if I could go to Vanderbilt and do what I did there, I could handle anything," says Presley, whose job in Seattle entails staffing, logistics planning and more.

Upon graduation in 1979, Fran Schwaiger Presley received the Engineering Science award from Howard Hartman, dean of the School of Engineering. Registrar Eleanor T. (Totty) Hughes (in background at left) filled in for Presley's mother during Commencement activities.

It's that attitude that has endeared her to the current administration of the School of Engineering. Two years ago, Presley contacted the school about giving back. David Bass, associate dean for development and alumni relations, was thrilled to hear of Presley's intent. Her easy manner—and her penchant for Harley-Davidsons—told him from the start it would be a nontraditional interaction. Bass helped her work out the details of a scholarship for needy students, preferably a young woman from Presley's high school.

Dean Kenneth F. Galloway points out that today, 30 percent of the students in the School of Engineering are female—a far cry from when Presley attended in the 1970s. "That's much higher than the national average," Galloway says. "We're very committed to that, and this helps us offer assistance to those female students who want to be a part of what we do."

Presley, in the meantime, remembers when $5,000 for a year of school seemed an incomprehensible amount.

"But now I realize I can send several people," she says. "I don't even know what to say, other than things do come full circle. Vanderbilt took a chance on me. Who was I? It's time for others to have a chance, too."

Celebrating Alumni

and the Impact of the School of Engineering

PHOTOS BY ZACH GOOYEAR PHOTOGRAPHY

More than 250 alumni, parents and friends turned out for the 2009 Engineering Celebration Dinner in October to commemorate the life-long impact of a Vanderbilt engineering education. Many of the attendees were Fred J. Lewis Society Members or alumni returning to campus for Reunion Weekend.

Alumni in attendance covered a span of more than six decades (from 1941 to 2008), represented 12 reunion classes, and traveled from 22 states and as far away as Singapore.

The event was hosted by Dean Kenneth F. Galloway and the Engineering Alumni Council. It was a celebration of all engineering alumni, but particularly of Lewis Society donors (those who donate $1,000 or more each year to VUSE) and members of the Vanderbilt University School of Engineering Academy of Distinguished Alumni.

Highlighting the evening was Dean Galloway's presentation of the Distinguished Alumnus Award to three accomplished graduates of the School of Engineering: Carl E. Adams Jr., BE'65, MS'66; Charles E. Fields Jr., BE'68; and George E. Cook, BE'60, PhD'65, professor of electrical engineering, emeritus. As recipients of this award, all three became members of the school's Academy of Distinguished Alumni.

Dean Galloway also surprised alumnus Ed Clark, BE'76, with a Dean's Outstanding Service Award. Clark joined the school's Committee of Visitors in 1997 and went on to serve as chair of the group. He stepped down from that role in October 2009 after serving as chair for eight years.

At the dinner, guests connected with former classmates and professors. They also interacted with current engineering students, including several scholarship recipients.

For more information on the dinner and awards, or to become a member of the Fred J. Lewis Society, contact the Engineering Development and Alumni Relations office at (615) 322-4934.

To nominate alumni for the Distinguished Alumnus/a Award, visit *http://snipurl.com/vuengform*.

Above, from top: Dean Galloway presents the outstanding service award to Ed Clark, BE'76, former chair of the school's Committee of Visitors. **Second:** Father and son alumni Tom Walters, BE'76, and Matt Walters, BE'08. **Third:** Jane and Bill Coble, BE'55, with their scholarship recipient, junior Ashley Bekerman. **Fourth:** Carolyn and Bill Featheringill, BE'64, distinguished alumnus and member of the Vanderbilt Board of Trust.

Academy of Distinguished Alumni 2009 Members

Carl E. Adams Jr., BE'65, MS'66

Considered one of the leading international experts in industrial wastewater management, Carl Adams is a principal at Environ, an environmental consulting firm. Adams has consulted on more than 900 U.S. and foreign industrial wastewater management projects, authored more than 100 technical publications and presentations, and co-authored and edited four books and several engineering manuals. He earned his bachelor's degree in civil engineering and his master's in environmental/water resource engineering. He later received his doctorate from the University of Texas, Austin, which has also honored him as a distinguished alumnus.

Above: Carl Adams (center) is congratulated by family and Distinguished Professor of Environmental and Water Resources Engineering Frank Parker and Elaine Parker.

George E. Cook, BE'60, PhD'65

George Cook has had a long career with the School of Engineering. He currently serves as the associate dean for research and graduate studies and professor of electrical engineering, emeritus. Cook focused his teaching and research on robotics and industrial automation, and his work has resulted in a number of U.S. and foreign patents on robotic welding. Cook is a registered professional engineer in the states of Tennessee, Kentucky, Alabama and Wisconsin. He is also a fellow of the Institute of Electrical and Electronic Engineers and of the American Welding Society. He was a member of the Engineering Alumni Council from 1990-1997.

Above: Mary Cook and Dean Galloway flank George Cook after his induction.

Charles E. Fields Jr., BE'68

Charles Fields is a retired executive vice president of ExxonMobil Development Co. After receiving his bachelor's degree in chemical engineering, he joined Exxon Co. USA in 1968 and rose through the ranks. In his 38 years with ExxonMobil—now recognized as the No.1 company on the *Forbes* 500 list—he held a variety of leadership positions both internationally and in the U.S. At ExxonMobil, Fields was a dedicated advocate of the Vanderbilt School of Engineering, and he remains a strong promoter of engineering education at Vanderbilt.

Above: Friends and family join Charles Fields (second from left) at the induction ceremonies.

VANDERBILT
SCHOOL OF ENGINEERING

PMB 407703
2301 Vanderbilt Place
Nashville, TN 37240-7703

Nonprofit Org.
U. S. Postage
PAID
Nashville, TN
Permit No. 1460

A Look Back

Engineering students get to do all the cool stuff

In 1960, the School of Engineering installed its own subcritical atomic reactor, which was capable of producing a reaction that emitted actual radiation. Located in the mechanical engineering laboratory, the reactor was equipped with 5,500 pounds of uranium and used for courses in nuclear engineering. The funding for the reactor was provided by a grant from the Atomic Energy Commission.

In charge of the reactor was John H. Dunlap, BE'53, MS'56 (second from left), now professor of nuclear engineering, emeritus. We don't have the identities of all the students pictured with the reactor. Do you? If you can provide further information, email *engineering.magazine@vanderbilt.edu.*

PHOTO BY HANSON CARROLL. COURTESY OF VANDERBILT UNIVERSITY SPECIAL COLLECTIONS AND UNIVERSITY ARCHIVES.