Taking Flight

The rewards of risky research

Health Care Engineer
A senior’s journey to GE

Space Man
Our NASA alumnus

Judo Teacher
One professor’s athletic past
From Dan’s Desk

There is great demand among students for the education we offer in Purdue’s School of Mechanical Engineering (ME). For the 2009-10 academic year our undergraduate enrollment (sophomore-senior) is at nearly 1,000, and we have more than 450 graduate students. The former is a record enrollment since the post World War II era, and the latter is, in fact, an all-time high.

Looking back, we see a decade-long trend in the growth of our ME student body. One reason for the demand of our program is the continued broadening of career opportunities for MEs, which is also consistent with the new directions in education and research by our faculty. The versatility of an ME degree is exemplified by the industries hiring our BSMEs in recent years. These industries include aerospace/defense, automotive, chemical/petroleum, computers/electronics, construction, consumer/food products, energy/nuclear, engineering and public policy, engineering consulting, government agency/lab, heavy/off-road equipment, management consulting, medicine/health care, and military. In addition, there are about 10 percent of our graduates that enter a field not captured in one of the aforementioned categories.

We also know through the excellent work you and your classmates have done over the years that a Purdue ME degree is respected and valued worldwide. While all of our students must achieve a high GPA their freshman year, we are increasingly emphasizing leadership, global perspective, innovation, and entrepreneurship as differentiating characteristics of our students and our program.

This may sound as if we have all the students we need, but there still remains a need to keep our pipeline filled with future scholars, particularly females and underrepresented minorities. Many alumni have asked how they can help recruit more students into the ME program and/or become more engaged with the school. We are working with one of our student organizations, the Purdue Mechanical Engineering Ambassadors (PMEA), to develop “ME in a Box.” This program will have interactive components and experiments alongside a lesson plan for teachers in K-12 schools or coordinators working with youth organizations to cultivate interest in mechanical engineering at a young age.

We have also heard from several businesses that they are planning to reduce the number of face-to-face interviews they conduct and do more of their preliminary screenings for internships, co-ops, and even jobs from student resumes and telephone interviews. This may present an opportunity for students to mail or e-mail a resume to an interested alumnus for a critique or even conduct a mock interview.

If you are interested in participating in either of these programs, please let us know. You can drop us a note or contact Cynthia Dalton at (765) 494-7320 or via e-mail cdalton@purdue.edu.

Thank you for your continued support, and if you are in the area please stop by for a visit.

E. Dan Hirleman
William E. and Florence E. Perry Head School of Mechanical Engineering

Tell Us What You Think
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Cooler Cars, Less Pollution, and More Thrills in the Classroom

Research and teaching breakthroughs keep ME in the headlines

**Doctoral student Tannaz Harirchian holds up special chips provided by Delphi Electronics and Safety that she and Professor Suresh Garimella used to simulate what happens in a real chip. (Purdue News Service photo/Andrew Hancock.)**

**Advanced engine-control system reduces biodiesel fuel consumption and emissions**

Researchers from Purdue and Cummins Inc. have developed an advanced “closed-loop control” approach for preventing diesel engines from emitting greater amounts of smog-causing nitrogen oxides when running on biodiesel fuels.

Operating truck engines on a blend of biodiesel and ordinary diesel fuel dramatically reduces the emission of particulate matter, or soot. However, the most modern and efficient diesel engines burning biodiesel emit up to 40 percent more nitrogen oxides at some operating conditions, and fuel economy declines by as much as 20 percent.

Unlike conventional diesel, biodiesel contains oxygen, and the researchers have shown that this presence of oxygen is responsible for the majority of the higher emission of nitrogen oxides, says Gregory Shaver, assistant professor of mechanical engineering and a member of Purdue’s Energy Center in Discovery Park.

Another key factor is a recent innovation called exhaust gas recirculation, which reroutes exhaust back into the engine cylinders to reduce emissions. The researchers found

**New findings could help hybrid, electric cars keep their cool**

Understanding precisely how fluid boils in tiny “microchannels” has led to formulas and models that will help engineers design systems to cool high-power electronics in electric and hybrid cars, aircraft, computers, and other devices.

Allowing a liquid to boil in cooling systems dramatically increases how much heat can be removed, compared to simply heating a liquid to below its boiling point, says Suresh Garimella, the R. Eugene and Susie E. Goodson Distinguished Professor of Mechanical Engineering.

