FROM THE DEAN

In this issue of *Engineering Impact*, we explore the many facets of entrepreneurship and the myriad of ways in which Purdue's Engineering faculty are taking their research from concept to commercialization.

Whether we call it innovation, invention, problem solving, or enterprise, this creative drive forms the heart of academic research. It is also the soul of entrepreneurship.

When astronaut Neil Armstrong (BSAE '55, HDR '70) was on campus last fall to dedicate the engineering home that bears his name, he spoke of his student days and the discovery that engineering deals with "what can be." That phrase—what can be—is the focus of an environment that sparks entrepreneurship in every aspect of what we do.

Purdue is fourth in the nation in new company startups, and much of that initiative comes from Engineering. Of the 235 invention disclosures filed with the Office of Technology Commercialization in 2006, 139 came from Engineering faculty. That count was up greatly from the mere 61 disclosures filed in 2001. The number of annual startups at Purdue rose from one to a peak of 14 in 2006 alone and a total of eight last year.

Entrepreneurship is of increasing importance as the academic world works to confront global challenges. It is, in fact, a point of focus directly in Purdue President France A. Cordova’s next strategic plan, an area that she calls Discovery with Delivery. One of the centerpieces of Engineering’s own strategic planning is Purdue’s Engineer of 2020, which includes a focus on developing students who are innovative, entrepreneurial, and intrapreneurial. As an example of how we are bringing entrepreneurship into the curricula, our Weldon School of Biomedical Engineering is partnering with the Krannert School of Management and the IU School of Medicine to offer a graduate certificate in biomedical entrepreneurship.

In these pages, you can explore the many ways in which the College of Engineering is responding to the rise of entrepreneurship. Researchers across the College share an unbridled enthusiasm for their work that lights a spirit in their students and colleagues. These are people like Alyssa Panitch in bioengineering, whose tissue engineering has brought two startups to life, and Hugh Hillhouse, whose studies in solar cell devices may help solve the world’s energy crisis. You’ll also hear from Keith Krach (BSIE ’79, DEA 2006), founder of Ariba and a cheerleader for innovation.

We hope you come away from this issue with a renewed excitement about the infinite possibilities for what Purdue Engineering Can Be.

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

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I am mystified by the content of your magazine. The thought of a liberal arts degree prior to obtaining the degree of choice is not on my recommended list. What makes engineers great is their ability to think, to analyze, to tell the truth, to do the right thing. Change for the right reason.

Gene Vitale
BSME ’52
**Going Up?**

Elevator pitch prepares Purdue entrepreneurs

**Ding!** The elevator doors close, sealing you and your potential investors in a shiny rectangular box for the next 120 seconds. You have exactly that much time to convince them to invest in your ideas. That’s the concept behind the Elevator Pitch Competition, an annual event at the Burton D. Morgan Center for Entrepreneurship. Hosted by Purdue’s Certificate in Entrepreneurship and Innovation Program, the competition is divided in two divisions: one for certificate program students and another for Purdue Research Park faculty and graduate student entrepreneurs. Project ideas range from innovations in wastewater treatment to biodegradable clay pigeons and Internet privacy programs.

As spring semester drew to an end, four engineering students talked about their elevator pitch experiences.

**What was the greatest challenge in preparing an elevator pitch?**

**Nakul Virat (ECE master’s student):** You must condense your idea into a minute or two, which makes it very, very hard, because you’ve been working on this for months or a year.

**Chirag Gupta (BSIE 2008):** You have to tell them about the “pain” [why this is a necessary venture], your solution, target market, and funding requirements. Four topics in a couple of minutes is very hard.

**What is the best part of the process?**

**Neetika Kohli (ECE master’s student):** Changing the pulses of my judges and audiences and getting them excited. I like adding drama or comic relief to get their attention.

**Alex Kim (ECE undergrad, completing his certificate in December):** Being spontaneous and creative.

**Virat:** If you can get someone excited about the business idea in one minute, then you have another 30 minutes [of his time]. And if you have those 30 minutes, then you’re that much closer to having the funding you need.

**Gupta:** Finding ideas and then researching them—are people willing to buy them and is there a market? To me, that is the fun part.

**Applying concepts beyond college—what have you learned?**

**Alex Kim:** Be proactive, have an open mind, and take opportunities when they come. Entrepreneurs are risk-takers, so always be honest with yourself and calculate your risks.

**Virat:** Keep getting critiques and reviews from other people. The $500 billion idea in your head may be worth 50 cents to someone else. You always have to adapt your ideas as you go.

**Kohli:** With each pitch, I learned that an entrepreneur is never unprepared. You have to be prepared at all times. Meeting someone in an elevator and talking to them for a minute can give you the million dollars you need for your project.

**Who do you want to meet in your elevator?**

**Kohli:** An angel investor. I want someone who works with me shoulder to shoulder. I want to work hard on my dream, so I need someone who will trust me and work with me on it as a partner—someone who’s very dedicated. ■ Rebecca Goldenberg

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**Why an Elevator Pitch Competition?**

The Elevator Pitch Competition is one of a number of initiatives at Purdue designed to raise awareness of entrepreneurship across campus. The university has just completed year one of a five-year, $1.5 million grant from the Kauffman Foundation to support this effort. The foundation, based in Kansas City, has awarded $200 million in Kauffman Campus Initiative Grants in the past few years in an effort to transform the way entrepreneurship education is delivered at the nation’s leading colleges and universities.

The 2008 competition drew 20 undergraduate students from as far away as Hong Kong and Florida to as close as West Lafayette and Carmel, Indiana. Another dozen participants were faculty, graduate students, or entrepreneurs affiliated with the Purdue Research Park. “These types of events are growing in popularity as the wave of entrepreneurship sweeps across U.S. and international college campuses,” says Nathalie Duval-Couetil, director of Purdue’s Certificate in Entrepreneurship and Innovation Program and associate director of the Burton D. Morgan Center for Entrepreneurship. “The competitions help students hone their leadership and communication skills, which will be valuable whether they choose careers in startups or larger organizations. Entrepreneurship education and experiential learning opportunities, such as competitions and internships, can provide students with a competitive advantage upon graduation.”

Purdue’s Burton D. Morgan Center is housed in Discovery Park, the university’s interdisciplinary research hub. It works closely with students, faculty, and Indiana entrepreneurs to bring research and technology to market.
Purdue biomedical engineers have discovered a possible new pathway for anti-tumor drugs to kill cancer cells and have proposed how to improve the design of tiny drug-delivery particles for use in “nanomedicine.”

The synthetic "polymer micelles" are drug-delivery spheres 60-100 nanometers in diameter, or roughly 100 times smaller than a red blood cell. The spheres harbor drugs in their inner core and contain an outer shell made of a material called polyethylene glycol.

The research is led by Ji-Xin Cheng, an assistant professor in the Weldon School of Biomedical Engineering and Department of Chemistry, and Kinam Park, Showalter Distinguished Professor of Biomedical Engineering and a professor of pharmaceutics. They have shown for the first time how this shell of polyethylene glycol latches onto the membranes of cancer cells, allowing fluorescent probes mimicking cancer drugs to enter the cancer cells.

“This is an interesting new step in developing nanomedicine techniques in drug delivery,” Cheng says.

The researchers used an imaging technique called Förster Resonance Energy Transfer Imaging, or FRET, to make two key discoveries: how fluorescent molecules mimicking the cancer drug Paclitaxel enter tumor cells and how the micelles break down in the blood before they have a chance to deliver the drug to cancer cells. 

Emil Venere
Explain your business idea.
**Brubaker:** It was to design and build a battery-powered inline skate that will compete with or take the place of an electric bicycle or scooter.
**Hursh:** It can go a maximum speed of 14 m.p.h. for an hour-long battery life with zero emissions.

What phase of development are you in?
**Hursh:** We are in the refining phase. I think we have a great product, but there are still things that can be improved.
**Brubaker:** The last thing we have to do for this level of development is to get the power electronics working, including the remote control.

Can you explain how the remote control would work?
**Kreder:** The idea was to have a smart controller that didn’t require any user interface. But we didn’t have the expertise in electronic design, so we decided it wasn’t something we could do right now.
**Dill:** Currently, the controller is a hand-held remote. But we designed the skates so a smart controller could one day be integrated into the design.

