The Cougar Engineer

winter 2011 volume 5

Engineering Resiliance

UH Education Helped Alumnus Rebuild the Galveston Seawall

Deep Roots

UH Couple Share a Rich History with the University of Houston

FEATURE

FUTURE POWER:
Securing Energy in the 21st Century

Could algae be harnessed as a reliable fuel source? Find out in this issue's feature, ***pg. 6***

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CULLEN COLLEGE of ENGINEERING

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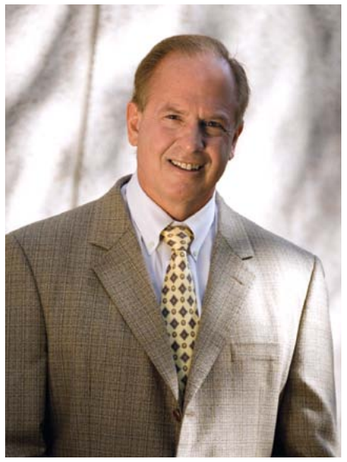


Greetings Cougar Nation!

Happy New Year! This year marks the 70th anniversary of the UH Cullen College of Engineering. Since 1941, the Cullen College has served the educational needs of the great city of Houston, our vast engineering-centered region and, frankly, communities around the world. Some 17,000 graduates have earned their degrees from our undergraduate and graduate programs, many of whom travel great distances to study at UH and many of whom have taken their education beyond the borders of Houston and are doing great things in their professional practices. It is absolutely amazing to look back at these 70 years and see the impact this educational institution has had through each one of your successes!

The University of Houston, at large, continues to make history. We recently received some very exciting news regarding our Tier One journey. In mid-January, the Carnegie Foundation categorized the University of Houston as having very high research activity, a classification equivalent to Tier One status. UH is now one of only three public universities in Texas with this classification, the other two being The University of Texas at Austin and Texas A&M University. This is tremendous progress for the University of Houston and we hope you join us in sharing the great things going on here at UH!

The University also made history this past year in an area that involves you — giving. UH raised more than $100 million in private and corporate support in fiscal year 2009-10, which is the largest fundraising year on record. Of that, Cullen College of Engineering donors gave more than $7 million in gifts, creating one of the most successful fundraising years in our college's history. We are truly thankful for your continued support of our programs and our students.

In this issue of *The Cougar Engineer,* we feature several alumni who are working to power the future through alternative energy sources. Cougar Engineers are involved in every aspect of developing technology in wind, solar, biofuel production and smart grid technology. From researching in the lab to starting companies and selling consumer products, these alumni are at the cutting-edge of what we're beginning to see and will be experiencing in the very near future.

Go Coogs!

Joseph W. Tedesco

Joseph W. Tedesco, Ph.D., P.E.
Elizabeth D. Rockwell Dean and Professor

TRAINING Grounds

by Toby Weber
photo by Thomas Shea

John Grounds (MSCE ’86, PhD CE ’88) had a daily routine when he was working toward his Ph.D. in civil engineering at the Cullen College. Most of it was pretty standard stuff. Research and thesis work in the morning, classes in the afternoon.

One part wasn’t so routine, though: the 20-mile bike ride he squeezed in during lunchtime every day.

Since earning his doctorate, Grounds has kept endurance-based exercise, particularly running, an integral part of his life. He’s completed 24 marathons, nine ultra-marathons, dozens of triathalons and three M.S. 150 cycling events.

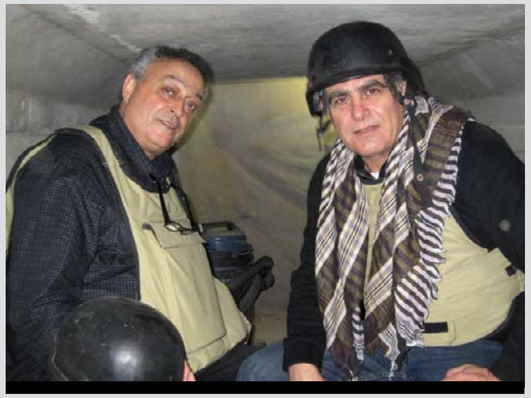
And he’s nowhere near finished. This January, in fact, he ran his 21st consecutive Houston Marathon.

For Grounds, exercise has always been about more than staying in shape. It’s a way to keep things in perspective and even get work done. “This is a great way for your subconscious to solve problems,” he said. “Back when I was in school writing computer code, sometimes what I needed to do wasn’t that obvious. So I’d just take off and go for a run or a bike ride and have it figured out before I got back. It’s the same way today.”

Read the full story at www.egr.uh.edu/cougarengineer

Above and Beyond:

Alum Working on International Initiatives



Ghodsi (right) with Majid Shayan, president of Concord International Import and Export Company, in Afghanistan

Cullen College alum Alireza Ghodsi, P.E. (MCE '78), chairman of the board of the international corporation Rigid Global Buildings (formerly Rigid Building), traveled to the Middle East as part of a small U.S. delegation to meet with officials in Afghanistan about rebuilding the war-torn country.

Invited to participate by Paul Brinkley, a deputy leading a special task force under U.S. Secretary of Defense Robert Gates, Ghodsi was one of only a handful of successful Iranian-American businessmen invited to Afghanistan to discuss how the private sector can help in the rebuilding of the nation.

"We were invited to participate not only because of the wealth of knowledge we've developed in our industries but because the Iranian culture is somewhat similar to that of Afghanistan," said Ghodsi. "Our appearance is quite similar as is our language, so it was thought we would be able to connect with the leadership and people in the country."

The trip included tours of Kabul and Herat, Afghanistan, meetings with their respective mayors and city officials and a special summit with General David Petraeus, the commander of NATO forces in Afghanistan.

The focal point of these discussions involved newly discovered mineral deposits located in the Afghan mountains and how the U.S. can aid the country in developing a transparent, international bidding process to help extract the minerals. Since most of the mining industry in Afghanistan is still artisan, the country does not have the industrial infrastructure necessary to mine the minerals.

Estimated to be worth more than a trillion dollars, the extraction of these minerals would fund the rebuilding of the country. The discussions ultimately resulted in the signing of various Memorandums of Understanding (MOUs) outlining the role of the U.S. and private industry in developing a framework for the process.

While visiting Herat, Afghanistan, Ghodsi had a very unique opportunity to help the people of the country. In a televised announcement, he donated a quickie building to the University of Herat for the purposes of establishing a facility to be utilized for women's health education. With a daughter serving as an obstetrician and gynecologist, the cause was very close to his heart.

"This gave me an opportunity to not only impact the business issues in Afghanistan, but to impact the human side," he said. "They are in great need over there, so it gave me a chance to help the people."