However, boiling occurs differently in tiny channels than it does in ordinary-size tubing used in conventional cooling systems.

**Gregory Shaver (left), assistant professor of mechanical engineering, and graduate student David Snyder discuss how to modify a commercial diesel engine with a new technique that promises to reduce emissions of nitrogen oxides for engines running on biodiesel. (Purdue News Service file photo.)**
that nitrogen oxide emissions rise by a higher percentage in engines equipped with this exhaust-recirculation technology compared with older engines that do not. However, the newer engines still emit less nitrogen oxides than the older engines.

The research addresses the need to reduce nitrogen oxide emissions and fuel consumption. Researchers at the Ray W. Herrick Laboratories used a Cummins 6.7-liter, six-cylinder diesel engine, a popular power plant found in Dodge Ram pickup trucks.

“We were able to improve the fuel economy with a biodiesel blend while reducing nitrogen oxides to where they were with conventional diesel,” Shaver says. “At the same time, we were able to maintain the customary biodiesel reductions in particulate matter emissions compared to ordinary diesel fuel while not increasing noise emissions.”

Students get engineering thrills in roller-coaster design course

Purdue mechanical engineering students taking a new roller-coaster design course have discovered that fun, real-world applications make solving difficult engineering problems more interesting.

“What we found was that if you show students the fun engineering applications of physics, all of a sudden learning the fundamentals becomes more enjoyable,” says Jeffrey Rhoads, assistant professor of mechanical engineering.

He and mechanical engineering professor Charles Krousgrill, who together started the roller-coaster dynamics course last year, say the approach draws in students who ordinarily might be turned off to engineering.

“It’s like we’ve tapped a passion early in their academic careers using a non-traditional teaching approach to get them into the engineering mindset quicker,” Krousgrill says. “So you might be able to break through to students who may not thrive under traditional methods.”

The 11 student teams in the course presented their roller-coaster designs in December, showing true-to-life animations that demonstrated their creations in action.

Emile Venere, Purdue University News Service

For these complete stories from the Purdue News Service, along with other spotlights, please visit the mechanical engineering homepage at www.engineering.purdue.edu/ME.
Faculty Accolades

Two Named
In December, trustees approved the appointment of Anil Bajaj as the Alpha P. Jamison Professor of Engineering and Suresh Garimella as the R. Eugene and Susie E. Goodson Distinguished Professor of Mechanical Engineering.

Three Awarded
E. Daniel Hirleman, the William E. and Florence E. Perry Head and Professor of Mechanical Engineering, received the Charles Russ Richards Memorial Award, presented annually by Pi Tau Sigma and the American Society of Mechanical Engineers (ASME) to one engineering graduate who has demonstrated outstanding achievement in mechanical engineering 20 years or more following graduation.

In January, Eckhard Groll received the E. K. Campbell Award from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). This award is made, not more than once a year, to someone who is or has been a full-time educator in recognition of outstanding service and achievement in teaching and/or research in subjects relating to the industry and professions represented by the ASHRAE.

Karthik Ramani received the 2009 Outstanding Commercialization Award for Purdue Faculty. The Outstanding Commercialization Award is given to a Purdue tenure-track faculty member in recognition of outstanding contributions to and success with commercialization of Purdue research discoveries.

Risk Management
How we’re responsibly taking chances in Mechanical Engineering

Emerson E. White, third president of Purdue, took a risk when he established the School of Mechanical Engineering in 1882. Engineering education was only a generation removed from the blacksmith’s shop and had not defined its position in academia. Additionally, he established stringent admission requirements. To those who decried Purdue’s rigorous standard and consequent low enrollments, White replied, “It is high time that there should be public recognition of the fact that the success of Purdue University is to be determined, not by the number of students it matriculates, but by the number of students taking its industrial and science courses, and especially by the character of work done in those directions.”

Dean A.A. Potter and President Frederick Hovde further exemplified responsible risk-taking by recognizing the potential of the field of jet propulsion and hiring Maurice J. Zucrow (the recipient of Purdue’s first Ph.D. degree) to establish a course in graduate instruction coupled with a supporting fundamental research program. Today, faculty researchers in the Maurice J. Zucrow Laboratories are nationally recognized for their work in propulsion, combustion, turbomachinery, fluid dynamics, and gas dynamics.
From railroad testing on the Schenectady to the smart parts associated with the latest in windmill technology, researchers from the School of Mechanical Engineering have long worked on the cutting edge.