How did you come up with this idea?
**Kreder:** It came out of a sophomore design class where we had to come up with an idea for an alternative mode of transportation. I worked on it a bit more last year in China during the Engineering Exchange Program, where we had to do a design project with the Chinese students.
**Brubaker:** Then it was approved as a project for senior design, and the rest of us signed on.

Why did you decide to enter your senior design project in the Burton D. Morgan Entrepreneurial Competition?
**Hursh:** We had heard about the competition, and we felt confident we had a solid product. Our confidence is what motivated us to enter.
**Kreder:** But it was definitely an eye-opening experience. We are engineers focused on the product. However, at the competition marketing people and venture capitalists wanted to hear about the value added, selling price, profit margins, etc. It was more focused on implementation and marketing than the technical aspect.

What is your marketing plan?
**Kreder:** I think it would be best to develop a small market in the U.S., such as environmentally conscious people or people who love new gadgets. It won’t appeal to masses, because everyone has a car. So this would only displace short-distance travel for a certain consumer group in certain areas of the country.

How did you do in the competition?
**Dill:** We got fourth place in the black division, which is for under-graduate students.
**Kreder:** I think we got fourth place because we were lacking in some of our marketing and finance analyses.

**Hursh:** Yeah, but, we were engineers in the Burton D. Morgan Competition, which is for business majors, and our competitors knew a lot more about marketing. I think we did awesome. Fourth out of 47 is not first, but I was impressed.
**Kreder:** If we did it again, I guarantee we could have gotten first place. But none of us had ever taken a business class so, we winged it.

What did you learn from the competition?
**Kreder:** I now know what they are looking for in terms of the whole picture in marketing a new product. Next time I talk to someone like a venture capitalist, I’ll know exactly what to present. It was disappointing that we didn’t do better, but we learned a lot from it.

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Kristen Senior
Entrepreneurial Boot Camp

Program drills researchers in startup basics

In October 2007, 70 entrepreneurs and prospective entrepreneurs from across the university met on campus for the second annual Company Fund Raising Boot Camp. Among those who attended were researchers from the College of Engineering.

The event—co-sponsored by the Burton D. Morgan Center for Entrepreneurship, the Purdue Research Foundation, and Lonergan Partners—was intended to highlight the “real world” skills necessary to launch a startup company. During the event, three companies were selected to formally present their ideas to venture capital firms in Silicon Valley in May of this year.

Among those chosen was Moerae Matrix, a startup company developed around the tissue engineering research of Alyssa Panitch, associate professor in the Weldon School of Biomedical Engineering, and her colleague Brandon Seal. Also chosen to present were Kylin Therapeutics Inc. and Events 180°.

Panitch and Seal were joined at the California event by College of Engineering Dean Leah H. Jamieson and alumnus/entrepreneur Keith Krach (BSIE ’79, DEA 2006). In her keynote address, Jamieson described the college as a dynamic environment and one that encourages and supports entrepreneurship.

“The entrepreneurial spirit that we are seeing in our faculty, staff, and students—in our focus on Discovery with Delivery, our curriculum for 2020, our growing global partnerships—brings home Neil Armstrong’s vision of engineering: Entrepreneurship is at the heart of ‘what can be.’" — Linda Thomas Terhune
2008 Faculty Excellence Awards

Mentoring Award
Jan Allebach
Hewlett-Packard Professor of Electrical and Computer Engineering

Engagement/Service Award
Charles Bouman
Professor of Electrical and Computer Engineering

Leadership Award
Phillip Dunston
Associate Professor of Civil Engineering

Early Career Research Award
Hugh Hillhouse
Associate Professor of Chemical Engineering

Dean A. A. Potter Award
Dimitrios Peroulis
Assistant Professor of Electrical and Computer Engineering

Engagement/Service Award and the Advising Award
Thomas Talavage
Associate Professor of Electrical and Computer Engineering and Biomedical Engineering

Research Award
Kaushik Roy
Roscoe H. George Professor of Electrical and Computer Engineering

Team Award
nanoHUB
Gerhard Klimeck, Professor of Electrical and Computer Engineering; Mark Lundstrom, Scaife Distinguished Professor of Electrical and Computer Engineering; and Michael McLennan, Senior Research Scientist at the Rosen Center for Advanced Computing
Elected to the National Academy of Engineering

Kumares Sinha
Edgar B. and Hedwig M. Olson Distinguished Professor of Civil Engineering

Andrew Weiner
Scifres Distinguished Professor of Electrical and Computer Engineering

Received a National Science Foundation (NSF) CAREER Award:

Chang Lu
Assistant Professor of Agricultural and Biological Engineering, Biomedical Engineering (by courtesy), and Chemical Engineering (by courtesy)

Robin Adams
Assistant Professor of Engineering Education

Monica Cox
Assistant Professor of Engineering Education

Inseok Hwang
Assistant Professor of Aeronautics and Astronautics

Dan Jiao
Assistant Professor of Electrical and Computer Engineering

Guy Lebanon
Assistant Professor of Electrical and Computer Engineering

Dimitros Peroulis
Assistant Professor of Electrical and Computer Engineering

Chang Lu
Assistant Professor of Agricultural and Biological Engineering, Biomedical Engineering (by courtesy), and Chemical Engineering (by courtesy)

Robin Adams
Assistant Professor of Engineering Education

Monica Cox
Assistant Professor of Engineering Education

Inseok Hwang
Assistant Professor of Aeronautics and Astronautics

Dan Jiao
Assistant Professor of Electrical and Computer Engineering

Guy Lebanon
Assistant Professor of Electrical and Computer Engineering

Dimitros Peroulis
Assistant Professor of Electrical and Computer Engineering
Awarded:

Rakesh Agrawal, Winthrop E. Stone Distinguished Professor of Chemical Engineering, the Chemical Weekly’s Padmashri Dr. G. P. Kane CHEMCON Distinguished Speaker Award and the 2008 AICHE Fuels and Petrochemicals Division Award

Jay Allebach, Hewlett-Packard Professor of Electrical and Computer Engineering, the 2008 Sigma Xi Faculty Research Award

Cordelia Brown, visiting assistant professor in Electrical and Computer Engineering, the 2008 Innovative Program Award by the Electrical and Computer Engineering Department Heads Association (ECEDHA)

Igor Jovanovic, assistant professor of Nuclear Engineering, the 2008 Young Faculty Award (YFA) by the Defense Advanced Research Projects Agency (DARPA)

Sangtae Kim, Donald W. Feddersen Distinguished Professor of Chemical Engineering, the 2008 George Lappin Award and the American Institute of Chemical Engineers (AIChE) National Program Committee Service Award


Robert P. Lucht, professor of Mechanical Engineering, the American Institute of Aeronautics and Astronautics (AIAA) Aerodynamic Measurement Technology Award for 2008

David Meyer, professor of Electrical and Computer Engineering, the 2008 Innovative Program Award from ECEDHA

Rabi Mohtar, professor of Agricultural and Biological Engineering, the 2008 Purdue University Agricultural Research Award

Gavriel Salvendy, professor of Industrial Engineering, the American Society for Engineering Education (ASEE) 2008 John L. Imhoff Global Excellence Award for Industrial Engineering Education

Y. C. Shin, professor of Mechanical Engineering, the 2007 Blackall Machine Tool and Gage Award by the American Society of Mechanical Engineers (ASME)

Nien-Hwa Linda Wang, professor of Chemical Engineering, the university’s 2008 Violet Haas award

Oleg Wasynyczuk, professor of Electrical and Computer Engineering, the 2008 Institute of Electrical and Electronics Engineers (IEEE) Power Engineering Society Cyril Veinott Award

Andrew Weiner, Scifres Distinguished Professor of Electrical and Computer Engineering, the 2008 Provost’s Outstanding Graduate Student Mentor Award and the R.W. Wood Prize of the Optical Society of America (OSA)

You-Yeon Won, assistant professor of Chemical Engineering and Materials Science Engineering (by courtesy), the 2007 Outstanding Young Investigator Award by the Korean Institute of Chemical Engineers—United States (KICHE)

