THE OREGON STATE ENGINEER
The College of Engineering trains a unique class of engineers who acquire a strong technical foundation coupled with well-developed leadership skills and a broad worldview. Oregon State engineers attain a breadth of knowledge in engineering fundamentals and a depth of technical expertise in a chosen discipline. They learn the value of and gain practice in clear communication and collaborative working processes. They become locally conscious, globally aware leaders who think critically and question assumptions. When they graduate, they join a community of high achievers whose collective efforts solve seemingly intractable problems, strengthen individuals and communities, and contribute to a better world.
Preparing for the Really Big One
In July 2015, the New Yorker published an article titled "The Really Big One" that described the widespread destruction of life and property expected to occur when the Cascadia subduction zone earthquake and tsunami happens. The article caused quite a stir in the national press, and Northwesterners began talking in earnest about individual and community preparedness — or the lack thereof — for such an event.

The dire report wasn’t news to engineers at Oregon State, however. They have been saying some version of “we need to prepare for this” for many years. Testifying before a U.S. House of Representatives’ subcommittee earlier this year, Scott Ashford, Kearney Professor and dean of the Oregon State University College of Engineering, asked legislators to support three federal initiatives to boost the nation’s efforts toward community resilience in the face of natural disasters like earthquakes.

“It will take 50 years for us to prepare for this impending earthquake,” said Ashford, referring to the inevitable Cascadia subduction zone event. “The time to act is before you have the earthquake. Everybody needs to take some responsibility and start preparing now.”

Ashford has seen first-hand the destruction caused by some of the worst earthquakes in recent years, including the 2011 9.0-magnitude quake and tsunami in Japan, a 2010 8.8-magnitude quake in Chile, and a swarm of earthquakes in New Zealand, including a 7.0 in 2010 and a 6.3 in 2011. He is one of a growing cadre of researchers at Oregon State that is looking at some aspect of preparedness for this predicted event, which may already be overdue based on historical data. Besides Ashford, civil and construction engineers Ilan Mason, assistant professor, and Andre Barbosa, Kearney Faculty Scholar and assistant professor, are among the leaders in this research field.

Addressing liquefied soils

Mason made two trips to Nepal this year, after a 7.8 earthquake in April and a 7.3 aftershock in May caused widespread devastation in Gorkha, the Kathmandu Valley, and the surrounding areas. Mason traveled to Nepal with the GEER Team, which is part of the Geotechnical Extreme Events Reconnaissance Association. The association coordinates National Science Foundation efforts to capture perishable data immediately following natural disasters.

As a resident of the Willamette Valley in Oregon, the data Mason gathered is personally relevant. “The Kathmandu Valley looks a lot like the Willamette Valley,” he said. “The type of earthquake we will get here when the Cascadia subduction zone ruptures will have a lot of similarities to what happened in Nepal.”

On his first trip to Nepal, Mason and his team members studied liquefaction, a phenomenon in which saturated soil behaves like a liquid. Liquefaction can create major foundational instability for buildings, bridges, and other infrastructure, as Ashford discovered when he traveled to Japan in 2011.

“Entire structures were tilted and sinking into the sediments, even while they remained intact,” said Ashford. “The shifts in soil destroyed water, sewer, and gas pipelines, stopping the utilities and infrastructure these communities need to function. We saw places that sank as much as four feet.”

In contrast, the phenomenon was not prevalent in Nepal’s Kathmandu Valley, but that was probably because the event occurred at the end of the dry season, Mason suggested. “Here in Oregon, of course, we get rain nine months of the year and our water table can remain pretty high throughout the year, so we can expect more liquefaction events, especially near rivers and other low-lying areas,” he said.

Mason is developing computer models that will help the construction industry build infrastructure that will better withstand liquefaction. These techniques might include making the soil denser and stronger using cement, or embedding foundations in bedrock, which comes with several design challenges. “This is a new research topic — how liquefaction underneath will affect the superstructure as well as how the building itself is going to affect the soil and the liquefaction,” Mason said.

On the second visit to Nepal, Mason’s goal was to develop more complete case histories, establish valuable local contacts, and form seed ideas for future research and collaborations. His team investigated ground failure, topographic effects, and basin effects. Ultimately, his research will help local efforts to prepare for similar events in the Pacific Northwest.

Engineering seismically safe structures

Barbosa traveled with another team to Nepal after the 2015 earthquakes; his trips were funded through a National Science Foundation Rapid Response Research award. The team specifically studied buildings constructed using a reinforced concrete frame with masonry infill — a type of construction that was heavily used in the Pacific Northwest in the 1920s and 1930s, and is widely used in Nepal.