Land on the university campus was donated for the erection of the building, which will be delivered via a C130 U.S. Air Force plane and built by Ghodsi's crew. It might be the first of many such opportunities, he said, to help the educational needs of the country.

In addition to touring Afghanistan, the delegation also visited Basra, Iraq, in pursuit of very similar discussions. Though Ghodsi acknowledges that the trip was quite substantial for both business and human interests, both countries have a long way to go in securing peace.

"We lived in bunkers while there and were faced with mortar attacks every night," he said. "It was definitely an eye-opening experience on every level. Our troops and soldiers are certainly doing a great job to make the United States a safer place."

Ghodsi opposite General David Petraeus, commander of U.S. NATO forces in Afghanistan, in a meeting to discuss how the private sector can help rebuild Afghanistan

Ghodsi (left) with Paul Brinkley, a deputy under U.S. Defense Secretary Robert Gates, and Bijan Kian, director of the Export-Import Bank of the United States

Reunions

The Engineering Alumni Association is teaming up with departments in the college to create reunion events for every discipline. For the second consecutive year, the civil engineering reunion attracted hundreds of alumni and students this fall to the Oct. 15 event, which included a reception, dinner, dance and casino night. As part of the EAA initiative "Connecting Alumni to Students," the event has been successful in drawing large crowds and will begin to branch out to other disciplines this spring, starting with the chemical engineering reception slated for April 7. For more information on these events and other activities, visit www.egr.uh.edu/EAA.

Most Spirited

The University of Houston Engineering Alumni Association captured the Most Spirited prize during the 2010 Tailgate Spirit Challenge on Nov. 13. The challenge was part of the annual homecoming festivities sponsored by the University of Houston Alumni Association. In addition to providing great food and networking, the EAA held an auction to benefit UH engineering students.

Mark Your Calendar

FEB 22 — **Engineering Alumni Association EWeek Reception**
6-8 p.m., UH Hilton
www.egr.uh.edu/eaa/events/?e=eweek

MAR 10 — **IEEE Chili Cookoff**
5 p.m., Between Engineering Bldg. 1 and The College of Technology Building

APR 4 — **UH Engineering Golf Tournament**
12 p.m., Hearthstone Country Club
www.egr.uh.edu/alumni/events/?e=golf

MAY 1 — **ASME/OH Cajun Crawfish Boil**
1 p.m., UH Lynn Eusan Park

JUN 3 — **Alumni Awards Gala**
6 p.m., Four Seasons Hotel, Downtown Houston

Stay **Connected**

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Are you a user of Twitter, Facebook or LinkedIn? If so, connect with your alma mater at one of the Cullen College's pages on these social networking sites, and join our new page on Amplify!

FUTURE POWER

securing energy in the 21st century

story by **TOBY WEBER** *photos by* **THOMAS SHEA**

Consider that the average life expectancy in the United States now stands at 78.4 years. That's more than 28,600 days, roughly 41,200,000 minutes.

Consider also that most of us easily could count on our fingers the total number of these minutes — whether young or old, awake or asleep, at home, at work or on vacation — when we won't consume power in one form or another.

And finally, consider population growth. The United States is expected to go from approximately 310 million people today to more than 373 million by 2030. Over that same span, global population is set to grow by nearly 1.5 billion people to 8.4 billion.

We need more power, and we need it soon.

Getting this power isn't simply a matter of pumping more oil or building new power plants. Economics and the environment have moved us past that point. Instead, it will require that we use the power we generate more efficiently, develop new sources of energy, and make alternatives viable not just in a lab but in the market.

University of Houston Cullen College of Engineering alumni are proving they are up to these tasks. From conducting ground-breaking research in biofuels and superconductors to making the economics of solar and wind work, Cougar Engineers are doing all they can to help power the future.

Alumni in the Lab

One of the Cullen College's top alums in the energy field is also one of its standout faculty members, Venkat "Selva" Selvamanickam (MSME '88, PhD ME '92), M.D. Anderson Chair Professor of Mechanical Engineering. In 1986, just a few months before Selva began graduate school, researchers in Switzerland discovered a superconductor (a material that conducts electricity with absolutely no electric resistance) made from ceramics that worked at significantly higher temperature than all other known superconductors. At the time, other superconducting materials were being used in niche applications, but their broad use was limited by their very low operating temperature. The high temperature ceramic superconductors opened up whole new fields for the technology.

Venkat Selvamanickam, Professor, UH Cullen College of Engineering

Power applications are chief among these. Seven to 10 percent of the power transmitted over legacy electrical lines, for instance, is lost due to electrical resistance. Removing that resistance could dramatically increase the amount of power utility companies provide without requiring the construction of new multi-billion-dollar plants running, most typically, off coal. Zero electrical resistance also makes superconductors ideal for energy storage, especially backup devices for wind and solar power. And higher conductivity means smaller, lighter components for all sorts of devices, allowing, for example, more powerful but smaller generators to be placed at the top of wind turbines.

This discovery started a new era for superconductor research, one that Selva has been involved in since the beginning. After completing his Ph.D., he entered industry where he eventually rose to chief technology officer with SuperPower, a firm specializing in superconducting materials. Two years ago, he came back to the University of Houston, where he continues working with SuperPower through research grants and licensing agreements.

With an engineering education and business background, it's no surprise that Selva's superconductor research focuses on real world problems and solutions. "My research has always been about taking the existing superconductors and making them into something useful and practical," he said.

For example, one of the biggest challenges of these superconductors is that, like all ceramics, they are brittle. While that might not matter much in a lab, in the field things that break easily just aren't very useful. Selva and his team, therefore, have developed a manufacturing technique that deposits layers of various materials, including a superconducting ceramic, atop a nickel alloy. The end product is a ribbon of superconducting material no thicker than a few sheets of paper that is both flexible and can be easily mass-produced. By refining this technique and adding nanostructures to the superconducting wire, his lab has recently doubled the performance of its superconducting wire, setting a world record for magnetic field generation in a coil.

This work has brought Selva and his partners considerable praise. Along with his research partners at SuperPower and Oak Ridge National Laboratory, in 2010 he won an "Oscar" of the science world, an R&D 100 Award. And at a U.S. Department of Energy annual peer review gathering, his lab was selected as the top superconductivity wire research program in the United States two years running.

Selva isn't the only Cullen College alumnus and faculty member researching the future of energy. Michael Harold (PhD ChE '85), M.D. Anderson Professor of Chemical and Biomolecular Engineering, is one of the college's most prolific investigators. His extensive research portfolio includes important work in the field biofuels.

Corn is the crop most commonly associated with biofuels. Luckily for its proponents, it conjures a near perfect image for an environmentally friendly alternative energy source: farmland filled with row after row of tall, gold and green cornstalks swaying in the summer breeze. Natural, pure and wholesome.