Bin Yao, professor of Mechanical Engineering, the 2007 Outstanding Young Investigator Award by the Dynamic Systems and Control Division (DSCD) of ASME
Honored:

James Caruthers, professor of Chemical Engineering, with a Faculty Fellowship for Study in a Second Discipline for the fall 2008 semester in veterinary medicine

Maria Santagata, professor of Civil Engineering, with a Faculty Fellowship for study in a second discipline for the fall 2008 semester in soil chemistry and soil mineralogy

Named:

V. Ragu Balakrishnan, Associate Dean of Engineering for Research and Professor of Electrical and Computer Engineering, a University Faculty Scholar

Katherine Banks, head of the School of Civil Engineering, a Fellow by the American Society of Civil Engineers (ASCE)

Charles A. Bouman, professor of Electrical and Computer Engineering, a SPIE Fellow

Monica Cox, assistant professor of Engineering Education, one of ten “Emerging Scholars” for 2008 by Diverse: Issues in Higher Education magazine

Edward Delp, professor of Biomedical Engineering and Silicon Valley Professor of Electrical and Computer Engineering, a member of the Scientific Advisory Board (SAB) of the Nokia Research Center

Scott Sudhoff, professor of Electrical and Computer Engineering, a Fellow of the IEEE

Arvind Raman, associate professor of Mechanical Engineering, a University Faculty Scholar

Doraiswami Ramkrishna, Harry Creighton Peffer Distinguished Professor of Chemical Engineering, a Fellow of the AIChE

The Summer Undergraduate Research Fellowship program (SURF) the United States 2007 Employer of the Year by the International Association for the Exchange of Students for Technical Experience (IAESTE)

Appointed:

Qingyan (Yan) Chen, professor of Mechanical Engineering, as the Chang Jiang Chair Professor by China’s Ministry of Education

Rabi H. Mohtar, professor of Agricultural and Biological Engineering, as the first permanent director of the College of Engineering’s Global Engineering Programs (GEP) office

Karthik Ramani, professor of Mechanical Engineering and Electrical and Computer Engineering (courtesy), to a three-year term with the National Science Foundation (NSF) Advisory Committee for Industrial Innovation and Partnerships (IIP) and as a visiting professor in Computer Science at Stanford University from January to June 2008

E. Daniel Hirliman, William E. and Florence E. Perry Head and Professor of Mechanical Engineering, a Fellow by the ASME

Klod Kokini, associate dean of Engineering for Academic Affairs and professor of Biomedical and Mechanical Engineering, a Fellow of the American Institute for Medical and Biological Engineering (AIMBE) and the winner of the American Society of Mechanical Engineers (ASME) Johnson & Johnson Consumer Companies, Inc. Medal

Venkat Venkatasubramanian, professor of Chemical Engineering, a Fellow of the Teaching Academy at Purdue

Gintaras “Rex” Reklaitis as the Edward W. Comings Distinguished Professor of Chemical Engineering

Kendall Thomson, associate professor of Chemical Engineering, a University Faculty Scholar

Jason Weiss, associate head and professor of Civil Engineering, a University Faculty Scholar
Hamburgers are America’s favorite fast food. At McDonald’s, burgers are made in five quick steps while the customer waits. Were the Purdue Society of Professional Engineers to open a fast-food restaurant, burgers would be made in 156 steps, and consumers would no doubt go away mad and hungry.

Unlike the speed of the fast food business, the 21st annual national Rube Goldberg contest in April called for inefficiency. Teams were required to assemble a hamburger consisting of no less than one precooked patty, two vegetables, two condiments, and two bun halves. For the third time in the last four years, the Purdue team took first place at the national contest.

The 17-member team used a global travel theme in their machine’s construction. It included a journey that started at Purdue, activated by a ticket punch for the Boilermaker Express, and continued around the world to Big Ben in England; the Eiffel Tower in France; through Germany, Venice and Egypt; to the Great Wall of China and Mexico; and then back to a tailgating party at Purdue where the hamburger was made.

“We put between 4,000 and 5,000 hours into this machine, and all the hard work has been well worth it,” says team captain Drew Wischer, a senior in aviation technology who has taken part in the competition for eight years, including time spanning both high school and Purdue. “It’s an amazing feeling to have gone from a brand new team last year to winning the nationals this year. I couldn’t think of a better way to go out.”

Contest Challenges From The Past Ten Years:

1998 Shut off an alarm clock
1999 Set a golf tee and tee up a golf ball
2000 Fill and seal a time capsule with 20th century inventions
2001 Select, clean, and peel an apple
2002 Select, raise, and wave a national flag
2003 Select, crush, and recycle an empty soft drink can
2004 Select, mark, and cast an election ballot
2005 Change batteries and turn on a two-battery flashlight
2006 Shred five sheets of paper
2007 Squeeze the juice from an orange

Kristen Senior and Kim Medaris

Engineers have created a method that uses pervasive Bluetooth signals from cell phones and other wireless devices to constantly update how long it takes vehicles and pedestrians to travel from one point to another. The method represents a potentially low-cost leap in technology to provide information on everything from the speed of the morning commute to the sluggishness of airport security lines.

“This is incredibly valuable information that could be used for many purposes, including better traffic-signal timing and management of construction work zones to reduce congestion, as well as real-time traffic information for motorists,” says Darcy Bullock, professor of civil engineering. “Now we have a way to measure how slow traffic is on a given stretch of road or how long it’s taking people to get through airport security at a given concourse and time of day.”

Bullock is developing the method with Jason S. Wasson and James R. Sturdevant, engineers from the Indiana Department of Transportation. The researchers have filed a patent on the method, and the basic technology is available commercially to create the tracking system.

The method picks up the identifying “addresses” from Bluetooth devices in consumer electronics. Because each device has its own distinct digital signature, its travel time can be tracked by detectors installed at intersections or along highways and other locations. Travelers could access the travel-time information using the same portable electronic devices that make the system possible.

Bluetooth technology connects and exchanges information for cell phone hands-free headsets, wireless keyboards, Internet access for personal digital assistants, and wireless networks for laptops and personal computers. The new travel-time estimation procedures detect and record “media access control,” or MAC identification signals, every time a Bluetooth device passes a detector.

E. V.
Researchers at the College of Engineering are prolific entrepreneurs when viewed through the lens of commercialization activity. Those who have translated work into product will say that engineering—as an applied science—is a natural fit for the marketplace. The Office of Technology Commercialization (OTC) at the Purdue Research Park works with researchers to help them navigate the murky and choppy waters of patents, intellectual property rights, funding, and the startup business. Based on data provided by OTC, Purdue engineers are leading the pack in terms of commercialization activity.

—L. T. T.
2005
- Of 237 disclosures university-wide, 117 were from the College of Engineering
- Of 27 U.S. patents issued university-wide, 10 were from the College of Engineering
- Of $4.16M in royalty income university-wide, $3M was from the College of Engineering

2006
- Of 265 disclosures university-wide, 139 were from the College of Engineering
- Of 30 U.S. patents issued university-wide, 9 were from the College of Engineering
- Of $3.83M in royalty income university-wide, $2M was from the College of Engineering

2007
- Of 249 disclosures university-wide, 156 were from the College of Engineering
- Of 33 U.S. patents issued university-wide, 17 were from the College of Engineering
- Of $5.15M in royalty income university-wide, $3.3M was from the College of Engineering
From Concept to Commercialization
As never before, academic researchers are breaking down the walls that have traditionally separated them from the outside world. No longer holed up in solitary laboratories behind ivy-covered walls, today’s researchers are forging connections to the outside world at an increasingly rapid rate. Nowhere is this entrepreneurial drive more apparent than in the College of Engineering, where connecting academic discoveries with marketplace delivery is routine. In fact, over 85 percent of Purdue commercialization revenue comes from technologies associated with the College of Engineering, according to Simran Trana, director of the Office for Technology Commercialization in the Purdue Research Park.