Zucrow now boasts world-class laboratories, research expenditures have gone up eight times in 10 years, and the research demands are pushing the capacity of the faculty and facilities.

In the 1950s, Professor William E. Fontaine established a graduate student thesis-oriented laboratory funded by industry for students to work on industry projects. Ray W. Herrick (principal owner of Tecumseh Products Co.) provided a grant to Purdue to establish the Ray W. Herrick Laboratories. Early research at Herrick produced results in compressor engineering and heat transfer for the refrigeration and air conditioning fields. Research on engineering mechanics, acoustics, and controls followed, and the new Herrick Labs will include a “living laboratory” as part of its sustainable buildings research.

New research labs in nanotechnology, biomedical engineering, and biosciences involve risk for our school in that they impact our faculty and our curriculum — the risks that have the most serious consequences to the school. Poor curriculum changes can profoundly affect our students (and school reputation), and faculty hires impact our students, research, funding, national rankings, and charitable giving.

To manage the curriculum, we survey our students two and four years following graduation, seek input from our advisory committee, and talk to corporate representatives throughout the year. As a result, we’ve added global engineering experiences, innovation focus and awards, and built flexibility into the curriculum so students can minor in many areas including nuclear, management, economics, physics, global engineering, biology, entrepreneurship, political science, math, and computer science.

We take the responsibility, and risk, for faculty hires very seriously since they require substantial investment and have a broad and long-lasting impact. It can cost hundreds of thousands of dollars to equip a new research facility, while taking a year or longer before attracting graduate students and funded research. Since the value of a research institution is a function of the discovery of new knowledge and the quality of the learning experience, the faculty hires literally make or break the institution.

During my tenure as head of the school, we’ve hired 36 faculty members and have “bet” on their ability to advance knowledge in areas that include, but certainly are not limited to, cooling technologies, fluid mechanics and propulsion, structural health monitoring, robotics, spinal cord injury and traumatic brain injury, multiphase combustion, and innovative approaches to teaching. Between our earlier publication, Memo, and this more recent Impact magazine, we’ve featured the work of 20 of the “new” faculty. In this issue, you are introduced to the work of three more outstanding MEs that have joined our faculty in recent years. We believe that our system for advancing the program is working very well. I hope you agree.

E. Daniel Hirleman, the William E. and Florence E. Perry Head of School Mechanical Engineering

in my view
If necessity is the mother of invention, we can see how the must-have mechanical engineering innovations throughout history have helped propel us farther, and further, as humans. Schoolchildren need only to Google steam engines to learn of the power of steam in revolutionizing ship and train travel, along with helping spawn the Industrial Revolution. Pull some frozen corn from your icebox or lounge comfortably warm on the coldest winter night and you can thank some mechanical engineer who helped advance heating and cooling technologies along the way. If you’re partial to Purdue history, you could trace the success of the Schenectady locomotive testing hub as it helped pave the way for space travel in the rocket propulsion labs now named for one of Mechanical Engineering’s pioneers — Maurice J. Zucrow.

And while high-powered planes, trains, and automobiles will remain vital research components in the School of Mechanical Engineering, today’s innovators are working on the cutting edges of nanotechnology, health sciences, alternative energies, and much more. Many of our faculty, researchers, and students are looking at long-range impact. They’re taking the time — not so much for the character enhancements of trial and error — but for the discovery leeway that could lead to the engineering breakthroughs that we may simply marvel at a decade or two from now.

Imagine a mechanical engineer in collaboration with health care practitioners to ease significantly the pain of cancer patients. Or how another, closely studying fish, birds, and insects, could create life-saving machines that can swim and fly to the rescue. Or even how the ultimate frontier can be made more reachable through a research group’s development of environmentally friendly propellants. This isn’t the stuff of the year 3000. It’s part of the everyday study and research within ME today.
Crossing disciplines

For some researchers trained to be experts in a particular field, there may be some risk in straying too far from one’s comfort zone. But in spite of his background in fluid mechanics, heat transfer, and more conventional mechanical engineering, Bumsoo Han is now flexing his mental muscles in trying to solve biomedical engineering problems. An assistant professor of mechanical engineering, Han is looking at two main applications in cancer therapy and tissue engineering.