“It’s a very vulnerable structural system,” said Barbosa. Although engineers have known how vulnerable these structures are, they haven’t been able to conduct experiments on standing structures. “So whenever we have a chance, we go out immediately after earthquakes to see what happened to those structures.”

Supported by the Earthquake Engineering Research Institute and the Pacific Earthquake Engineering Research Center, Barbosa had been to Napa, California, after a 6.0 earthquake there in 2014. Earlier quakes in the area prompted the City of Napa to pass an ordinance requiring mandatory retrofitting of buildings constructed using unreinforced masonry, so many of those buildings had been retrofitted prior to the 2014 quake.
“In August 2015, we saw that all unreinforced masonry buildings that had not been retrofitted are now commissioned to be demolished,” said Barbosa. “The ones that had been retrofitted suffered damage, but it was possible to repair them. That’s a big finding. In Oregon, there’s much discussion about what to do here; these types of buildings are the fabric of all our downtowns in Oregon.”

Data gathered during these trips will help engineers develop computer models to aid in creating better and more economical retrofit strategies or repair strategies. “In the computer model, we can test different strategies to see which are most effective,” said Barbosa.

During his trips to Nepal, Barbosa and his team also inspected numerous monuments that represent the cultural heritage of the nation—a process he referred to as forensic engineering. “We characterized the damage to those 300- to 500-year-old structures,” he said.

At the smallest scale, they used laser scanning to measure the size of individual cracks, and they used drones to quickly estimate damage on a wider scale. Vibrational data gathered before and after the quakes is providing the foundation for their modeling efforts.

Toward greater community resilience

Underlining the major contributions Oregon State engineers are making in the efforts toward building more resilient communities, Barbosa is one of three College of Engineering faculty members who are now part of the newly formed National Institutes for Standards and Technology Center of Excellence for Community Resilience. The organization, which is a $20 million effort involving about 30 researchers nationally, is working to build a model that will enable communities to assess their resilience capacity.

“At Oregon State, we’re looking at earthquake and tsunami resilience, but also the impact of climate change on structures,” said Barbosa. “Right now, we have members who are looking at what’s happening in Charleston, South Carolina, as a result of the 1,000-year rain and floods. We’re looking beyond Oregon at the whole United States.”

Mason is continuing his work with Nepalese engineers. “With the lessons learned, I’m trying to get future research funding and direct student research towards what I saw was important,” he said. “I’m also trying to get funding to go back to Nepal for capacity-building operations—performing workshops and bringing field equipment to help the Nepalese engineers determine what they need to perform seismic assessment and start making their buildings safer for future events.”

He stresses that his work overseas continues to inform resilience decision-making here in the United States. “On some level, we dismiss natural disasters that happen in developing countries, because we have the thought that we’re going to be better prepared,” he said. “But what really hit home to me, having seen the damage patterns over there, is that we will face the same problems. And we’re not as prepared as we need to be.”
Additive manufacturing

Addressing global challenges in product development
As part of its newly adopted strategic plan, the College of Engineering strongly supports four signature research areas to address global challenges, and among them is advanced manufacturing. Several research projects are underway in the college that contribute to one particular form of advanced manufacturing: additive manufacturing.

Additive manufacturing refers to a process where materials are applied with spatial, compositional, and quantitative precision to create 3-D objects and the patterned thin-films used in electronics. Although additive manufacturing has been around in some form for nearly half a century, the movement toward economic, environmental, and social sustainability has led industry and the scientific community to explore new potentials for this revolutionary technology.

Researchers generally agree that the primary benefit to additive manufacturing is that it saves 90 percent or more in materials usage. In contrast to subtractive manufacturing, where manufacturers begin with a block or layer of material and remove what they don’t want, additive manufacturing applies powders or liquid solutions only where they are needed. The process requires fewer natural resources and has the potential to vastly improve performance, enable distributed and just-in-time manufacturing for more products, and drastically reduce manufacturing and shipping costs.

Additionally, printing technologies allow functionality to be applied to all kinds of materials and in all shapes and sizes, enabling the creation of new designs and products that would not be possible using traditional methods. “You can get to more organic shapes that aren’t possible to produce using conventional manufacturing processes,” said Karl Haapala, associate professor in the School of Mechanical, Industrial, and Manufacturing Engineering. “I’ve seen examples where manufacturing tooling is made using additive manufacturing that goes into production — let’s say for a specialized geometry or a specially shaped part — that would be very difficult to produce using conventional manufacturing technology.”