This issue of Engineering Impact offers a comprehensive look at entrepreneurship in the College, examining enterprise at its youngest, its most mature, and all levels in between. It is increasingly apparent that Purdue researchers are connecting their ideas with the outside world in innumerable and fascinating ways, ways that are at once both profitable and beneficial to society.
Michael Capano: Pitching a Product

Michael Capano’s research path has, until recently, been a straight one, focusing on semiconductor fabrication processes using silicon carbide. But in 2006, the professor of electrical and computer engineering ventured down a side street that has taken him in a new direction that could lead to enterprise.

“I realized that silicon carbide was becoming a mature technology and began looking for my next research activity,” he says. His search took him to a related area—graphene, a carbon-based electronic material that can be used to manufacture next-generation transistors for consumer electronics. In a relatively short time, Capano’s research group developed a way to grow graphene to a quality that is as good, he says, as that produced by any lab in the world.

The side street, it turned out, led to a global interstate and the quest for commercialization. Capano is determined to stay in the lead of the graphene electronics and materials race, ahead of competition from the academic and industrial worlds, including Georgia Tech, IBM, the Naval Research Center, Teledyne, and Northrop-Grumman.

“It’s fun being in the leadership position, but I feel the need to push on, be aggressive and find better ways of growing our material,” he says. “There’s a tremendous opportunity here, and you can’t let those opportunities come and go.”

Capano—researcher and professor—has added a new title to his list: entrepreneur. He has traveled extensively in the last year, drumming up interest for the nascent company. He is the front man of the research group, talking to venture capitalists, hiring legal counsel, and spreading the word at events such as the 2008 University Research and Entrepreneurship Symposium, which took place in Boston in April. It’s a busy time for him; in one 16-day period this spring, he made four trips. While some researchers shy away from the business side of startups, Capano seems to thrive in the environment.

It takes some types of research a decade or more to approach commercialization. Capano’s enterprise, however, is moving along quickly. In two short years, the team’s idea has entered the enterprise stream. That’s the nature of electrical engineering, he says. “In the electronics field, you have to be fast. If you’re not, you’ll get crushed.”

Growing graphene, like growing a business, is an expensive prospect. It will cost an estimated $25 million to get the company going, which is why venture capitalists are crucial to the success of the plan. Indiana 21st Century funds have provided seed money but not enough to cover equipment and staffing needs. The group is now at a point where it needs an additional $2 million to enter the next phase of development. Without it, the project will fail. So Capano pushes on. “I have a few years ahead of me dealing with this,” he says. But the ultimate payoff, a graphene manufacturing facility, would be good for the group and Purdue and could boost Indiana’s economy.
Hugh Hillhouse holds a small, metal sculpture in the palm of his hand. Though shaped like a cube, it has more in common with a rolled up sheet of paper. Its beauty belies its strength.

The sculpture is a model of a surface that defines what is called a double-gyroid structure. Hillhouse has developed nanoporous films and nanowire arrays defined by this structure that are the end-product of a nearly decade-long quest for small diameter semiconductor wire arrays as the active component in next-generation solar cells. Solar cells based on the technology have the potential to be more energy efficient than any other existing today and could displace the existing technology of power applications, Hillhouse says.

Hillhouse, an associate professor who joined Purdue’s chemical engineering faculty in 2002, researches the development of nanomaterials and new devices for energy conversion. As part of this effort, he has developed membranes with small pores—less than five nanometers in diameter—to template the formation of small diameter semiconductor wires. In fact, they are the smallest diameter wires ever synthesized from the materials he works with. Hillhouse and his team are the first to develop a method to make the films so that they self assemble, which means they form automatically under the proper laboratory conditions without costly manufacturing processes.

The technique, protected by a provisional patent that was filed in 2006, could dramatically lower the cost of electricity from solar cells and is suitable for mass manufacturing at reasonable prices. This could lead to solar cells that are economically competitive with other forms of power generation, such as coal-fired power plants.

“The energy problem has been on my mind for a very long time,” Hillhouse says. “Fossil fuel resources will run out, and issues with CO2 emissions and the burning of fossil fuels make it imperative that we develop clean energy and find ways to make it happen.”

In April, Hillhouse took his idea to the marketplace and formed NanoG, a limited liability corporation that is backed by a group of private investors. Hillhouse is chief scientific advisor of the company.

The recently launched company will now work on development of solar cells and creation of a prototype suitable for manufacturing.

“I want the ideas and processes that we develop in my lab to get turned into useful things,” he says. “I will participate as much as needed to get the company started, then I’ll return to what I really love doing: picking problems important to society and finding ways to solve them.”
Biomedical engineer Alyssa Panitch came to Purdue from Arizona two years ago and within a month had found commercial backing that is taking her research into the marketplace. In a twist that would make most entrepreneurs green with envy, Panitch wasn’t looking for an investor, but found one anyway.

Panitch, new to the faculty in the Weldon School of Biomedical Engineering in 2006, was in her lab working on tissue engineering when investor and entrepreneur Cynthia Lander happened by. Lander was on campus looking at technologies for her venture incubator, Nascent Enterprises, LLC, and took an interest in Panitch’s work. She told Panitch she wanted to start a company based on her research. The result is Moerae Matrix, formed in 2007 with Panitch as chief scientific officer and Nascent Enterprises as the business team.

Panitch specializes in bio-organic chemistry, with particular interest in the design and synthesis of biomaterials for drug delivery and tissue engineering. Upon joining the Purdue faculty, she began developing therapeutic peptides with colleague Brandon Seal, an assistant professor of biomedical engineering.

The peptides can enter cells and inhibit inflammatory responses that follow some surgeries and lead to scarring complications. The research could aid abdominal surgery patients, as many as 93 percent of whom have trouble with adhesions following surgeries ranging from appendectomies to hysterectomies. Panitch’s peptides could be delivered in a saline solution that is either sprayed or applied during surgery as a preventive therapy. She is also exploring its applications in tendon sheath adhesion and dermal scarring situations.

Moerae Matrix is the second company for Panitch, who formed the engineering therapeutics company Azerx while on the faculty at the University of Arizona. “As an engineer, I work on applied topics, so I am trying to develop things. It’s important to be able to see that through to the end, so entrepreneurship is key to the process,” she says.

The first company, however, was a near-burn-out experience for Panitch. “With co-founder Colleen Brophy, I really drove the company,” she says. “I did payroll, fundraising, and worked with lawyers. I have the experience now and could do that, but it’s hard to do that and be a professor. It’s not my job. The university doesn’t pay me to do that. Instead, you work with a business group and maintain your focus on the scientific, academic, and educational sides.”

Panitch says the experience in Arizona helped her develop a method for approaching drug development and commercializing the research. This laid the groundwork for the rapid birth of Moerae Matrix: research began in August 2006, went to a provisional patent in early 2007, and was quickly followed by incorporation as a company. The company is now in a fundraising stage, going through due diligence and entering Phase II of the Small Business Innovation Research Program.

Panitch, who came out of graduate school in 1997, says neither she nor many of her classmates gave entrepreneurship much thought when they were in school. Now, she says, students are eager to discuss the topic. In fall 2007, she piloted a class on advanced tissue engineering in which the students undertook entrepreneurial projects and were keenly interested in the subject.

An emerging player in the world of scientific enterprise, it becomes clear when Panitch discusses her work exactly which of her two personalities—academic and entrepreneur—she prefers.

“If one of my therapeutics really helps, it would be nice to look back and say I had a part in improving human life,” she says, then shifts gears. “Biology is so elegantly engineered. It’s how to bring that into synthetic materials so they are more precisely designed that is what intrigues me.”
When Joseph Pekny cofounded Advanced Process Combinatorics in 1993, the line between pure academia and enterprise was crisply drawn. On one side was research done for its own right and for the quest of knowledge; on the other was research turned into enterprise and profit. The two didn’t co-exist comfortably. Those days are long gone.

Pekny, a chemical engineering professor who was founding director of the Regenstrief Center for Healthcare Engineering and now heads Discovery Park’s e-Enterprise Center, is an academic. He is also an entrepreneur. And he holds strong views on the two occupations and where they intersect on university campuses.

In the early 1990s when Pekny was just starting his company, many universities didn’t emphasize or actively support entrepreneurship. By the end of the decade, however, the impact of the “Dot-Com” boom led universities to support enterprise; incubation centers such as the Purdue Research Park grew rapidly. Now, in 2008, the academic environment is fertile ground for entrepreneurs.