Throughout his postdoctoral days, Han was looking for ways to expand his research in a way that would make the most of a 20- to 30-year career. That’s when he began walking across campus — then at the University of Minnesota — to begin collaborating with medical doctors.

“In solving biomedical engineering problems, you typically take a more qualitative approach than the quantitative approach that mechanical engineers are used to,” Han says. “My first main challenge was going to a lab where both backgrounds are necessary.”

Now he’s applying the heat and mass transfer principles to cancer therapy and tissue engineering. “We’re looking to destroy the tumor by using excessive heat or cold,” says Han who earned a National Science Foundation Faculty Early Career Development (CAREER) award for his research. “You burn the damaged tissue, while controlling the heat transfer so as not to harm the surrounding normal tissue.”

Han is also looking at mass transfer issues in drug delivery systems like chemotherapy. In another project, he’s learning how to better freeze tissues that could be used in transplantation surgeries. Working alongside biochemists, the research group is one of the first to approach the challenge from an engineering perspective.

“Harvested organs need to be stored at a certain temperature,” he says. “Extending that time period for organs could have a huge impact.”

Whether he’s making a risky career move, or simply using an unorthodox approach, Han is aware of the potential pitfalls of crossing disciplines. “You may do the work but no one will appreciate it,” he says.

The goal of the “responsible risk-taking,” however, he says, “is communicating with the right people who will appreciate your work. It’s being aware of the common problem and knowing how engineers can contribute to it.”

And for at least this researcher who’s turning his mechanical engineering mind toward health matters, the rewards outweigh the risk.

continued on next page
Robotic animals
Most of us have seen the slow-motion videos of hummingbirds sipping nectar from a flower. You may have even heard statistics about the number of times they flap their tiny wings. Xinyan Deng, assistant professor of mechanical engineering, is making a unique career of studying winged and finned creatures in great detail. Collaborating with biologists, Deng is trying to mimic those animals in the machines she’s building.

“We study animal motion to see if they have some inherent stability that makes them so maneuverable,” says Deng who also won a CAREER award while at the University of Delaware. “Then we try to extract those principles and end up with models. From there we try to build manmade vehicles that mimic the animals.”

Among her prototypes are machine versions of dragonflies and hummingbirds. The next step in the research is to control the hovering in these animal-like machines by generating enough lift to sustain the weight from a pair of fast-flapping wings. Deng uses mathematical modeling to predict how fast the animals turn, with a keen eye on creatures ranging from fruit bat to hawk moth, to flies, honeybees, and fruit flies. She uses scaled robotic wings in experimental fluid dynamics tests to study their unconventional aerodynamics. Looking to animals to learn about hovering capability and maneuverability, Deng is setting up a small wind tunnel in Zucrow Labs to study the flight of several insect species and their response to wind gusts.

With her background in controls and robotics, Deng has enjoyed working closely with biologists since her graduate studies at University of California, Berkeley. These interdisciplinary studies not only have produced fruitful scientific discoveries in biology, but also are providing guidelines for building next-generation, bio-inspired machines.

As with flying animals, Deng discovered fish to be a good underwater vehicle model for their maneuverability and efficiency when compared with conventional, manmade machines with propellers. One interesting fish in particular, the boxfish, which looks to be a very clumsy swimmer, proved to be a motivator for her.

“Boxfish live in shallow and very turbulent waters,” Deng says. “But they can swim very well from one point to another in almost a straight line because they keep on generating counter-rotating vortices to keep their bodies stable.”

Deng’s subsequent robotic fish mimics the boxfish, navigating sharp corners with ease and plowing through rough waters. Such a robot could prove useful in search and rescue missions, as a marine sensing microorganism, or even exploring shipwrecks.
As she begins to put together her research space in Zucrow Labs, Professor Xinyan Deng, shown above with Liang Zhao, a PhD student in mechanical engineering, will place test her robotic wings in a tank filled with oil. With the use of lasers and high-speed photography, Deng’s team can better adapt her prototypes for maneuverability.

ALICE in space

Another researcher in Zucrow Labs, Steven Son, associate professor of mechanical engineering, is leading a group in space travel innovations. The researchers are developing a new type of rocket propellant made of a frozen mixture of water and nanoscale aluminum powder that is more environmentally friendly than conventional propellants. Their concoction could also be manufactured on the moon, Mars, and other water-bearing bodies.