Several researchers in the College of Engineering are researching new and existing technologies that use or are excellent candidates for exploiting the potential of additive manufacturing: transistors, quantum dots, solar cells, and biosensors. Engineers are also exploring the possibilities for 3-D printing magnetic particles for various cutting-edge applications.

Transistors for computer displays
While working at HP, Greg Herman collaborated with Chih-Hung Chang, a professor in the School of Chemical, Biological, and Environmental Engineering, and colleagues to develop and patent indium gallium zinc-oxide (IGZO) thin-film transistors, which are now widely used in display technologies like Apple’s iPad. Their collaboration broke new ground when they applied solution-based methods to create transparent amorphous oxide transistors, such as IGZO, using additive manufacturing. Now Herman is a professor in the same school at Oregon State and the engineers are continuing their collaboration.

“The idea with these methods is that we can reduce the amount of material that’s used, but at the same time this is something we can do in our lab with a printer, under conditions that are much less energy intensive,” said Herman. “We’re wasting less material, using less energy, and can ultimately make lower cost displays that perform better.”

The precursors used in this process are also less toxic and much less flammable than those used for silicon-based devices. They use much less water to produce, and tests indicate that they may perform better. “Using our material, we can get about 30 times higher mobility than with amorphous silicon,” said Chang. Mobility describes how quickly an electron moves through a material, and is an indication of performance.

Work remains to be done to improve certain other aspects of the technology before it is ready for commercialization. Manufacturers could be slow to adopt additive manufacturing into their processes. “I think the biggest challenge is that even though the printed materials work really well, the industry standard is still the subtractive manufacturing approach,” said Herman. “So it is a new method of manufacturing that needs to be further developed before a company decides to change their display fab to this new technology. It will more likely take hold when products begin to transition to flexible substrates (as opposed to glass), because they will end up building new manufacturing lines anyway. But there is a fair amount of interest from industry in terms of moving to this technology to reduce costs.”

Quantum dots for solid state applications
Herman is also using copper indium disulfide to improve the photoluminescent properties of displays and other light sources. Some technologies, such as Kindle Fire, are currently using quantum dots, which are semiconductor...
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nanocrystals with unique properties. Quantum dots can give manufacturers much better control over the quality and color of emitted light, and improve efficiencies.

“Quantum dots produce very tight distribution of light,” he said. “We can control how broad the emission is, allowing us to produce much sharper greens, blues, and reds. But to get high-quality quantum dots that efficiently emit a specific color can be fairly expensive, and manufacturers want to minimize the waste as much as they can. That’s where additive manufacturing improves utilization of expensive materials.”

Current technologies that use quantum dots are built using traditional subtractive manufacturing processes and incorporate quantum dots where they are not effectively being used. They also use quantum dots composed of cadmium compounds, which are relatively toxic. Herman is testing copper indium disulfide quantum dots, but is seeking a patent for a new material that might produce as good or better performance. He is working with two companies to develop an additive manufacturing process to improve the color spectrum of LED lighting and displays. “The integration of quantum dots with additive manufacturing is still a couple years off, but could be much sooner depending on what we discover during the next several months,” he said, regarding the timeline for commercialization.

Anti-reflective coating and printed solar cells

In addition to working on the display transistors, Chang is deeply involved in seeking solar energy solutions using additive manufacturing. He is director of the Oregon Process Innovation Center for Sustainable Solar Cell Manufacturing and founder of an Oregon State spin-off called CSD Nano. CSD Nano developed and patented the next generation of nanotech anti-reflective coatings for the solar industry.

The anti-reflective coating is made using nanoparticle inks that mimic the structure and antireflection properties of moth eyes. CSD Nano is in the market research phase, working with solar farms to determine the feasibility for commercializing the technology. A fair amount of international interest in this technology is evident.

Chang is also using additive manufacturing to print chalcopyrite (composed of copper, indium, gallium, and selenium) solar cells. The material is much more efficient than silicon, which is now used to manufacture solar panels. “Most of the solar cells are manufactured using a vacuum process to make the film that captures sunlight, but the process is slower and the cost is higher,” said Chang.