“It’s the best time I’ve seen in my professional life for entrepreneurship in academia,” Pekny says, who is also interim head of Industrial Engineering. “It’s the best time I’ve seen in my professional life for entrepreneurship in academia,” Pekny says, who is also interim head of Industrial Engineering. “Purdue is being influenced by forces that are playing everywhere,” Pekny says. “The speed of the economy is driving Purdue’s role in the world. People change jobs more readily and new companies go from $0 to billions. The students think differently. The faculty thinks differently. Entrepreneurship is critical to the university. If we do not see each other contribute to the economy, it has to be attached to the speed of the economy.”

Pekny’s company, based on his research in combinatorial optimization, was created to fill a need he saw to help people make discrete choices, analyze all possible combinations, and either minimize waste in processes or maximize throughput. It numbers industry giants as its clients, including Coca-Cola, Eli Lilly & Company, Procter&Gamble, and the U.S. Army. In the early days, Pekny took a leave of absence from Purdue, wrote software, and did core product work. Now, with the company’s annual income pushing $2 million, he is less hands-on and more of a technical advisor.

For Pekny, the decision to commercialize was a no-brainer. “I like my research to have the maximum possible impact,” he says. “One way is to publish papers and teach students; the other is to have it published in the marketplace.” Likewise, he believes that universities can have maximum impact by seeking new ways to promote entrepreneurship.

“The key to staying ahead of the curve is to develop new entrepreneurial models. The traditional method of taking an idea, starting a company, and getting support from venture capital or an angel is pretty well saturated,” Pekny says. “It behooves Purdue to foster other models.”

The Chao Center, a pharmaceutical product development and small-scale manufacturing facility in Purdue Research Park, is an alternative and complementary model. It is an incubator company that supports an idea, perfects the technology, and then puts it into an instant distribution channel. According to Pekny, the global economy now moves so quickly that entrepreneurs no longer have the luxury of a 15-year period to hit that channel.

Reflecting on the place of entrepreneurship in a teaching institution, Pekny is quick to praise it. He says his own experiences out in the field have helped him become a much more effective teacher and researcher. Not only did the experience lead him to develop a class on risk management, but it informs his research and all the courses he teaches.

“We are out there engaging with companies. We tend to see the cutting-edge problems, which is huge for research and knowing what to teach students,” he says. “For example, building a new plant is very expensive, so you want to squeeze out as much waste as possible. I wouldn’t have seen certain evolving practical needs for that for several years if I hadn’t been interacting with industry partners.”

Pekny also believes firmly that universities have to nurture intrapreneurship. He points to his own involvement with the creation of the Regenstrief Center and the university’s Discovery Park, which he says were developed like startups.

“We need as much intrapreneurship as possible at Purdue for the faculty, students, and staff to be as empowered as possible to take measured risks,” he says. “Students have to be entrepreneurial and take prudent risks to achieve their goals, or they will be left behind. Entrepreneurship is a journey, not an endpoint. It’s frame of mind.” —Joseph Pekny, professor of Chemical Engineering and head of Purdue’s e-Enterprise Center

“Entrepreneurship is a journey, not an endpoint. It's frame of mind.” —Joseph Pekny, professor of Chemical Engineering and head of Purdue’s e-Enterprise Center
Whether you’re a researcher developing a fan-proof goal post, stronger car tire, or better imaging device, Purdue’s Office of Technology Commercialization (OTC) can play a role. The office serves Purdue through the “commercialization of its intellectual property,” whether patents, copyright, trademarks, or tangible research property.

OTC came into being in 1999 when the university vowed to undertake a greater effort to educate its faculty on intellectual property and support Purdue’s economic development initiatives with an emphasis on faculty startup companies. This was driven by newly appointed President Martin C. Jischke, who sought to engage with the community and partner in economic development.

Though reborn in 1999, the office had existed for over 20 years as the Office of Technology Transfer. Today, OTC, which is a division of the Purdue Research Foundation, works with faculty, staff and student entrepreneurs to provide information on university policies related to intellectual property and help them navigate the path it takes to turn a concept into a product or service.

Here’s how it works:
1. Researcher visits OTC and “discloses” his or her idea. This step is known as invention disclosure. OTC handles more than 250 of these annually, about half of which come from the College of Engineering.
2. OTC deems the concept viable enough and files a provisional patent application to protect it.
3. After two to five years of U.S. Patent and Trade Office adjudication, a patent is issued in the U.S. If, for example, someone files a patent in chemical or electrical engineering, this process can cost between $25,000 and $50,000. Researchers hope to make that money back in royalties.
4. For protection abroad, researchers must file patent applications in the desired countries at a cost of about $200,000 per patent or around $500,000 for global coverage.
5. OTC licensing associates—there are six (electrical and computer engineering, biology, food science, chemistry, mechanical engineering, and pharmacy)—work with the researcher to determine key markets and engage the researcher with people who understand the technology and are willing to invest.
6. For the lucky few, the result is a startup backed by investors or an angel. In all, about 20 percent of the invention disclosures make it this far, have patents issued, and are licensed. A U.S. patent protection is good for 20 years from the filing date if renewed at 7½, 11½, and 14½ years at a cost of several thousand dollars.

Of the thousands of patents filed every year, less than 5 percent lead to commercially successful products. And even that doesn’t spell success. Of new U.S.-based technology businesses, only 25 percent survive the first year.

Not all faculty entrepreneurs pass through OTC. Some build their companies independently while some arrived at Purdue with companies already intact. For those who do engage OTC’s services, the gratitude comes quickly.

Chemical engineer Hugh Hillhouse, whose research recently landed investors and incorporated in April as a limited liability corporation, was effusive in his praise.

“None of this would have happened without senior technology manager Mark Krivchenia. He was extremely helpful and his ability to really understand the key aspects of the technology is what made it easier to market. I was inspired by the end goal nine years ago and filed an invention disclosure two years ago, but that doesn’t necessarily mean it will happen. OTC has been critical in making it come together.”

Simran Trana, director of OTC, is grateful for the kind words but is cautious in taking full credit.

“We have to engage the scientist with people who understand the technology and are willing to invest, but it’s the faculty who has, in the end, to sell it. Especially in the case of very early-stage technology, the investor has to have complete faith in the technologist, who is the scientist,” she says.
Purdue can claim a leading role in opening the door to technology transfer with China, after beginning an exchange of superalloy technology long before the country’s economic and technological boom.

The partnership began in 1980, when John Radavich, then professor of materials engineering, met two professors from China’s Beijing University of Science and Technology. The Chinese professors were interested in building up their technology and expertise in the field of superalloys—alloys that are very strong and resistant to high temperatures, corrosion and oxidation, with primary applications in the aerospace and power industries.

In 1984, Radavich was invited to China to teach the use of electron microscopes and to lecture on superalloys. During his five-week stay, he met a group of engineers who were interested in coming to the United States to attend seminars on superalloys. The problem was that they did not have enough funding.

Upon his return to the U.S., Radavich contacted companies in the superalloy field and arranged funding for the scholars. He then suggested a symposium in China, which took place in 1985. Since then, there have been 11 symposiums on high temperature materials, each growing larger; the last two drew over 300 scholars.

Radavich considers himself a “door-opener” between American and Chinese companies. The Sino-American symposiums have been attended by such companies as General Electric, Pratt and Whitney, and Rolls-Royce.

“Purdue and I were there before China bloomed into its terrific technology,” says Radavich, who retired from Purdue in 1995 and is now the president of Micro-Met Laboratories, Inc. “Purdue has been a leader in getting the people in this country to work with people in China. Purdue and I are proud of the part we played in the growth of superalloy technology.”