The aluminum-ice, or ALICE, propellant might be used to launch rockets into orbit and for long-distance space missions and also to generate hydrogen for fuel cells, says Son, who also has a courtesy appointment in aeronautics and astronautics.

The Purdue team is working with NASA, the Air Force Office of Scientific Research, and Penn State University to develop ALICE, which was used last year to launch a 9-foot-tall rocket. The vehicle reached an altitude of 1,300 feet over Purdue’s Scholer farms, about 10 miles from campus.

“It’s a proof of concept,” says Son. “It could be improved and turned into a practical propellant. Theoretically, it also could be manufactured in distant places like the moon or Mars instead of being transported at high cost.”

Findings from spacecraft indicate the presence of water on Mars and the moon, and water may exist on asteroids, other moons, and bodies in space, Son says.

Considered a green propellant, producing essentially hydrogen gas and aluminum oxide, ALICE provides thrust through a chemical reaction between water and aluminum. As the latter ignites, water molecules provide oxygen and hydrogen to fuel the combustion until all of the powder is burned.

In addition to the possibility of an environmentally friendly blastoff into outer space, the research, Son points out, is helping train a new generation of engineers to work in academia and industry, as well as for NASA and the military. More than a dozen undergraduate and graduate students have worked on the project.

“It’s unusual for students to get this kind of advanced and thorough training — to go from a basic-science concept all the way to a flying vehicle that is ground tested and launched,” Son says.

“This is the whole spectrum.”

From an education and research perspective, that whole spectrum continues to distinguish Purdue’s School of Mechanical Engineering. And from biomedical breakthroughs to new firsts in manmade flights, the responsible risks taken today could be those milestone markers of tomorrow.
Patricia Davies works in a big, red brick barn — the old building housing the Ray W. Herrick Laboratories. But despite its vintage, Herrick Labs was and is cutting-edge. “Herrick was ahead of its time because it started as an interdisciplinary collaboration when it wasn’t fashionable to do so,” says Davies, who, as its director and a professor of mechanical engineering, continues the longstanding tradition of academic cross-pollination and cooperation.

In 2008 Herrick Labs marked a half-century of discovery. Looking back at its history, Davies recounts that the first experiments were conducted by two diverse teams of experts. Researchers from the departments of animal sciences and mechanical engineering put their heads together to study the impact of variations in climate on domestic animals (would refrigerating the henhouse help chickens lay more eggs?).

The heritage of the lab seems to be this idea of joint academic pursuit. “Nobody ‘owns’ space in the lab,” Davies explains. “We all work together. It’s always been very collegial.”

Also like the historic work of the lab, much of Davies’ current research focuses on how environment affects subjects. Davies studies how sound gets into buildings and how that noise affects people. “What is a productive, healthy work environment?” she asks.

To get at the heart of these issues, Davies is part of a new interdisciplinary group of scientists from mechanical engineering; psychology; and speech, language, and hearing sciences. The group, which organizes itself around various projects, falls under an area known as “perception-based engineering.” They even put the concept in the classroom as “Perception-Based Engineering” offered to both psychology and mechanical engineering students. Davies reports the class enjoyed good enrollment and might become a permanent part of the engineering and psychology curriculum.

Herrick Labs will soon bust out of the horse barn and expand into a new building. Purdue will break ground in late 2010 on phase 1 of the Herrick Laboratory Replacement project. The building, to be completed in 2012, will include Living Laboratory office space; vibration, electromechanical and thermal systems laboratories; and equipment to test alternative fuels and power generation. The building will be the third Purdue facility to seek LEED (Leadership in Energy and Environmental Design) certification from the U.S. Green Building Council.

The work at Herrick Labs has always represented a fruitful partnership between research, education, and industry. “All of our research has synergy with industry needs,” Davies says. “For example, new concepts using theoretical modeling and advanced experimental techniques developed at the laboratories continue to have a great impact on the design of cars and trucks and equipment used in heating, ventilating, air conditioning, refrigeration, and other systems.”

And as technology gets more and more advanced and integrated into the daily lives of people, Davies sees a special need for engineers to “take a broader view, to understand how people interact with machines.” She thinks it’s important to design machines and technology to enhance people’s lives.

The challenges related to energy and the environment are poised to be the most crucial ones for mechanical engineering to tackle, says Davies. She cautions that sometimes a solution can cause even greater problems, giving the example of a machine designed for optimal energy efficiency that generates so much noise it negatively affects people. “I think we are becoming more cognizant of the fact that we need to take a holistic view of a problem,” she says.