Harold doesn't work with corn. He works with black and green sludge in glass jars. That sludge is the product of aquatic biomass, typically algae, that Harold is working to turn into a crude oil-like substance through a process known as pyrolysis. "We take algae or any aquatic plant and heat the heck out of it in an inert atmosphere," he said. "That breaks it down into its components.

"How do you optimize the **algae** to extract as much value downstream from a fuel standpoint? It's a very interesting question."

Michael Harold, Professor, UH Cullen College of Engineering

What you get is kind of an energy-rich mess of four phases — oil, aqueous, solid and gas phases. What we are trying to do is upgrade that mess into something valuable."

So what is valuable when it comes to pyrolized aquatic biomass? The easy answer is its hydrogen and carbon content. The real answer is much more complex. Algae are primarily made up of carbohydrates, proteins and lipids. Any algae that is used as an energy source on a large scale would be grown and harvested. And the farmers and refiners will have to make decisions regarding what strains of algae should be grown and how to cultivate that algae. These decisions have a significant effect on what its chemical content will be. And that means tradeoffs.

If the rate at which algae is grown is given the greatest weight, it would likely require the use of more fertilizer, light and carbon dioxide. But fertilizer contains nitrogen, and that nitrogen would lead to higher protein levels in the algae. When that algae is ultimately combusted the same nitrogen will lead to the pollutant NOx in the exhaust of biofuels made from it. Ironically, NOx is one of the very things Harold is working to remove from engine exhaust in other research projects.

Alternatively, algae strains with high lipid, or fat, content are very desirable, since the lipids are similar to the hydrocarbon molecules that make up crude oil. One way to grow algae with high lipid content is to grow it in the dark and feed it less nutrients. This will cause the algae to go into survival mode and to synthesize the lipids. But algae grows much, much slower in the dark than in the light. This slow growth would detrimentally impact the algae to fuel economics, Harold said.

"You can't separate the algae growth and harvesting from what you do downstream, because what you get from the algae is impacted by that growth and harvesting," he said. "It's a very interesting question: how do you optimize the algae to extract as much value downstream from a fuel standpoint."

Given these tradeoffs, Harold's research extends beyond just perfecting the pyrolosis of algae to include providing information on exactly what is produced from algae with different compositions. With that information, energy companies, refiners, and potential algae farmers can make informed decisions about which path, if any, their algae-to-oil work should follow. He and his coworkers are also figuring out ways to upgrade the pyrolysis products into fuels that can be burned in conventional applications like furnaces and even engines.

"The biggest energy challenge the country is now facing is transportation fuels," Harold said. "There's wind, nuclear, solar and even clean coal that can be brought to bear on our electricity needs. But liquid fuels have to come, for the foreseeable future, from petroleum. Biofuels are a way to compete with petroleum in the short and longer term. So we're in the early stages asking whether it's viable to think about growing fuels."

Innovating in Industry

There's already at least one Cullen College alum who thinks he's found a key to making biofuels viable: Roman Wolff (BSChE '83, MSChE '87), president and founder of Enhanced Biofuels. As a longtime veteran of the petroleum industry, Wolff readily admits that his entry into the biofuels sector was something of an accident.

About three years ago he was asked as a favor to find a U.S. buyer for a biodiesel producer in Argentina. He began investigating the market and technology and found the process for producing biodiesel surprisingly simple. "You just take vegetable oil, a caustic and methanol. This is just old soap-making technology from the Middle Ages. I was coming from the refining industry, so it seemed just crazy."

So crazy, in fact he was convinced he could develop a more rational method of producing biodiesel. And so Enhanced Biofuels was born.

"If I had been better in the lab, we probably would have started with glass," said Wolff. "But I'm best with steel, so we built a pilot unit and started mapping out a big area of technology to see where we needed to go. We got lucky and hit on something fairly close pretty quickly. We've been optimizing ever since."

While Wolff won't explain the exact process, it utilizes the basics of every refining process, combining temperature, pressure and a catalyst to yield a desired product.

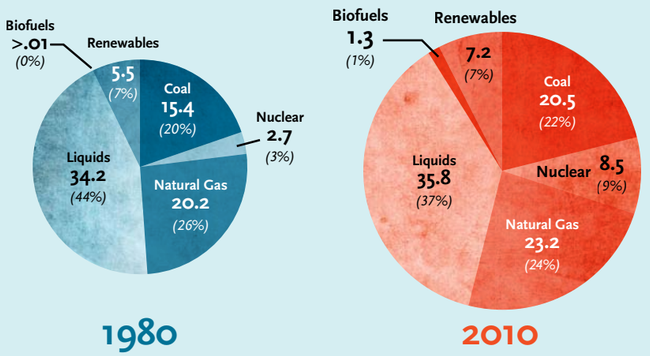
But what most defines Enhanced Biofuels process is that it changes the economics of biofuels by eliminating the use of caustics.

Caustics, Wolff said, are a major source of trouble and expense in the biofuels refining process. When combined with the high levels of free fatty acids in cheaper feedstocks, for example, caustics form soaps, which grind the refining process to a halt. With no caustics in the process, refineries can more easily use these feedstocks, lowering their overall costs. This is particularly important since feedstock makes up more than 85 percent of all operating costs of a biofuels process. No caustics also means no money is spent removing them from fuel.

What's more, Wolff said, using his process can not only cut costs, but can increase income. Biofuels refineries produce glycerol as a co-product of the refining process. When caustics are mixed with glycerol, he said, these biodiesel refineries can sell it for about three cents per pound. Without caustics, the price of clean glycerol shoots up to about 30 cents per pound. Beyond biofuels, the technology also has applications in reducing acidity of crude oil to improve the margins of conventional refiners by lowering the price of their feedstock.

"We can lower the amount refiners pay for their feed, lower the cost of operation and increase the value of their co-products," said Wolff. "This is about the economics of any chemical process."

U.S. ANNUAL PRIMARY ENERGY CONSUMPTION, THEN AND NOW *(in quadrillion BTU)**



SLOW CHANGE

Not surprisingly, energy consumption in the United States has dramatically increased during the last 30 years. While biofuels and renewable energy sources such as solar and wind have grown as well, they don't make up a significantly larger portion of the nation's energy portfolio today than they did in 1980. Clearly, engineers and businesspeople must continue working diligently to make alternative energy both abundant and affordable.

* Source: U.S. Dept. of Energy

Roman Wolff, President, Enhanced Biofuels

Improving the business case for **wind** power means improving blade design to increase energy production.

Wolff isn't the only Cullen College alum working to improve the economics of energy. He has at least three counterparts in the wind sector: Ryan Link, Shanshan McNeill and Aisha Garel.