Joseph Fowler
The Seven Key Factors for Success as an Entrepreneur

It was not long ago that engineers graduating from Purdue leapt at the chance to join an established company like IBM or GM to begin their engineering careers. Today, engineers are increasingly taking the risk to start their own companies and become entrepreneurs. However, while technical knowledge gleaned in college is critical to the product or service being developed, it is not enough for entrepreneurial success. Rather, engineering entrepreneurs need to know how to build a company that creates lasting value. After 10 years with GM and 20 years as an entrepreneur in Silicon Valley, it became clear to me that there are seven key factors that maximize the probability of taking something from a concept to a great sustaining company and achieving escape velocity:

1. A Big Market:
   Always look for a big market for the product or service being offered because, with a big market, there is more opportunity to maneuver and more opportunity for growth and profit. If possible, identify a market undergoing a paradigm shift. An example of a significant paradigm shift was when the software business moved from a client/server architecture to the Internet. When such shifts occur, the existing big players go back to ground zero, opening up the market for new innovative players.

2. Focus/Focus/Focus:
   Fifty percent of Silicon Valley startups fail each year, not because they suffocate from a lack of opportunity, but because they drown from lack of market focus. The key is to segment the big market, determine in which segment the product or service can be differentiated, target that segment as the initial beachhead, and then fan out from there.

3. Clear Positioning:
   Always keep the company positioning simple and clear. The most intellectual exercise is taking something complex and making it simple. Executives and employees must be able to describe what their company does in a few words in order to execute, differentiate, and dominate in the chosen market.

4. Effective Execution:
   You can have the greatest strategy in the world, but if you cannot execute, you will fail every time. Have a management system that sets clear annual objectives, quarterly goals, and assigns ownership to each. Measure everything. Put metrics in place to evaluate progress and hold leadership accountable, especially yourself.

5. A Real Business Model:
   Revenue is everything. Successful business opportunities are not based on hope or conjecture; they are based on revenue minus expenses. Making a profit is an unnatural act, but entrepreneurs must have a real business model that can generate cash, not just hype.

6. The Right People:
   Simply put, the company with the best people wins. This is the most important factor in building a great company. Institutionalize the team rule—“hire the best people, especially if they are better than us.” Magic happens when a leader inspires great individuals to work together as a team. That is synergy. That is one plus one equals one hundred.

7. Enough Capital:
   Once the right team is in place, it needs time to make the magic happen. In business, time equals money. Raising enough capital is essential. Whether you are reaching out to contacts, venture capitalists, or banks, showcasing past successes, passion, and potential will ultimately convince someone to take that risk.

These seven success factors will maximize the probability of building a company with lasting value. With these in mind, engineers can readily become the great entrepreneurial leaders of tomorrow.
Darryl Dickerson can claim quite a few accomplishments. He’s conferred with Bill Gates, traveled to Nigeria as the national chair of an organization with 30,000 members, and managed that same multimillion dollar organization with a fulltime staff of 26. And he did all of that before he turned 26 himself.

Dickerson, a PhD student in biomedical engineering who also spent the last year as national chair of the National Society of Black Engineers (NSBE), has indeed accomplished more in his quarter century than most will in a lifetime. But for the young man from New Orleans who anticipates defending his dissertation within the next year, all that experience is just a beginning.

Having attended his hometown Tulane University as an undergrad, Dickerson stayed in the Big Easy to begin his graduate work. He won every fellowship he applied for, including ones from the Ford Foundation, the Howard Hughes Medical Institute, the Whitaker Foundation, and the National Science Foundation, though he could only accept the latter two. When the research faculty he was working with at Tulane decided to move on, however, Dickerson’s plans changed too. He ended up following one of his committee members, Eric Nauman, to Purdue.

For the last three years, Dickerson has worked with Nauman, an assistant professor of both biomedical and mechanical engineering, in the cutting-edge field of tissue engineering. “Specifically, hard tissue and soft tissue interfaces,” Dickerson says. “We’re looking at ways to create a scaffold that will reproduce what’s normally seen in the body.”

Dickerson has always been eager to make a difference, and the research in biomedical engineering lends itself to being immediately impactful, as well as potentially helpful to a lot of people. While he anticipates teaching at a university someday, the challenge of starting his own company is an appealing after-school step. “Going the entrepreneurial route really makes sense in the research that I do, and it makes sense from a delivery standpoint,” he says. “If you really want to see something delivered to market you have to be able to bring it to market. Being on the academic side right now, I see where there can be further connections between academia and industry. And I think I have the right experience to be able to bridge that connection.”

Dickerson felt so connected to NSBE, even crediting the organization for his own development, that he decided to run for the national chair position. It proved to be another winning decision. As he juggled his research and studies at Purdue, he traveled monthly to NSBE headquarters in Alexandria, Virginia; kept in frequent contact with staffers through conference calls; and helped develop a strategic plan for the organization’s future. He says the February outreach trip to Nigeria brought home the magnitude of the plan they were working on. “I gained a greater understanding of the urgent need to develop more engineers and specifically minority engineers,” Dickerson says. “The world absolutely needs that sort of intellectual innovation. “We focused a lot of our efforts on pre-college initiative,” he says. “We’re reaching out to students in lower grades to give them an understanding of engineering.”

Dickerson’s rapport with students and his desire to continue in a mentoring role will likely draw him back to academia, but he’s keeping his career options open. The immediate impact of research could be a strong pull to the marketplace and entrepreneurship. Whichever path he follows, Dickerson’s impressive resume is sure to open some doors.

Bill Gates presents a gift to NSBE chair Darryl Dickerson.

Dickerson (front row third from the left) visiting in Nigeria.
When Good Food Goes Bad

ME and Food Science pair up for consumer safety

While researching the use of light-scattering sensors to detect microscale contaminants on semiconductor wafers in the 1990s, Dan Hirleman got to thinking: Could the same technology be used to identify tainted food?

At the time, the United States Department of Agriculture was encouraging interdisciplinary research. Hirleman, mechanical engineering professor and William E. and Florence E. Perry school head, got in touch with food science professor Arun Bhunia at Purdue’s Center for Food Safety Engineering and learned that fast identification of food pathogens was a goal for scientists there. A partnership formed. The world of mechanical engineering cross-pollinated with food safety science.

“We realized that rapid, non-contact identification of bacteria was a similar problem to ours and that there should be significant cross-fertilization of our semiconductor work to food safety, so we did some preliminary research,” Hirleman says.

In the spring of 2000, an initial development proposal went before the food safety group; the research was promising, and the full proposal to pursue the light-scattering technology was funded.

**Bacteria Beware**

Named BARDOT (Bacteria Rapid Detection using Optical-scattering Technology), the process may revolutionize the world of pathogen detection in food, paving the way for quickly testing chicken, spinach, or other foods to determine whether it is safe or laden with bacteria that could make a person quite sick.

*Bacteria* include *Listeria, Staphylococcus, Salmonella, Vibrio, Escherichia*. With the advent of the BARDOT system, these bacteria can be identified in less than a day, instead of the current five- to seven-day period with conventional testing that involves growing bacterial cultures in agar.

Society is crying out for a better system for detecting toxins and making sure food is safe. Anyone who pays attention to the news knows that putting your trust in food manufacturing processes brings the possibility, albeit slight, of food poisoning.

A Centers for Disease Control (CDC) study determined that the United States had 10,421 food-borne disease outbreaks from 1973 to 2006. So detecting food pathogens, and doing so quickly in order to focus in on the source, is crucial. The just-patented BARDOT system may well be the answer.

In a report outlining BARDOT’s evolution, its creators say the method can detect and identify bacteria in food samples “essentially instantaneously.” Using electromagnetic waves, it can identify bacteria in a petri dish within seconds. Scientists tested hot dogs, spinach, chicken, tomatoes, ground beef, and oysters spiked with bacterial cultures ranging from *E. coli* 0157:H7 to *Salmonella enterica*.

“These products were challenged with various pathogens at very low doses and our system is very sensitive and was able to detect the pathogens,” Bhunia says. Final results that now take almost a week are available in less than a day. “For food processors, products must be tested for pathogens before they are shipped for retail distribution. Also, some products have short shelf lives; thus, fast test results would protect consumers.”
Shining a Light on E. coli
Hirelman, Bhunia, and other researchers know from previous research that the transmission and reflection of laser light is sensitive to minute changes in a sample. They decided to apply the research to their food safety project.