For Davies, the best part about her job at Herrick Labs is creating an environment that can have a positive impact on her students. “They come in, and they learn a lot while they are here,” she says. “Enabling the success of other people and seeing them grow is wonderful.”

Professor Patricia Davies works with students from Purdue’s Summer Undergraduate Research Fellowships program. (Photo by Vincent Walter.)
Finding the Right Fit
One ME senior’s rewardingly indirect path to her future

Demi Hutchinson’s career aspirations began close to home. Her father was diagnosed with multiple sclerosis when she was in junior high, and that inspired her to pursue the medical profession. That was until she encountered the specifics of becoming a doctor. “Too much blood and guts,” Hutchinson says. “I quickly realized that practicing medicine wasn’t for me, so I began exploring my options in related fields.”

First came biomedical engineering. “That worked well for the first semester, when I really got into chemistry,” she says. “And while I loved thinking about the chemical side of things, I didn’t love the memorization required to get out of those second-semester courses, so I decided to move on.”

She then decided to pursue mechanical engineering because of its broad spectrum of offerings. And the fact that Engineering Projects in Community Service (EPICS) — and her work with a local school system’s technical team — required mechanical engineering knowledge spurred her on further.

“My main goal, ever since junior high, was to work to make people’s lives better,” she says. “So through EPICS I assisted in making a technical device for a junior high student who had very limited physical and mental capabilities. We created an environment for him where he could be appropriately stimulated through sight, sound, and touch.”

Hutchinson remained in the program for two years, became project leader, and took the project from concepts all the way through implementation. She was beginning to figure out her path.

“That’s when I got really involved in student organizations,” she says. “I became social director for Pi Tau Sigma [the mechanical engineering honor society], became a coordinator for ME ambassadors, and then was elected vice president for Tau Beta Pi [the all-engineering honor society].”

Now into the second half of her Purdue career, Hutchinson began searching for internships to further solidify her ambitions. She found that very opportunity with GE Healthcare.

“I realized what was good at — and what I enjoyed — was working in the quality control side of engineering to ensure people’s needs were met in that way,” Hutchinson says.

First she worked in a lean manufacturing role, eliminating the excess steps it takes to insert X-ray tubes inside diagnostic-imaging equipment to deliver them to customers faster. Then it was on to refining ergonomic projects that made work safer for people on the line.

“I never thought I’d be doing anything in manufacturing,” she says. “I thought I’d be in the lab studying. But once I started and saw how much impact I could have in real time, I knew it was for me.”

And now, after she graduates this spring, she’ll be going back to GE Healthcare for a two-year rotational program in their operations product leadership program, which entails four six-month rotations in four different specializations.

“I’m still keeping my options open,” Hutchinson says, “but I’ve certainly narrowed it down a lot.”

And though it’s been a largely self-directed process, her professors were extremely helpful along the way. “Mechanical Engineering is one of the biggest schools, but there’s never been an instance where I didn’t feel like I could walk up to a professor and ask for help,” she says. “I knew they’d always know who I was, and that was really important on my way through.”  ■ Patrick Kelly
Since its inception in 1991, the Outstanding Mechanical Engineer (OME) award has been given to 195 alumni. The inaugural celebration presented 102 awards, many of them posthumously. In 1992-98, the OMEs were awarded as individual presentations, honoring the winners as their schedules permitted. The annual OME awards banquet, established in 1999, has been held as an event honoring all OMEs at one time. Recipients must have earned a BS, MS, or PhD degree from Purdue’s School of Mechanical Engineering, and 10 years must have passed since the honoree’s first earned degree. Demonstrated excellence in industry, academia, government, and other mechanical engineering fields distinguish these OME winners.

In 2009, the school welcomed six new members to the running list of OMEs. Here, each shares in his or her words, how the School of Mechanical Engineering proved to be great preparation for the road to follow.

“Having a PhD in mechanical engineering from Purdue has provided me with a great deal of career flexibility. I have built an independent research career and have recently become a public servant in a scientific field. Perseverance and the support from many people were essential while pursuing my degree. The mechanical engineering staff, students, and faculty, including my advisor, Professor Jay Gore, contributed support, and I received a lift from the Women in Engineering Graduate Mentoring Program. In the time since I marched across the Elliott stage, I have found connections with hundreds of alumni and alumnae across the country. I appreciate this award from a department and university that will always feel like home.”