All are researchers with Vestas Technology Americas Inc. in Houston, a subsidiary of Denmark-based wind turbine manufacturer Vestas. The company has operated in the United States since the early days of wind turbines, but in recent years has expanded its research, engineering and manufacturing operations in this country.

While they don't all work on the same projects — Link and McNeill are structural engineers while Garel focuses on turbine controls — all their research has the same endgame: to improve the business case for wind power.

For Link and McNeill, that means analyzing and improving blade design to increase the amount of energy they produce and/or reduce the loads on blades. This, said Link (BSEE '02, MSME '04, PhD ME '08), is an aeroelastic challenge, one that involves the interplay of the blades with wind.

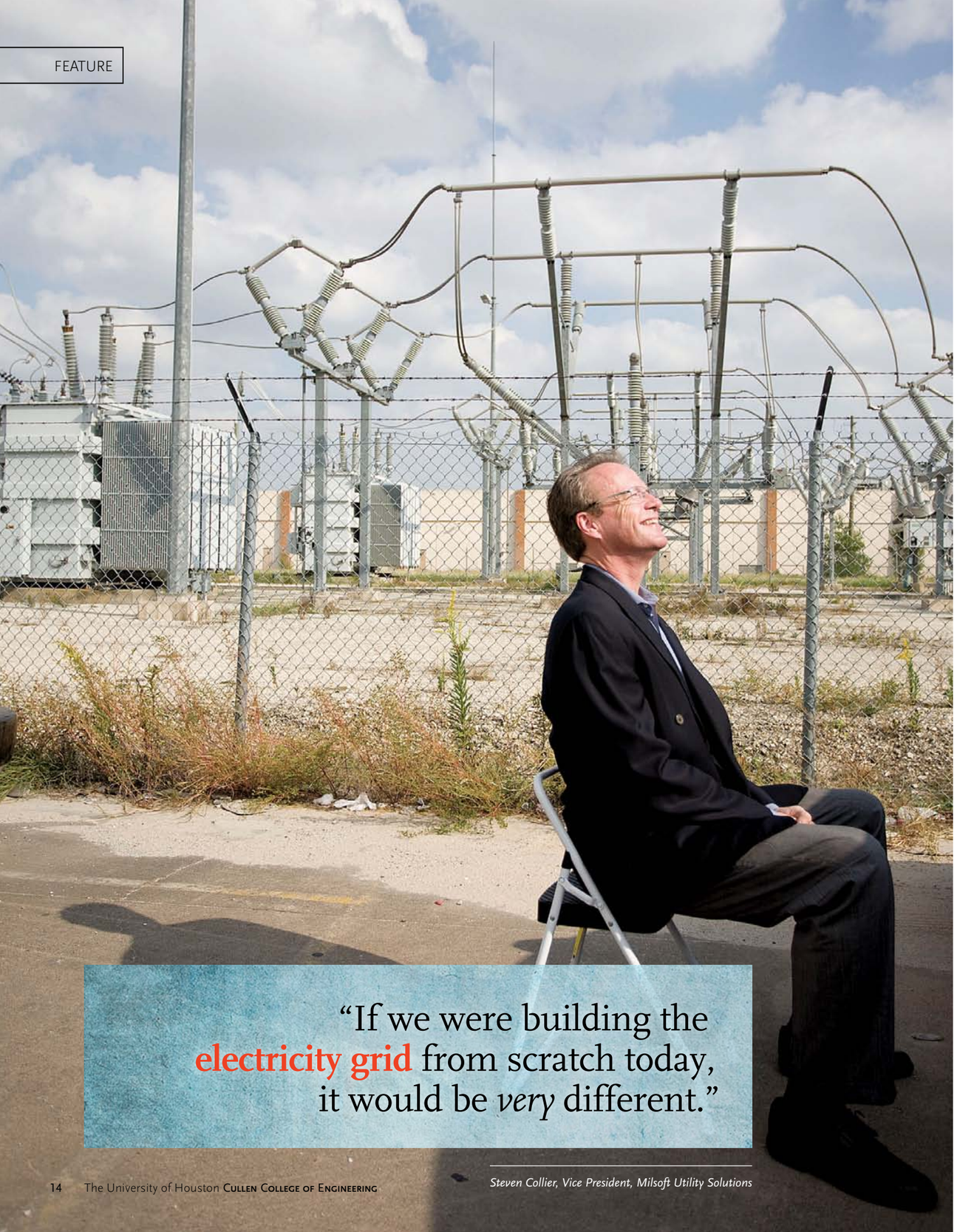
"The movement of such a long, slender structure can become very complicated, and when you couple it with air loads, it becomes even more complex. So our work is a matter of understanding that complexity and designing for increased power based on this understanding."

Increasing power is only one part of the equation, though. Wind turbines are large investments, so improving the reliability of the blades (and the entire structure) is the other major goal of Vestas' structural engineers. If, said McNeill (MSME '05), researchers can extend the reliable lifetime of a wind turbine, the lifecycle costs of a wind farm will drop dramatically, making them more appealing to energy suppliers and more affordable for consumers.

Structural research, of course, is not the only way to improve the economics of wind. As a controls engineer, Garel (MSAeroE '07) develops the code for controls that operates the turbines. These manage basic turbine functions such as startup and shutdown. Like the work of Link and McNeill, though, they are also used to increase energy output or improve the reliability of a turbine. As the wind shifts, for instance, the direction of the blades can be adjusted to generate the most energy. Or on a too-windy day, they can be turned or pitched at different angles to reduce the loads on the blade, thereby reducing wear and tear.

"Everything we do has to be justified by one of two goals," said McNeill. "We either have to bring down the cost of energy or increase the business case certainty for the customer by improving output, increasing reliability or reducing operation and maintenance costs."

Vestas engineers Shashan McNeill, Aisha Garel and Ryan Link



"If we were building the **electricity grid** from scratch today, it would be *very* different."

Steven Collier, Vice President, Milsoft Utility Solutions

The Theory and Practice of Smart Grids

Steven Collier is a utility lifer. Currently a vice president at Milsoft Utility Solutions, he's worked in the utilities industry for more than 35 years. Known as the SmartGridMan, Collier's decades of knowledge, experience and leadership make his thoughts on the nation's electrical grid widely respected and sought after.

And what are these thoughts? "If we were building the electricity grid from scratch today," he said, "it would be *very* different."

In Collier's eyes, the defining feature of the country's electrical grid is its use of brute force for planning and operations. The grid is designed and operated to meet a peak demand that is reached for only a few hundred hours each year. The average demand throughout the year is less than half the peak, resulting in expensive grid assets being underutilized for a vast majority of the time.