Although commercialization is on the horizon, the team is not quite ready yet. “We’re at about eight percent efficiency for the ink, so we need to improve the efficiency before we consider commercialization. We’re looking for 12 to 16
Biosensors for continuous glucose monitoring

John Conley, professor in the School of Electrical Engineering and Computer Science and co-director of the Materials Synthesis and Characterization facility at Oregon State, has been working closely with Pacific Diabetes Technologies to build the biosensors for what will eventually become an artificial pancreas. The research team is working on the second generation of the device, which is more robust and reliable than the first generation.

“We’ve helped them improve the adhesion of the biosensors to the substrates,” said Conley. The technology is undergoing animal testing at Oregon Health and Sciences University in Portland and on campus in Corvallis. “Basically, the idea is to combine continuous glucose monitoring with controlled injection of hormones, and their ultimate goal is to make an artificial pancreas, but they’re doing it one step at a time.”

At this prototyping phase, the devices are built using subtractive manufacturing, but Conley, Herman, and their team recently published a paper that describes how additive manufacturing technologies to print magnetic materials composed of magnetic nanoparticles. These materials might be used in the future to 3-D print electronic components, nonvolatile memory elements, and even fully functional motors. Dhagat co-founded the Applied Magnetics Laboratory at Oregon State — the only lab of its kind in Oregon.

“The lab has been inkjet printing magnetic materials for about a year and is already breaking new ground. We’ve shown some preliminary results indicating that there is something to be gained with the inkjet printing,” said Dhagat.

“The biggest advantage is that as you’re dropping the ink containing the magnetic nanoparticles, you can apply a magnetic field to orient the nanoparticles, and you can do so drop by drop by drop, which means you can do it in any shape. This is something you cannot do with any other technology,” Dhagat envisions the day when three-dimensional devices will be built layer by layer using additive manufacturing. “You can have several jets: one for optical material, one for magnetic material, one to print the electronics, one to print something else,” she said. “So the possibilities are limited only by one’s imagination, if we can get the technology to be successful. We could print a robot that already has the electronics and the program to do what it’s supposed to do. It walks off the platform and does its thing.”

Conley observes that materials research for additive manufacturing is still in the early stages. Many materials must be stored or handled under tightly controlled conditions, and even fully functional motors. Dhagat co-founded the Applied Magnetics Laboratory at Oregon State — the only lab of its kind in Oregon.

The research on additive manufacturing in the College of Engineering is aligned with Oregon State University’s strategic goal of actively promoting and supporting researchers whose work advances the science of sustainable ecosystems, improves human health, and promotes economic growth and social progress. This innovative technological solution could provide vastly improved functionality while drastically reducing the use of natural resources and lowering manufacturing costs. Early results are promising, and the opportunities for more research seem endless at this point in time.
New hope for treating sepsis
They used to call it “blood poisoning,” and the term is still descriptive, if outdated. Like a poison, sepsis works fast and is frequently deadly. A modest infection suddenly turns into whole-body inflammation, complete with fever, flushed skin, swelling, and hyperventilation.

The risk of sepsis is surprisingly common. It can develop after an injury from an automobile accident, from a dirty wound, during an extended operation in a hospital, or opportunistically when people with a weak or compromised immune system contract an infectious disease.

In the United States, one out of every four people in a hospital emergency room is there because of sepsis. More than $20 billion was spent on this problem in 2011 — it’s the single most expensive cause of hospitalization. Millions of people worldwide die from it every year. Even with aggressive treatment, about a third of the people diagnosed with sepsis do not survive. It killed Pope John Paul II and at least two sitting U.S. presidents.

The term sepsis means “the process of decay” and was first identified by Hippocrates around 400 B.C. As a syndrome leading to multiple organ failure, it is an apt description. But unlike most forms of decay, sepsis works amazingly fast. Every hour of delay in administering an antibiotic can raise the mortality rate by another eight percent.

“Sepsis is a hidden killer, the one nobody really talks about,” said Adam Higgins, associate professor of bioengineering. “It kills more people in the U.S. every year than AIDS, prostate cancer, and breast cancer combined, and you still don’t hear much about it.” In many cases, the death certificate may list cardiac arrest, kidney failure, or other medical condition as the cause of death, even though sepsis was the trigger for those conditions.

Fortunately, hope is on the horizon for treating this syndrome. Several researchers in the College of Engineering are working with teams of undergraduate and graduate students on a project that may soon have the whole world talking about sepsis. Finally, there may be a way to combat it with something other than antibiotics, which often don’t work.