Linda G. Blevins, PhD ’96
Senior Technical Advisor
Office of the Deputy Director for Science Programs
U.S. Department of Energy

“The rigorous Purdue engineering program prepared me well for everything I have accomplished since graduation. After Purdue mechanical engineering, law school seemed easy even though I was working full time. As a patent attorney, I prepared and prosecuted patent applications in diverse technical areas that used virtually every area I studied at Purdue. Mechanical engineering prepared me to learn, which I have had to do throughout my career. Although most mechanical engineering students don’t appreciate it while in school, writing is an important skill valuable to every engineer. I was privileged to work with CEOs, engineers, corporate managers, laboratory technicians, professors, entrepreneurs, and many others. I am delighted that Purdue now emphasizes international experiences.”

Ken C. Decker, BSME ’64
Patent Attorney Consultant
"Engineering provides the bridge between the basic laws of science and the production of the goods and services increasingly used around the globe and beyond. Reflecting on my four years of engineering education at Purdue, and in view of my career concentrating on fluid film bearings and seals, it is clear that those Purdue years provided the technical and scientific foundation for my part of that bridge. Those key basics were primarily fluid dynamics and machine design as the basis for creating sound designs and successful products and services. The discipline of satisfactorily completing multiple technical courses each semester provided good examples of the benefits of time and resource management that were carried over to help provide on-the-job success."

Willis W. Gardner, BSME '53
Retired Vice President
Waukesha Bearings Corporation

"A solid technical foundation has been critical to managing the problems of human space flight. This field, in particular, is unforgiving of any leadership that is not thoroughly grounded in engineering. Purdue provided me with a wonderful opportunity to hone those skills that are vital to success in this unforgiving business in which success only comes with perfection."

N. Wayne Hale Jr., MSME '78
Deputy Associate Administrator for Strategic Partnerships
NASA

"I recall walking around campus when I started my PhD at age 23 and wondering if I could succeed at such a prestigious and venerable institution. In other words, I was just plain scared I’d flunk out! To my surprise, the Purdue faculty made the experience fun and helped me graduate in a remarkably short time. I’ve since wondered if those guys hurried me through because they didn’t want me burning up any more lab equipment. A quarter-century later, I’m still pulling out my notes and texts from Purdue days as I lead energy research on everything from fuel cells to plant cells. I could not do it without the foundation I received at Purdue."

George A. Richards, PhD '87
Focus Area Leader, Energy Systems Dynamics
National Energy Technology Laboratory
U.S. Department of Energy

"My Purdue engineering experience has served me well in my business career. Successful businesses are often differentiated by structured processes, continual optimization and redesign, clear cause and effect analysis, and logical solutions to problems. That’s why engineers do well in technical companies. Plus, everybody knows Purdue and recognizes Purdue engineers as very well trained and able to take on challenging situations."

David M. Wathen, BSME '77
President, CEO, and Board of Directors
Trimas Corporation

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David M. Wathen, BSME '77
President, CEO, and Board of Directors
Trimas Corporation
Rocket Man

NASA manager talks about taking risks and aiming high

N. Wayne Hale Jr. (MSME ’78) knows all about taking risks. Joining Johnson Space Center in 1978, he was assigned to mission control and worked console operations for 15 early shuttle flights, principally as propulsion systems officer. In 1985 he was promoted to a supervisor in the Flight Operations Directorate.

Hale was working on January 28, 1986, when the space shuttle Challenger broke apart 73 seconds into its flight, leading to the deaths of its seven crew members. “I worked closely with Dick Scobee, Judy Resnik, Ron McNair, El Onizuka,” Hale recalls. “These were close co-workers. Their loss is still painful to me some 23 years later.”

The disaster affected Hale and his colleagues professionally, too. “Before the Challenger accident, we were naïve about the dangers of space flight or at least about the shuttle. Those of us who were junior in our careers knew that spaceflight was intrinsically dangerous and required careful attention, but we believed that the system was mature enough to protect against a catastrophic failure. Afterward we knew differently. There is no space launch — shuttle, Soyuz, whatever — that does not elicit my complete attention. No launch or landing is ever routine to me anymore.”

Hale was selected as a flight director in 1988 and was responsible for the successful operation of 40 space shuttle missions including 28 launches and 26 landings.