Such brute force just isn't feasible anymore, said Collier (BSEE '76). Increasing electricity demands continue to be placed on this aging and inflexible grid infrastructure, while daunting barriers exist to the addition of new generators and power lines. At the same time solar, wind and other distributed sources of power generation are rapidly increasing. Given these realities, instead of a powerful fixed grid we need an agile smart grid, he said.

So what makes a grid smart? Collier divides it into three parts. The first is widely distributed intelligent electronic devices to monitor and control the grid, like smart meters that allow customers and utilities to monitor and manage power usage in real time.

The second is fast, digital telecommunications that enable data and control to be shared between and among devices, customers and utilities (more on this later).

And the third part is software, the makers of which include Milsoft, that will be the brains of the smart grid. This software will radically change how utilities operate, especially how they relate to their customers, Collier said.

Take power outages. Historically, utilities learned about outages when their customers called to complain about having no electricity — a rather backward way of doing business in the 21st century, Collier points out. With smart grids, grid operators will be able to immediately detect outages, pinpoint the problem and dispatch a repair crew while keeping customers fully informed.

Or consider increasingly unpredictable supply and demand for electricity. Consumers use power whenever they wish, all at the same price, with minimal motivation and no convenient tools to reduce peak demand. Solar and wind generate power intermittently depending on when the sun is shining or wind is blowing. Plug-in hybrid electric vehicles are mobile, consuming (and sometimes even producing) power anywhere, anytime.

All of this, he said, represents a revolutionary change in how electrical utilities must plan and operate.

"We're changing from a centralized, monolithic grid that I can plan for long term and add more capacity before things get really bad to a dynamic, decentralized grid that's always changing," Collier said. "To help our utility customers, we are changing our software from occasional use planning and operations tools to an all day, every day platform that utilities and their customers can use to fly the grid like a plane, in good conditions and bad."

A few things have to happen before the smart grid can fully take flight, though.

Smart meters and other smart devices must be further developed and the software that manages the smart grid must be continually refined and honed. And then there's that middle part: the communication.

That's where Thanh Tran (MEE '95, PhD EE '01) comes in. As a technology manager with Texas Instruments, he leads a team that specializes in the power analytics and communications aspects of smart grids.

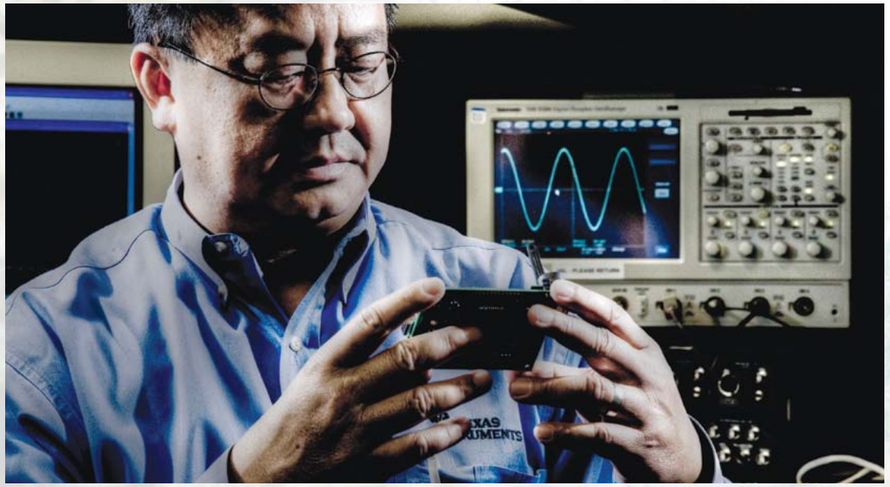
This communication relies on a proven but little-known ability of electric power grids: data transmission. Data can, in essence, be attached to the electric current that travels over the lines and sent to a desired location. Using this ability, smart meters residing on each customer premisis can communicate with concentrators or data collectors further up the grid. These concentrators can then send the information, both on individual customers and on overall grid trends and health, to utility control rooms, where operators can use it to make decisions on grid management.

Tran's group focuses on these concentrators, which must do a lot more that just collect and transmit information. They must also be able to read weakened or distorted data. That's because as data is sent over long distances on power lines and passed through transformers, its signal is attenuated, or weakened. This phenomenon occurs in both directions, whether data such as instructions regarding voltage levels is being sent to a customer, or sent from a customer, such as information on power needs.

What's more, these concentrators must be able to analyze, manage and read this data using very little power themselves. While they sit on the grid just feet away from power lines, the voltage on these lines is far too high to be useful. "The analogy is like being on the ocean," said Tran. "You're surrounded by water but can't drink any of it."

While challenges such as these wouldn't be so daunting in a built-from-scratch grid — or wouldn't exist at all, in some cases — Tran sees the integration of old and new as one of the best, most elegant aspects of this new electrical transmission paradigm.

"The beauty of smart grids is that the grid has been here for decades," said Tran. "Now we're developing technologies that can make it better than it has ever been."



"The beauty of smart grids is that the grid has been here for decades."

Thanh Tran, Technology Manager, Texas Instruments

Building Businesses

Ning Ma
Senior Project Manager, Trina Solar

> "My mission is to figure out how to reduce the cost of **solar** to a level where we can compete with conventional power."

The power research of Cougar Engineers is being performed with the clear recognition that for innovation to matter, it must make economic sense.

You can see this way of thinking in the work of other Cougar Engineers who, instead of developing new technologies, are using their engineering background to build alternative-energy businesses.

Take Ning Ma (PhD ME '05) as an example. After earning his Ph.D., Ma has spent most of the time working in the solar power industry. In early 2010, he joined China-based Trina Solar, one of the world's largest solar power companies, which opened its first offices in the United States a little more than a year ago. The key challenge to solar power's widespread adoption here is the obvious one: price. Solar, Ma said, can cost anywhere from two to four times as much as electricity from legacy sources.

As a senior project manager for Trina Solar, Ma works to bring that figure down on a project-by-project basis. While improved efficiency of solar cells does help make solar more competitive, cost savings can also be found through the design of whole solar systems, he said.

"You can break the system design down into three parts. How many photovoltaic modules do you need and can you put in a series to feed into a DC to AC inverter. The second step is the structure itself. That's where we do wind calculations, structure strength analyses and foundation design. And the third part is the AC interconnection calculation. You have to design all the circuit protections to shield the grid from the PV system and the system from the grid to prevent damage during an emergency. All of these play a big role in the initial and ongoing costs of a solar system," he said.

But Ma's responsibilities extend beyond the design of individual solar farms or installations. His biggest task over the coming years will be to develop Trina Solar's roadmap for making solar power economically viable in the United States.

That's an incredibly complex challenge with a great number of variables. He has to factor in not just the cost of a solar farm and all its components, but multiple non-engineering variables like local, state and federal regulations; permitting processes and costs; tax incentives and the political environment; and labor costs.