This is how the testing works: BARDOT shines a laser beam through a petri-dish sample of a suspected pathogen or colony. “The colony interferes with the laser beam, and the image on the screen is of the beam plus all the distortions imposed by the colony as the laser beam passes through it,” Hirleman explains. “We call this image a forward-light-scattering signature, because it turns out that each strain of bacteria has a unique signature or fingerprint.”

He continues painting a picture. “In effect, BARDOT is sensitive to the differences in physical properties of colonies of bacteria. BARDOT then uses a computer to analyze these forward-scattering signatures and determine whether or not the bacteria forming the colony are harmful.”

In the world of food pathogens, this all means that once the technology is in use, detecting bacteria that lead to sometimes deadly food poisoning in humans may be as simple as shining a light through a tainted piece of turkey, then taking a look at the resulting scatter patterns to identify the culprit.

The BARDOT system took years to develop and perfect. But soon, it will save time and lives.

A Joint Effort
Collaboration and creative thinking from all around Purdue University combined to take the food safety invention on the road to commercialization. This ranged from the creation of a database to the development of a marketing plan.

“As for all research projects, the BARDOT project had its ups and downs,” Hirleman says. “Nothing would have been achieved without the partnership between food science and mechanical engineering, since neither group had anything close to the expertise required to do the project alone.”

When it came time to create a database for the scatter signatures and to develop more sophisticated image processing, the team brought Purdue Cytomics Professor Paul Robinson’s expertise to the table. He and some students had been working on multi-spectral analysis for cell detection and were able to adapt their research to develop methods that worked well with the BARDOT system.

Financial help came from graduate students at Purdue’s Fort Wayne campus, who developed a business plan and marketing strategy that resulted in funding for construction of the BARDOT system prototype.

“Financial help came from graduate students at Purdue’s Fort Wayne campus, who developed a business plan and marketing strategy that resulted in funding for construction of the BARDOT system prototype.

Recent Outbreaks
Last year, more than 270 cases of Salmonella infection that spread across 35 states were attributed by the Centers for Disease Control (CDC) to tainted 7-ounce ConAgra-produced pot pies. Sixty-five people were hospitalized; no deaths were reported among the ill, who ranged in age from one to 89.

In March of this year, state health officials in southern Colorado attributed a Salmonella outbreak to a town’s water supply. And the CDC on March 22 warned consumers to stop eating cantaloupes from a Honduran grower and ordered the FDA to intercept the company’s cantaloupe shipments. More than 50 people were infected with Salmonella; 14 of them were hospitalized.

Back in 2000, Cargill Inc. voluntarily recalled 16.7M pounds of ready-to-eat poultry deli meats after a Listeria outbreak that was the suspected cause of four deaths and three miscarriages. The year before, Listeria-contaminated hot dogs distributed by Sara Lee Corp. were blamed for 15 food-poisoning deaths and six miscarriages.

Over time, outbreaks of E. coli and Salmonella from fresh fruits and vegetables have greatly increased. One of the biggest E. coli outbreaks in recent history happened in the fall of 2006 when bagged baby spinach from Dole Food Co. caused more than 200 people to fall ill; three of them died. The cause of the contamination? Runoff water from a cattle farm adjacent to the spinach field contained cow feces.
2008 Distinguished Engineering Alumni

Michael J. Cavé
Senior Vice President
Business Development and Strategy
The Boeing Company
BSE ’82

For his financial and managerial leadership in the commercial aircraft industry

Moira A. Gunn
Host, National Public Radio
“BioTech Nation” and “Tech Nation”
PhD ’74 (Mechanical Engineering)

For her leadership in bringing together people and technology, building conversations at the frontiers of new knowledge, and making possible the informed considerations critical to responsible citizenship in a global community

Anthony Harris
President and CEO
Campbell Security Equipment Company
BSME ’75

For his outstanding leadership in transforming the social fabric of engineering and for excellence as an engineer and entrepreneur

Debra L. Haley
Special Assistant to the Commander (Ret.)
Aeronautical Systems Center
Wright-Patterson Air Force Base
BSAAE ’78

For her civilian leadership activities in the United States Air Force

Tresa M. Pollock
Professor of Materials Science and Engineering
University of Michigan
BSMetE ’84

For her leading research on high-temperature materials and leadership in the broad field of materials science and engineering
Purdue University’s Ray W. Herrick Laboratories, a hub of industry-oriented research in areas ranging from advanced automotive technologies to “smart” buildings, turns 50 in July with an eye toward the future.

The labs were spawned from the marriage of two distinctly different disciplines at a time when interdisciplinary research was rare. The collaboration that launched the labs was between an animal sciences professor and a mechanical engineering professor who wanted to study the effects of climate on animals. The mechanical engineering professor, William “Bill” Fontaine, mentioned the concept to Ray Herrick, the owner of Tecumseh Products, one summer while Bill was visiting Tecumseh Products to explore research relationships. Ray Herrick liked the idea and donated enough money to start the labs. Established in the 1950s, the laboratories are housed in a brick horse barn built a century ago near State Street and Russell Drive.

“Herrick was ahead of its time, because it started as an interdisciplinary collaboration when it wasn’t fashionable to do so,” says Patricia Davies, Herrick director and professor of mechanical engineering. “Today, of course, interdisciplinary research and vital ties to industry are the foundations of Purdue’s Discovery Park, but Herrick was really founded on the same principles many years ago. And we’re still very interdisciplinary.”

Some 688 Herrick students have completed master’s and doctoral degrees. Among the research conducted at the labs are projects that involve collaborations with faculty in areas including other engineering disciplines, speech, language, hearing sciences, and psychology. The Herrick family is still involved with the laboratories. Ray’s great-grandson, Todd, through the Herrick Foundation, is sponsoring some of the research in thermal sciences done by ME professors Eckhard Groll and James Braun.

Plans are under way for a new building to be located adjacent to Herrick that will house offices and experimental facilities for more than 90 graduate students, 25 faculty, post-docs and visiting researchers as well as technical and administrative staff. The building itself will also serve as a living laboratory for its researchers.

“The overall concept behind the new Herrick labs is to go ‘beyond green’ and learn through research how to further increase energy efficiency and lower environmental impact but also integrate occupant comfort and productivity into building design objectives so that you design spaces that people actually want to be in,” Davies says. “The living lab is important, because we want to be able to demonstrate that the concepts work and identify where the problems are, so that they can be addressed.”

E. V.
Lasting Tribute

Scholarship honors long friendship

When Richard T. Hartzell (BSME '57), died of cancer in 2006, his longtime friend Larry Miller wasn’t ready to say goodbye. Instead, he funded an engineering scholarship in the hope that Hartzell’s spirit—his excellence in engineering and his dedication to family and community—would live on in future engineers.

What makes this a remarkable story is that donor Larry Miller has no connection to Purdue. He was simply so moved by his friend’s accomplishments that he endowed Hartzell’s alma mater with the four-year renewable scholarship for undergraduates.

Hartzell spent his career as an automotive engineer. He was driven by an entrepreneurial spirit and passion for life. After Purdue, he joined the Air Force in 1959 as a lieutenant and put his engineering skills to work studying maintenance procedures, drafting guidelines, and creating training manuals for the upkeep of the fleet. He joined Pontiac Motors in 1962 in the experimental and testing department and moved in 1984 to Nissan Motors USA as vice president of service.

Hartzell’s creative spirit and curiosity drove him to explore many fields beyond engineering. They ranged from education—he obtained an MBA—to antiques and real estate, and from farming to classical music. He was active in his community of Orchard Lake, Michigan, serving on the city council and as mayor of Orchard Lake. A hunter and nature lover, he helped write development codes to preserve the natural beauty of the area and its lakes and wetlands.

He was also involved at Kirk in the Hills Presbyterian Church as a trustee and curator of the art collection.

Miller and Hartzell met over tennis and played regularly for 30 years. They also shared a love of engineering. “We were both passionate about what we did, and we respected each other’s interests,” Miller says.

Ann Hartzell says she and the couple’s four children were moved by the show of friendship for her late husband. “What a wonderful tribute to Dick and to their friendship,” she says. “I know that Dick never expected to receive such an honor. What a tremendous legacy.”