“A big part of the problem with sepsis is that it moves so rapidly,” said Joe McGuire, bioengineering professor. “By the time it’s apparent what the problem is, it’s often too late to treat it. What we have in mind is a way to process the blood and prevent sepsis, something that could be used at any time.”

The underlying cause of sepsis is endotoxins — molecules that are released from bacterial cell walls and lead to rapid, systemic inflammation. These pieces of bacteria can disrupt the immune response, causing it to overreact. Patients can quickly develop blood clots and other problems that lead to multiple organ failure. If given early enough, antibiotics and other treatments can sometimes stop the process, but they may not work as fast as the sepsis does.

“Once these bacterial fragments are in the bloodstream, antibiotics won’t always work,” said McGuire. “You may have successfully eradicated the living bacteria even as a patient is dying.”

The approach in development at Oregon State is to move blood through a very small processor about the size of a coffee mug and literally grab the endotoxins and remove them. The concept is surprisingly simple, and builds on some of the university’s revolutionary work with microchannel technology.

By moving fluids through tubes the width of a human hair, microchannels accelerate chemical reactions and heat transfer. They can be produced in mass quantity at low cost and stamped onto a range of metals or plastics that are then used to process large volumes of liquid in a comparatively short time. Other researchers at Oregon State are studying microchannel applications in heat exchangers, solar energy, and chemical manufacturing.

In this case, the liquid is blood, which may contain the endotoxins that cause sepsis. In Oregon State’s system, blood can be pumped through thousands of microchannels coated with something researchers call “pendant polymer
brushes.” These are tiny strands equipped with chemicals that can grab endotoxin molecules like a fishing hook. On the business end of the strand is a peptide, a bioactive agent that binds tightly to the endotoxin and removes it from the blood, which then goes directly back to the patient. To keep blood proteins and cells from sticking or coagulating in the channels, the strands also have been designed with repeating chains of carbon and oxygen atoms anchored on the surface.

“This doesn’t just kill bacteria and leave floating fragments behind; it sticks to and removes the circulating bacteria and endotoxin particles that might help trigger a sepsis reaction,” said Karl Schilke, assistant professor of bioengineering.

The team hopes to use low-cost polymers to keep the technology costs low. “The device should be inexpensive enough that it can be used once and then discarded,” said Schilke. “The low cost would also allow treatment even before sepsis is apparent—a prophylactic approach to prevent it, not just treat it after the fact. Anytime there’s a concern about sepsis developing due to an injury, a wound, an operation, an infection, you could get ahead of the problem.”

The researchers recently received a $200,000 grant from the National Science Foundation and an OSU Venture Development Fund grant of $150,000. These investments will allow them to refine the design and move the technology closer to clinical trials. The emphasis is on demonstrating the efficacy of the microfluidic device architecture and surface coating, with a goal of moving the project to commercialization. The value of this medical technology could be enormous once the work is complete.

“When we first conceived of this approach to prevent sepsis, my initial reaction was, ‘Wow!’ ” said McGuire. “Think of the number of deaths we could prevent. Think of the billions of dollars spent in intensive care that could be available for something else. Think of all the infants and young people who could have their whole lives given back to them.”
Miranda Raper already has three years of lab experience under her belt, and has learned a lot about how to structure and execute research. She also has developed a couple of key intangibles: the confidence to thrive as a female in the male-dominated engineering world, and a drive to help other women engineers succeed.

Raper's first exposure to research came the summer after her freshman year, when she worked in Karl Shilke's lab through the Johnson Internship Program. She quickly discovered a passion for research, and spent time on several different aspects of a project focused on a cure for sepsis, giving her a broad overview of the research (see New hope for treating sepsis).

Becoming familiar with the analytical techniques used in the sepsis project was a key part of her learning. For example, she used optical waveguide lightmode spectroscopy to obtain in situ measurements of the surface immobilization of biomolecules in an aqueous environment. “This technique measures refractive index changes from which the mass of the adsorbed species can be calculated,” Raper explained. “We flowed lipopolysaccharides — which are part of the membrane in the bacteria — across a peptide-coated surface, to see if they stuck to the surface. That was an indication of whether or not there is an interaction between the two.”

After her first summer, Raper continued on as an intern, and her research became more focused, turning into her honors thesis. “I'm studying the attachment of a polymer tether to the end of the peptide and seeing if that changes how the peptide interacts or how it forms different structures,” she said. “I'm trying to find out how to chemically attach the two and have it be a covalent attachment, and whether or not the peptide can adopt a helical structure.”