You only need to look at one of these to get a sense of what a complex task this is. Take labor. Labor costs in the United States are notably higher than in China. That means Ma will have to determine just how much of a photovoltaic system can and should be preassembled in China before being sent to the United States. How do the preassembled PV units impact shipping costs? And what does it mean for the construction process if and when a unit is damaged.

"My mission is to figure out how to reduce the cost of solar to a level where we can compete with conventional power," said Ma. "The main obstacle to solar is price. You have to make the business economically viable, otherwise, it cannot be sustained."

While Ma is working on the large-scale economics of solar power, Cougar Engineer Katherine Kent (BSChE '86) has already figured out how to make it work on a different level.

Katherine Kent, President The Solar Store

Kent is president and founder of The Solar Store. Based in Tucson, Ariz., her company specializes in solar-based projects for consumer, commercial and government clients. Instead of assembling large solar farms, the company handles primarily small to mid-sized projects ranging from installations of simple solar hot water heaters for homes to photovoltaic systems reaching in some cases above 50 kilowatts.

The Solar Store, Kent said, was originally a vision of her father, a Tucson-based homebuilder with strong ties in that community. In 1998, he called members of the area's solar power sector together to discuss forming a new solar venture. Kent, who at the time was working as a consultant, attended the meeting. With more rigorous professional experience than most of the others there, she agreed to perform some basic market research and assemble a rough business plan.

"When I put this together, I realized that this could actually work, that the interest was there," she said. "But the management needed to be stronger. There was no one there who knew how to put together an accounting system. Other solar people were working out of the back of their pickup trucks, buying what they needed for each job out of their personal checking accounts. That's not how you run a successful business."

So after reviewing this information, Kent, along with her father and one other partner, founded The Solar Store. Today, she is the sole owner of the business with 27 employees and annual revenues of roughly $5 million.

Looking at her background, it's no surprise that The Solar Store is a success. Kent has a strong entrepreneurial streak. As a teenager, she and her brother operated a successful business selling firewood in the Houston area, complete with advertisements on a local cable television channel. And while a single mother attending the Cullen College, she operated a delivery business that covered hundreds of square miles in Texas and Louisiana.

She called upon this experience to establish a basic level of professionalism for The Solar Store. Instead of running it like others in the area's solar community, dominated at the time, she said, by the "hippie-dippy Birkenstock crowd," she instituted basic business practices and structure: such as uniforms for her installers, the company name on the side of its trucks and membership in the local homebuilders association and other professional organizations.

Her insistence on professionalism and performance even extended to members of her family, she admits with a smile. As her business grew she hired her late husband and her son, and then fired both of them — twice.

Beyond such a strong commitment to success, though, Kent has relied upon what she learned at the Cullen College to help make The Solar Store a success. While at UH she took a series of electives with a business focus, including technical writing, engineering economics and business law. And while most of her time is spent on non-engineering tasks, she credits her engineering education with helping her learn how to think and to solve problems.

"The Cullen College provided me with a strong ability to look at a problem, determine the data I need to formulate a decision and the resources I had to pull together," she said. "It really taught me how to cut through the information that was superfluous and get to the goal."

engineering RESILIENCE

by Toby Weber

photos by Thomas Shea

JIM PALAVAN IS A BUSINESSMAN, FIRST AND FOREMOST. Yes, he's got a master's and bachelor's degree in civil/geotechnical engineering and, yes, he's a licensed professional engineer. But it's his business skills and drive that have most defined his career.

And this career has, by any measure, been extremely successful. Palavan (MSCE '79) is owner and president of one of the largest geotechnical engineering firms in Houston and operates a real estate mini-empire of 24 rental properties — to say nothing of various other smaller but successful ventures, such as fast food restaurants and medical clinics.

At the center of Palavan's work is Geo Science Engineering and Testing, which performs foundation design work, construction materials testing and environmental site assessment and review.

Palavan isn't the founder of Geo Science. He actually bought the firm in 1987 when it was known as Campbell Testing. At the time, the company had only four employees working out of one office in Houston. Twenty-four years and one name change later, Geo Science has approximately 55 employees with offices in Dallas, Houston, New Orleans and San Antonio.

While many entrepreneurs work their whole career without even approaching this level of success, Palavan insists there's no secret formula. Instead, Geo Science's impressive growth over the years is the result of hard work. Very hard work. "I'm on top of my business, day and night," he said. "I get in at 6 a.m. I work late. I come in on Saturday and Sunday. I'm always there."

That level of dedication matches up well with Palavan's business strategy for Geo Science. Instead of focusing on landing a handful of large clients, the company is built around volume, Palavan states, with most of its profits generated by its sheer number of clients and jobs.

"I'm not Saks or Macy's. My company is more like Wal-Mart," said Palavan. "I think if you do more work, you're much better off. I do a lot of volume and I have a lot of customers. That's how I thrive."

A look at Geo Science's client list shows how Palavan has pursued this strategy. While the company has worked on plenty of marquee projects (more on these later), many of its clients are chain business that, by their very nature, offer high-volume, repeat work. Over the years, these chains have included restaurants such as Whataburger, Boston Market, Burger King and Schlotzsky's Deli as well as businesses like Jiffy Lube, Christian Brother's Automotive, Family Dollar and Dollar General.

In addition to these chain customers, Geo Science is closely tied with several of Houston's largest homebuilders, including Lovett Homes and Tricon Homes, handling site review, foundation design and materials testing for practically all their projects.

Of course, just because Geo Science focuses on volume doesn't mean it passes up larger, more notable jobs. Quite the opposite, in fact. In recent years the company worked on some of the highest profile engineering projects in the entire country — many related to the devastating hurricanes that hit the Gulf Coast over the past decade.

In Galveston, Geo Science was deeply involved in the renovation and repair of the island's seawall, weakened first by age and then damaged by Hurricane Ike in 2008.

Like all projects of this nature, the engineering and design of the seawall was performed by the United States Army Corps of Engineers. Geo Science came in during the actual construction of the seawall, performing the crucial job of materials testing.

Given the scope of the project, that was a huge task. At its west end, the seawall ended at the ramp previously sloped down to sea level. These repairs eliminated the slope and extended the seawall roughly 200 feet.

For Geo Science, that meant testing every layer of soil used to raise the adjacent parking area to the height of the seawall for proper compaction and moisture levels. On the work site itself, Geo Science tested the temperature and consistency of the wet concrete in every truck brought in for new seawall construction. Then, once poured and hardened, the company conducted four tests of concrete compressive strength every 50 yards, at seven and 28-day intervals. The whole process took well over a year, Palavan said.