In September 2005 Hale’s trajectory at NASA landed him in the position of program manager for the space shuttle, where he served until February 2008.

Since then, Hale has been developing collaborative partnerships for NASA with other government agencies, commercial firms, academic institutions, and other nations’ space agencies as the deputy associate administrator for strategic partnerships for the space operations mission directorate.

In his new job, Hale looks ahead to the future shape of space exploration. The safety of humans in space continues to occupy his attention. So far, the Russians have taken seven paying “space tourists” up in their Soyuz craft. “We are thinking very hard right now about what it means to launch a commercial spacecraft with a NASA astronaut on board. How do we become comfortable with issuing a certificate of flight readiness?”

The question is pressing because, surprisingly, the Federal Aviation Administration does not require spacecraft to undergo the 1,000 hours of flight testing that regular aircraft must. Risk is accepted as necessary for advancing technology, Hale points out that all players in the nascent commercial space travel industry are aware of the fundamental importance of safety to their success.

“We’d like to have space become a vibrant place for industry,” Hale says. Besides space tourism, he notes the potential value of business in space: performing experiments, generating energy, gathering natural resources (such as tritium, abundant in the lunar soil and, speculatively, useful as fuel for nuclear fusion), and expanding the reach of humanity into the solar system to build outposts and colonies.

All of this development hinges on keeping people safe in space. “There is a general sense that we must strive for perfection in everything we do when humans are involved,” says Hale. “Some would say that makes us risk averse, yet we continue to launch human beings into space, riding on top of 6 million pounds of high explosives, accelerating to speeds some five times faster than a rifle bullet. If we were risk averse, it seems to me, we would never do this.”

Gina Vozenilek
From judo flips to lectures on fluid mechanics, Professor Ashlie Martini, shown below in white throwing a competitor and now in an ME classroom, does well in front of a crowd. (Photo by Vincent Walter.)

**The Gentle Way**

ME professor’s judo past translates to today’s classroom confidence

As she tries to gain a greater fundamental understanding of tribology, the study of things in relative motion, Ashlie Martini may, from time to time, harken back to the moves she made on the mat as a world-class judo athlete. Now an assistant professor of mechanical engineering, Martini says her 12-year devotion to the sport is part of a proud past, but one she’s happy to move on from.

Martini came to judo at a relatively older age — as a 21-year-old fifth year co-op student at Northwestern University. She was looking for something to do, so she joined the Judo Club in Chicago, and it quickly developed into something bigger. After a few years of simply learning the sport, Martini says it nearly took over her life. “It was a huge part of my life throughout my PhD [also earned at Northwestern],” she says.

After running or lifting in the morning, she catered to the demands of a PhD program, before practicing moves on the mat in the evening. “You don’t punch or kick,” explains Martini. “It’s more like wrestling. Judo actually translates to the ‘gentle way.’ So you try to use someone’s force against them. The fundamentals are to use maximum efficiency and minimum effort.”

Martini put forth enough effort to medal at the national championships in six consecutive years, including a gold in 2005. In her final year of competition — the bridge year as she made her way to Purdue — Martini was shooting for the 2008 Olympics. She admits it was one of the toughest years of her life, pushing herself through injuries while focusing on the heady stuff of tribology. Most people at that level are focused solely on the sport.

Though she wouldn’t live out her Olympic dream, Martini credits judo with her ability to teach classes of 60 to 70 students. “I taught a lot of judo the last few years,” she says. “Much of that translated directly to what I’m doing here. Even though I’m not teaching judo, I’m communicating. I’m being confident in front of people.”

William Meiners

From judo flips to lectures on fluid mechanics, Professor Ashlie Martini, shown below in white throwing a competitor and now in an ME classroom, does well in front of a crowd. (Photo by Vincent Walter.)

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**check it out**

William Meiners
A scanning electron microscope picture of nacre, also known as mother-of-pearl, a biomineralized composite that is known for its strength and resilience. The image is from civil engineering’s Computational Multi-Scale Materials Modeling Group, led by Pablo Zavattieri, who also has a courtesy appointment in mechanical engineering. He has paired with David Kisailus, assistant professor of chemical and environmental engineering at the University of California, Riverside, to study the structure-mechanical property relationships of composites in order to develop new materials and structures that will offer a new combination of low weight, high strength/toughness and multifunctionality. The materials could have applications in the auto, energy, shipbuilding and defense industries, as well as widespread use in civil and aerospace engineering.