Raper was a high school valedictorian with a professed love of math and science. She recently earned an honorable mention in the Barry Goldwater Scholarship and Excellence in Education program for her work on the sepsis project, and also won the Women in STEM award from the Oregon State University Honors College.

But even with this stellar résumé, studying engineering has raised some doubts in her mind from time to time. “In my first year of pro-school, classes were very difficult,” she said. “It went through my mind that I'm not smart enough to be an engineer. But I know that's not true.”

The challenges inherent with the discipline coupled with the uphill battle of being a minority are deal-breakers for many women. “There are men in my field that think because you are a woman you know less, and that has been frustrating — trying to work in teams when people don’t trust your judgment,” she said.

Luckily for Raper, the confidence she has gained through her research has enabled her to overcome those challenges. “I'm not afraid to speak up,” she said. “I try and get everyone to work as a team, and if I have an idea I say it, regardless of whether or not it gets shut down. The fact that I now have the confidence to speak out is tremendous to me.”

She is also active in the Society of Women Engineers, which provides support for her and encourages other women to stay involved in engineering. “Women shouldn’t be afraid to do what makes them happy,” she said. “Keeping more women in these programs and keeping them going is important. Having that support is a real booster, so that is why I stay involved.”

Now entering her junior year, Miranda Raper already has three years of lab experience under her belt, and has learned a lot about how to structure and execute research. She also has developed a couple of key intangibles: the confidence to thrive as a female in the male-dominated engineering world, and a drive to help other women engineers succeed.

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The challenges inherent with the discipline coupled with the uphill battle of being a minority are deal-breakers for many women. “There are men in my field that think because you are a woman you know less, and that has been frustrating — trying to work in teams when people don’t trust your judgment,” she said.

Luckily for Raper, the confidence she has gained through her research has enabled her to overcome those challenges. “I’m not afraid to speak up,” she said. “I try and get everyone to work as a team, and if I have an idea I say it, regardless of whether or not it gets shut down. The fact that I now have the confidence to speak out is tremendous to me.”

She is also active in the Society of Women Engineers, which provides support for her and encourages other women to stay involved in engineering. “Women shouldn’t be afraid to do what makes them happy,” she said. “Keeping more women in these programs and keeping them going is important. Having that support is a real booster, so that is why I stay involved.”
Overcoming life’s challenges to earn a college degree

At age 40, Rosalba Brambila, mother of four sons, expects to receive her bachelor’s degree in environmental engineering, after completing a final class.

Her path to graduation has been fraught with challenges that many would find hard to imagine. Brambila’s parents emigrated from Mexico and she grew up in a “nasty, ugly, bad” part of south-central Los Angeles, where she witnessed gang violence and heard gunshots regularly, and where drive-by shootings happened frequently. At age 14, she had to start working full time when both of her parents became disabled. Her father, a construction worker with a third-grade education, suffered a back injury. Her mother, a sewing machine operator with no schooling, developed debilitating carpal tunnel syndrome from working long hours in a factory.

While going door-to-door selling Shaklee nutritional products to support her parents and four siblings, Brambila barely managed to graduate from high school. Although she took advanced placement classes in high school and passed, she struggled to keep up in her classes while working full time and facing an hour-long bus ride to school.

Even so, she always knew she wanted to attend college. “My interest has always been the well-being of people, especially children, so I always knew I wanted to go to college to make a difference and to help people,” she said. “But somebody in high school told me there would be no way I would ever be able to pay for it.”

Losing everything

Brambila married and started a family at age 20, but her husband struggled with alcoholism and became abusive. She fled to Gresham, Oregon, where her parents had relocated.
“When we got there, my boys and I had nothing,” she said. “But I managed to get on my feet.” For seven years, she held a good job with a large import company to give her bilingual skills as an international licensing coordinator for high-end swimsuits made by Louis and Mike. On her annual salary of $48,000, she even managed to buy a house. When the economy tanked in 2008, Brambila lost her job. She struggled to pay her bills and eventually lost her house.

“I tried so hard to keep that house… there were times when I took the boys to a gas station down the street to use the toilet because the water had been shut off,” she said. She heated bath water on the kitchen stove when the gas company turned off the gas. “We learned to shower from a five-gallon bucket,” she said.

With no college degree, her search for work in the suddenly tight job market turned up nothing, so she let go of her house, moved in with her parents, and reluctantly applied for public assistance. This allowed her to start taking classes at Mt. Hood Community College.