While that project was completed in 2010, Palavan recently opened offices for Geo Science in New Orleans in order to facilitate work in that area. Not surprisingly, much of this work involves building new seawalls designed to contain storm surges from major hurricanes. Given the traumas suffered by the people of Louisiana in recent years, Palavan and his employees fully appreciate the importance and seriousness of their work in the area. "We feel sympathy for the people of New Orleans because of Hurricane Katrina, and the oil spill just made things worse," he said. "But the main thing now is to protect New Orleans from another hurricane."

Geo Science's responsibilities on these projects are very similar to its work in Galveston. In Bayou Segnett State Park just outside of New Orleans, for instance, a new nine-foot seawall is being constructed. The structure, which is intended to stand up to a Category 3 storm, has been designed to be extremely sturdy, with foundation piles and piles supporting the footing being placed every seven linear feet.

Geo Science is overseeing the driving of the piles to ensure they reach the proper depth, as well as testing the seawall's concrete for proper strength and its backfill soil for proper compaction. The company is also doing work on a lakefront airport's T-wall style levees, as well as several other projects in Orleans Parish and Monroe, La.

While the opening of Geo Science's New Orleans office shows that the company is still growing, Palavan admits that he does occasionally entertain the idea of retirement. He's not sure what he'd do with his time, however. Fellow Cougar Engineer and wife, Geneva (BSME '82), enjoys her work as a teacher. He has two grown sons that are making their own way in the world.

The older, Sean, has a bachelor's of engineering from The University of Texas at Austin and a law degree from UH, while Shea (BSME '08) holds a degree from the South Texas College of Law. With that level of education, Palavan said, they will be able to reach success without much assistance from their father.

At the same time, Palavan's work has taken him across the country and even around the world, so travel doesn't hold any particular appeal. He is a partner in a small environmental site review firm, and may spend time performing the actual site visits. One thing is almost certain, though: he's going to find some way to stay busy.

"I haven't thought too much about what I'll do after I retire," he said. "But I'm a workaholic and I don't think I can stop. People like me probably never stop working."

Jim Palavan stands at the end of 200 feet of new seawall his firm helped to build in Galveston.

National LEADER

Cullen College Alum Serving as SWE President

by Toby Weber
photo by Thomas Shea

Students at the University of Houston Cullen College of Engineering learn a lot more than just engineering. Siddika Demir (BSCE '93) is living proof. Though she graduated from the University of Houston with honors in her major, it's the soft skills she honed here — leadership, networking, problem solving — that most define her career and her service to the profession.

Demir developed these skills not just inside the classroom, but outside of formal learning environments through her involvement in student organizations, such as the American Society of Civil Engineers and Chi Epsilon.

The group that she was and remains most active in, though, is the Society of Women Engineers (SWE). Since graduating from the Cullen College, Demir has risen through the ranks of SWE and is now serving as its 2010-2011 president. "SWE has helped me find mentors and hone my leadership skills, and has provided me with a lot of great professional development. It's been an amazing experience for me, both personally and professionally," she said.

As president of SWE, Demir is committed to making those same opportunities available to other women engineers. Under her leadership, SWE is developing a series of webcasts that focus on both technical knowledge and non-technical skills that are necessary for professional success, such as networking and project management. She is also working with the organization as it expands its efforts to recruit young women to the science, technology, engineering and mathematics fields. This not only helps create a community for young women entering these fields, but also results in a larger and more diverse group of engineers that helps to fuel innovation and economic growth, she noted.

Aside from SWE, Demir of course uses her Cullen College education in her daily work at Genentech, a biotechnology firm that uses genetic information to develop new medicines. Demir's official title at Genentech, which is a member of the Roche Group, is head of business process excellence for contract manufacturing operations. While that's quite a mouthful, it's also very accurate. Demir helps oversee the improvement of the company's internal processes for outsourced manufacturing of numerous medicines, including the anti-viral Tamiflu® and the oncology drug Herceptin®. This work involves continually honing the work Genentech performs with its collaborators, finding new efficiencies in their processes and ensuring that all manufacturing operations are followed to the letter.

Demir readily admits that refining manufacturing and business processes has little direct connection to civil engineering. Indeed, she said, it's much closer in nature to industrial engineering. But just as she picked up valuable skills outside the classroom, the tools she developed in her courses at the Cullen College allow her to succeed in this role.

"An engineering education provides great problem-solving skills. It helps me think in a very methodical way to identify problems, figure out the exact issues we're dealing with and lay out a roadmap to a solution," she said. "This is extremely valuable when you have to deliver practical business results in a very expeditious way."

1960s

Norman F. Carnahan (BSChE '65) was elected a fellow of the American Institute of Chemical Engineers and was honored by the South Texas Section with a 2009 Distinguished Service Award.

1970s

James Slaughter Jr. (BSChE '70) was awarded the Carroll H. Dunn Award of Excellence, the highest honor given by the Construction Industry Institute.

Timothy Swaty (BSChE '74) is currently working for Fluor doing petrochemical refinery investment planning, analysis and project development for international clients in the Middle East and China.

D. Wayne Klotz (MSCE '76) was named to the board of directors of Neighborhood Centers Inc., a network established to address the need for affordable nursery and kindergarten programs in Houston. In addition, the *Professional Services Management Journal* has put Klotz's company, Klotz Associates, in the top 20 percent of design firms for best overall business performance in the Architecture and Engineering industry.

1980s

Stephen F. Harper (BSEE '86) has been promoted to project manager at Contech Control Services. He is currently managing a $10 million safety system upgrade for a major petrochemical client. Contech Control Services is located in La Porte, Texas.

Venkat Selvamanickam (MSME '88, PhD ME '92), and collaborators at Oak Ridge National Laboratory and SuperPower Inc., received a 2010 R&D 100 Award from *R&D Magazine* for their high-performance superconducting wires.

2000s

Sharon James (BSChE '06) married Ryan Drake on June 26, 2010. She is a process control engineer at Dow Chemical Company.

Alex Van Duzer (BSChE '08) works at Cobb, Fendley and Associates in municipal and land development.

In Memoriam

Cleo Bickford (BSME '50) passed away Nov. 20, 2010 at the age of 85. He served in the U.S. Air Force during World War II as a B-17 radio operator in England. After graduating from UH, he designed aircraft for several aerospace firms, such as Boeing, Anderson-Greenwood and Presnal Engineering. His passion for flying led him to purchase a Cessna 170 and he helped form the International Cessna 170 Association and attended the group's convention for 42 years. He is survived by wife, Louise; three sons, Doug, Terry and Jeff; and their families.