Lindsay Van Esler, who in the fall will enter her sophomore year in civil engineering, is one of the first recipients of the Hartzell Scholarship. She hopes to use her education to do something for the environment, possibly in green building. The scholarship, she says, has given her the freedom to study at a top engineering program and engage in the Engineering Student Council and her sorority without worrying about a part-time job. As a student, Hartzell shared similar interests, as a member of the Student Union Board and spending time outside the classroom with his fraternity.

Van Esler, a Missouri native, seems to fit the description of a Hartzell scholar, who in the words of Ann Hartzell, should understand that “one never knows what life will bring; uses the skills they have been given to the best of their abilities; enjoys life; has fun; accepts challenges and learns from them; and values faith, family, and friends.”

The Hartzell scholarship opened doors I did not even know existed. I can receive a first-class education while participating in research, service projects, and other activities that will equip me with the skills and experience necessary to succeed in the ever-widening field of engineering. With the knowledge and experience I gain as a student here at Purdue, I will be able to fulfill my personal goals as well as contribute to the advancement of science and technology.

Name: Kristin Wood, Hartzell Scholar
Hometown: Littleton, CO
Major: AAE (sophomore in fall 2008)
Career goal: Work with spacecraft and space equipment
Global Engineering Seeks Engagement at all Levels

What does it mean to be a global engineer? Rabi H. Mohtar, director of Purdue’s Global Engineering Program (GEP), has an answer. And it is one that goes far beyond traditional definitions. It includes immersion in other cultures that surpasses the traditional concept of study abroad and is broadened to include complete engagement with other cultures from the undergraduate level to the most senior professors.

“It is our belief that preeminence in global engineering comes through engagement of the international community and in sustaining our presence and leadership where we are needed the most,” says Mohtar, who is a professor of agricultural and biological engineering and the recipient of the 2008 Purdue University Agricultural Research Award.

With help from GEP, Purdue Engineering will continue to make a difference in the world but will do so with even more impact, Mohtar says. This will happen by training well-rounded global engineers who assume international leadership roles, leading in research discoveries on issues of global concern, and taking responsibility for international development where appropriate technology is needed.

The United States currently spends $329B a year on research and development, the equivalent of 31 percent of the world’s total expenditures, according to Mohtar. By 2030, that number is expected to dip to 18 percent. Mohtar is determined to reverse that trend by taking an integrative approach ranging from finding a way for any student—regardless of financial ability—to engage in overseas study to an innovative database that matches researchers with international development projects.

“The rising globalization trends, international competition, and the changing societal, professional, and global landscapes for engineering graduates call for action towards integrated strategies in learning, discoveries, and engagement to prepare engineers for the future and to claim the position that engineering once had in society,” Mohtar says. ■ L. T. T.
Economy and Environment

With claims that environmental regulations, green building, and other protect-the-earth measures could strangle the economy, many corporations, developers, and investors feel they face the challenge of sacrificing one for the other. Others believe there’s a middle ground that could satisfy both factions. What’s in the cards for our future?

Question:
Can economic growth occur alongside increasing concerns about the welfare of the environment—energy needs, sustainability, green building, water quality—or does one trump the other?

Answer: We have the creativity, knowledge, and resources for both the environment and the economy to win—now, we need the will.

Working in the environmental area, it is easy to become pessimistic because of terrible calamities befalling us. But I tend to be an optimist. People are extremely clever and very entrepreneurial and our society is resilient. No environmental issue—energy, deforestation, overpopulation, or any grand challenge—is technically impossible to address. For every environmental issue I can think of, we at least have the technical capability to solve it.

The question is, “Do we have the will?” I hope we do. It will come with time and struggle.

Today, we are faced with tremendous environmental challenges: climate change, our relationship to energy and oil consumption, an extinction event that the earth hasn’t seen in 65M years. This can be depressing.

Yet, we’ve achieved some successes, such as banning chlorofluorocarbons to save the ozone layer. While today’s problems may be more challenging, they are not substantially different. If we apply that same sense of urgency to today’s issues, we can make it happen.

I’m optimistic we will solve these problems. We can have sustainable energy. Green technology allows us to lower our carbon footprint. We can design buildings that use less energy, develop new technology to more efficiently turn sunlight to electricity, and run cars off of light. Solutions are not dependent on substantial, new scientific discoveries. They are engineering problems, and I think of a lot of these solutions will be found right here at Purdue.

Any objection that solutions would cost too much is a red herring. It’s a matter of how you want to allocate your resources, a matter of doing things differently. And what’s more expensive—$4 for a gallon of gasoline or research that leads to a 58-mile-per-gallon car? It seems to me that future high-energy costs are inevitable. Investing today in programs that will lead to alternative energy, environmental sustainability, and energy conservation makes good economic sense.
Answer: Absolutely the two can successfully co-exist. In fact, environmental efforts are going to be catalysts to economic growth.

I see environmental concerns taking the lead in many different markets, especially in the building industry. Companies are looking for office spaces that fit their corporate social-responsibility commitments to their shareholders. More than 60 percent of Fortune 500 companies have joined the Carbon Disclosure Project, all seeking to reduce their carbon footprints. Attention to the environment is creating new industry sectors and a demand for specialized trades and designers or engineers with advanced technology degrees. It’s a huge driver for the economy.

Most clients I deal with are beyond the question of cost. People who focus on costs first are late to the game. The more educated, advanced owners know sustainability may cost more in the initial development project budget. The savvy owners are asking, “What can I sell this building for? How quickly? What premiums can I command in rental rates?” They’re looking at reduced insurance rates, tax incentives, and development density bonuses—all offsetting those first costs. They’re investing in something that has a payback, and the return can be very, very short.

Today, the question is no longer, “How much does it cost?” The question now is, “What is the payback or return on investment?” In places like Chicago, where expedited permitting is available for green buildings, the question I pose is, “What is the cost of not going green in a city like Chicago?”

Buildings are huge energy consumers, representing some 39 percent of our country’s energy use. Not only do we want to curb that, studies show that green buildings offer other benefits. Retailers with day-lit stores are achieving higher sales, green hospitals report quicker recovery times for patients, and schools find students perform better on math and reading tests with more daylight in their classrooms.

Sustainability and environmental best practices for design and construction are the next step in the building development industry. Without it, there even may be a stall in economic growth.

Answer: It’s possible to avoid the trump, with planning and cooperation.

When it comes to construction, new methodologies and preplanning techniques are emerging that will help reduce building costs and increase the rate of return on investments, so you don’t have to choose between protecting the environment or constructing your building.

Upfront design and good planning are key. By training students to use modeling systems, we can simulate what it will take to execute the project and look for ways to improve construction methods, saving time and money, reducing waste and protecting the environment—all without changing the original intent of the project or building. And all of this can be done up front.

The focus on both a wise economic investment and the environment should be established as success criteria from the start of the project—at demolition, if it’s needed, during excavation and throughout site preparation. An implosion can be attentive to environmental impacts. For example, there are ways to reuse concrete and other materials to avoid or curb landfill waste. And construction methods can be used that avoid over-use of water or air pollution. If you’re doing a lot of grinding, for instance, you might use bubble containment to filter the dust.

While green materials can be more costly, materials with higher recycled contents offer considerable benefit. They’re available in drywall, floorings, and ceiling tiles. Even paving materials can be specified to utilize materials with higher recycled content. That’s one aspect. Another is reusing existing materials.

No, neither the economy nor the environment trump the other. But added assurance comes through innovative methods and an early partnership between design professionals, contractors, and the owner.

—KATHY MAYER

What’s your take on this issue?
Write to us at peimpact@purdue.edu
What Is It?
See lower right for answer (rotate page).
This colorful collage consists of work by MSE Professor R. Edwin García. It is actually two superimposed simulations of the nucleation and growth process of an undercooled Nickel melt. The background shows periodic nuclei during the initial stages of the solidification process. The superimposed structure in the center corresponds to a single solidified Ni-dendrite. The coloring embodies the degree of crystallinity and the orientation of each nuclei. Simulations were performed by Michael Waters (BSMSE 2008). García's work is featured in the current issue of MSE Impact.
Before 26,000 joined the National Society of Black Engineers, six sparked the flame. Here. At Purdue.