Getting started on the dream

Going to school was challenging with four young boys at home. “I used to put them to sleep and go to bed myself, then set the alarm and get up at midnight and study until 4 a.m. while it was quiet in the house, then sleep a little more,” she said. “Every term, I would tell myself, ‘I am a crazy woman! What the hell am I doing?’ But I could see ahead 10 years, and I just knew it would get better.”

So she hung in there for two years, taking classes every term. She continually applied for scholarships and worked as a tutor on campus to help pay the bills. At times her parents didn’t understand why she was so driven to do this.

“They are very traditional and felt my top priority should be with my children, my family,” she said. But she was looking at the long-range picture, toward a better future for her boys.

She credits the Transitions Program at Mt. Hood Community College with helping her succeed as a student and helping her to determine that environmental engineering would be a good career path for her.

Because Oregon State had an environmental engineering program and a strong emphasis on research, it was her first choice, but she worried that she wouldn’t be able to pay tuition at a more expensive four-year school — not to mention covering housing and food costs for her and her boys.

Then one day, she hit the jackpot. She got the news that she was one of 120 students selected from almost 5,600 applicants to receive a Ford Family Foundation Scholarship, which would cover 90 percent of the costs of her college education.

“Getting the Ford Scholarship was better than winning the lottery for me — it made a huge difference,” she said. “There is no way, with four boys, that I would be able to be here right now without that scholarship. It’s still really hard to pay all the bills, but since getting the scholarship, we’ve never had the gas or power shut off.”

The scholarship also helped her parents better understand why their daughter was working so hard to get a college degree. “Now when they visit, they tell the boys, ‘You have to help out your mom because she has to study.’”

Although her parents have very little money, they bring a food box when they come to visit. “They can’t do much, but they do that,” she said. “And my dad, he is a good role model for my boys.”

Struggling with finances

Brambila lives in Albany, where rental rates are cheaper, and drives back and forth to campus in an early-1990s green Cadillac she bought from a mechanic friend for $1,500. She knows how to change the oil and check the fluids, but the car has left her stranded on the road more than once.

“But it has a green leather interior!” she joked. “I say I ride in such luxury!”

She has applied to live in family housing on campus to save commuting time and fuel costs, but so far, she has not been selected.

When she first started attending Oregon State, her youngest son, Brian, was not yet in school. She couldn’t afford childcare, so she relied on friends. Sometimes, however, things came up and she had to bring Brian to class with her. “I always called and asked my professors first if that would be okay, and they were always very accepting,” she said. “I would bring coloring books and a bag of carrots for Brian.

The hardest part of her journey toward a college education, she said, has been “dragging my kids through all of this.” She hopes the hardship will help them in the long run. “I think it’s been harder on them than me,” she said. “I don’t care if I’m wearing new clothes. But when they need new shoes, it’s hard to tell them to wait for their birthday, or Christmas. But I think it’s helping them learn to budget and value things. And they’re awesome kids.”

Seeing light at the tunnel’s end

Today, Brambila and her boys, now 18, 14, 13, and 7, all study around the kitchen table in the evenings. “We are all learning,” she said. “They see me putting in the time, and I’m hoping that will have a huge influence on them.”

She plans to continue her education toward a master’s degree under the tutelage of Stacey Harper, an assistant professor in the School of Chemical, Biological, and Ecological Engineering. She hopes to eventually work for a nonprofit or government agency to bring safe, potable water to future generations. “Water is a very limited resource,” she said. “Today, we’re fighting wars over petroleum, but soon they will be fought over water.”
Investment in humanitarian engineering builds community
Part of the College of Engineering’s strategic vision is to become nationally recognized for modeling a diverse, inclusive, and collaborative academic community.
choose to push the edges and expand their perspective...

As one step toward that vision, a recent $1.5 million gift from Richard (“Dick”) ’69 (Industrial Engineering) and Gretchen ’69, (Elementary Education) Evans will create one of the nation’s first endowed professorships in humanitarian engineering. Earlier gifts from the Evans helped to launch Oregon State’s Humanitarian Engineering program two years ago. The program was created in response to growing interest among engineering students to make a lasting, positive impact on the world. Humanitarian engineers seek science- and engineering-based solutions to improve the human condition by increasing access to resources like clean water and clean energy, enhancing quality of life, and improving community resilience, whether in the face of natural disasters or economic turmoil. Although the greatest need often lies in developing countries, the program also focuses on disadvantaged communities in the Pacific Northwest.