Clark L. Jackson (BSE '50) passed away Oct. 21, 2010 in Palm Beach Gardens, Fla. at the age of 89. He served in the Pacific Theater as a marine aviation mechanic for four years during World War II. His career includes working for Griffin Wellpoint Corp., AUTEC Naval Base, DeGouw & Sons. He served as the FES Florida Engineers in Construction president and was named "Engineer of the Year" in 1986 by its Palm Beach Chapter. He is survived by his wife of 60 years, Virgina Jackson; children, Marsha, Keith, Melisa and Kerry; and grandchildren, Brooke and Bradley.

Robert Francis Tennant (BSPE '52) passed away Oct. 20, 2010 at the age of 91. He served as a pilot for the Air Corps in the U.S. Army during World War II. His service overseas in the European Theater earned him a European, African, Middle Easter Service ribbon with one Battle Star. After receiving his degree and P.E. license in 1954, he worked as a petroleum engineer for Tennant Oil, Gulf Oil Co., and for British Petroleum in Libya. He eventually taught high school math until his retirement. He is survived by children, Robert and Patricia, and five grandchildren, Dawn, Jennifer, Samantha, David and Cheyenne. He is proceeded in death by his wife of 63 years, Edna Harrison Tennant.

Hunter Franklin Garrison (BSCE '59) passed away Nov. 17, 2010 at the age of 78. He earned his civil engineering degree following his service during the Korean War. He started his career with TxDoT and retired after 28 years as the district maintenance engineer for the Greater Houston area. He went on to work another decade for Turner, College and Braden. He is survived by his wife of 55 years, Virginia, children Brenda and Michael, and two grandchildren.

John Clayton Walling (BSChE '64) passed away Oct. 24, 2010 in Houston at the age of 70. A fourth-generation Houstonian, he had a long, successful career at Dow Chemical before working with Enterprise Products. He is survived by his wife of 46 years, Alice Ann Alsup Walling; two daughters, Sabrina and Stacy; and grandchildren Anna, Will, Christopher, Audra and Lilah.

Herbert Meyer (MSEE '71) passed away Nov. 25, 2010. He was a retired Texaco engineer and is survived by his wife, Florita, a stepdaughter and two step sons.

If you would like to contribute a class note, visit **www.egr.uh.edu/news/submissions**

[deep roots]

Ernest and Barbara Henley

by Lindsay Lewis

photo by Thomas Shea

Ernest and Barbara Henley have been part of the University of Houston community longer than most graduates have been alumni. For nearly 50 years, the couple has drawn upon their individual passions — Ernest as a chemical engineer and Barbara as a social worker — to build, advance, advocate and support their respective professions and programs at UH.

"We've seen UH develop and feel like it is one of the best secrets in Houston," said Barbara. "It has a marvelous engineering college, a wonderful theater; an outstanding college of social work; it brings superb music to the Houston community. It is blossoming before our eyes into an institution with an international presence."

The couple first found their way to UH in the early 1960s, when a fortunate connection developed into a professional opportunity. While pursing his undergraduate degree at the University of Delaware, Ernest met Abe Dukler, who became one of the founders of the chemical engineering department at UH and later served as the Cullen College of Engineering's third dean. He worked with the first dean of the college, Frank Tiller, to recruit Ernest to head up the college's international studies program in Latin America.

Ernest and Barbara spent a couple of years in Brazil, where Ernest worked with the embassy to setup graduate programs for engineering schools and Barbara designed and launched a social work internship program to serve the country's favelas, or impoverished regions.

When they returned to Houston in 1964, Ernest held a leadership position as the college's associate dean of graduate studies. He became one of the major players behind the significant academic and federal research funding push that led to the chemical engineering department's rise as one of the top programs in the country.

"I was very fortunate to be a part of the college when it began to grow in the mid-60s," Ernest said. "We made a lot of good hires and had a few very productive years. This is when UH began to breakthrough academically."

These years also proved to be quite productive for Ernest's many corporate ventures. His first entrepreneurial adventure, though, began in a basement while attending graduate school at Columbia in the early 1950s. RAI Research produced his first patent for radiation membranes for cross-linked batteries and eventually appeared on the stock exchange before being sold in 1962.

A true inventor, Ernest soon started another company (Procedyne) to manufacture large furnaces or fluidized beds for chemical plants. It is still in existence today.

The most successful venture, however, came during the 1970s when he started developing heat therapy devices in his garage. Henley International went public in 1980 on the New York Stock Exchange and grew into a 4,000-employee, $700 million per year operation and eventually renamed Maxxim Medicine.

Although Ernest was able to start up and succeed financially with several ventures, he continued to serve as a professor at UH. In fact, he co-authored a text book (now with several editions) called *Separation Process Principles*, one of the bestselling books for chemical and biochemical operations. All in all, he has published 16 books (including an autobiography printed in Japanese) and earned 10 patents for medical and chemical technology.

Barbara eventually joined the UH Graduate College of Social Work as an adjunct professor and special assistant to the dean after retiring as head of social services at Ben Taub, a position she held for 25 years. She worked to develop a community base for programmatic and student support for the college, where she continued promoting the profession and the importance of internships and field experience to accompany classroom learning.

The deep roots created by the Henleys over the last 50 years as part of the university community will have a lasting effect for many years to come. Ernest's academic and research contributions, along with Barbara's instructional and development activities, have created many opportunities for UH faculty and students alike. Though the couple's major financial contribution to the Cullen College was an endowed professorship in the chemical engineering department, their other philanthropic support is quite generous and diverse — the Graduate College of Social Work, the School of Theatre and Dance, the M.D. Anderson Library, the Moores School of Music, Blaffer Art Gallery and The Honors College, not to mention many campaigns, festivals and other university activities.

[UH] is blossoming before our eyes into an institution with an international presence.

"We love the university," said Barbara. "It is very exciting to be part of an organization that is taking off."

September 1, 2009 – August 31, 2010

Last year, the University of Houston raised more than $100 million, marking the largest single fundraising year on record. The Cullen College of Engineering also had one of its largest funraising years in the history of the college, thanks to your generous donations. More than $7 million was given in support of UH engineering students and programs. Thank you!

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Engineers are problem-solvers. Give them a challenge they'll work thorough it, step-by-step, until they find the solution. It's what they're good at and what they enjoy.

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The Setup

In coin-operated billiards tables, balls that are hit into a pocket are kept inside the table until the next game is paid for. The cue ball is the one exception. The table is designed to recognize and return the cue ball based on its weight, which is either slightly more than or slightly less than the other balls.

The Problem

FIND THE CUE BALL – Imagine that there are 12 balls sitting on a coin-operated billiards table. While they're all painted and numbered, one of them is actually a cue ball that has been numbered by mistake. Your job is to find that ball. You have access to a balance scale, but may only use the scale three times. Create an algorithm to determine which ball is the cue ball and whether it is lighter or heavier than the other balls.

photo by Thomas Shea

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