The curriculum addresses what Dick Evans calls “human skills” in addition to the requisite technical skills. “The technical skills of engineering are essential, but so are things we might call human skills, such as communication, problem-solving, leadership, and the ability to work across cultures,” said Dick, who was president and chief executive officer of Alcan, a Fortune-100 mining company and aluminum manufacturer based in Montreal. “The humanitarian engineering curriculum is a structured way for engineers to practice those human skills in challenging, real-world settings.”

Dick’s own education in these human skills was less structured. He recalls being sent to Ghana, West Africa, with a humanitarian engineering curriculum is a structured way for engineers to practice those human skills in challenging, real-world settings.

Over the next four years, Dick successfully broke down the most counterproductive behaviors of this tribalism and developed a cohesive team that outperformed all similar plants in the company. In the years following that experience, he applied the lessons he learned to numerous other business situations. “While Ghana was a case of overt tribalism — and relatively easy to spot — I was able to generalize and apply the lessons in dozens of much more subtle cases of tribalism, such as IBM-versus Apple-ites, engineers versus accountants, and lawyers versus just about everyone else,” said Dick.

Today, Dick defines tribalism as the tendency of groups of humans to coalesce around common beliefs and behaviors perceived to be in their own self interest and survival, and to exclude and punish those ideas and behaviors perceived to threaten the group. He said that recognizing and understanding tribalism in this broader sense was one of the most valuable insights he gained in more than four decades in the metals industry.

The Evans hope to help create a new breed of engineers who consciously choose to push the edges and expand their perspective, gain work and life experience outside their home country, and seek and embrace diversity in their career and life. They envision these engineers helping to create a diverse, inclusive, and collaborative community while they are at Oregon State and gain the sensibility and sensitivity to recognize and combat tribalism wherever their careers take them.

“Humanitarian engineering is a unique and impactful way to enable talented students with a passion for making a better world do exactly that,” said Gretchen, who is a visual artist and active community volunteer. “When I heard of the connection with the humanities, I perked up my ears. Sometimes there can be a very narrow technical focus in engineering education, but the addition of humanities can lead to a more rounded education and help engineers think outside the box . . . Humanitarian engineering means listening to the culture and employing a little humility to arrive at more creative and sustainable solutions.”

The Humanitarian Engineering program reflects a campus-wide emphasis on engaged service, which springs from the university’s historic land grant mission. Multiple student organizations, including Oregon State’s award-winning Engineers Without Borders chapter and the American Society of Civil Engineering student chapter, have been working on water, energy, and other projects in the developing world. The Humanitarian Engineering program also is one of the only such programs that are firmly rooted in an academic curriculum.

Oregon State’s program also is one of the only such programs to reside in a university that also offers a Peace Corps Master’s International program in engineering. The university was the first in Oregon to join this program, which allows graduate students in several disciplines to get a master’s degree while doing a full 27-month term of service in the Peace Corps. Oregon State remains one of just 10 universities nationwide to offer this degree in engineering.

This fall, a new undergraduate minor in humanitarian engineering will be open for enrollment, with classes that emphasize the importance of context (socio-cultural, economic, environmental, resource), ethics and social justice, and cross-cultural communication. Students will be exposed to case studies of development projects, including learning from project failures as well as successes and a historical perspective on humanitarian interventions.

...seek and embrace diversity in their career and life...
Endowed Positions and Professors

**Boeing Professorship in Mechanical Engineering**

Bob Paasch
Professor | Mechanical, Industrial, and Manufacturing Engineering

Paasch conducts research in mechanical design theory, design methodology, and systems design for reliability and diagnosis. He also serves as faculty advisor for the Oregon Student Automotive Racing team, the Oregon Student Motorcycle Drift team, the Oregon Student Solar Car team, and the Oregon Student Racing Car team. Paasch received a Bachelor of Science degree from the University of Washington in 1970 and a Master of Science degree from the University of California, Berkeley, in 1973.

**Callahan Faculty Scholar in Chemical Engineering**

Nick Aufmuth
Professor | Chemical, Biological, and Environmental Engineering

Aufmuth develops sustainable chemical processes that use concentrated solar thermal energy. Potential applications include fuel production, energy storage, and applications for solar-driven production of renewable chemicals. His research focuses on remote or developing regions, and converting waste into fertilizers.

Darryl Callahan (74), spent nearly 40 years in the energy industry, serving as president of Chevron Chemical Co. and executive vice president of power, chemicals, and technology following the company’s 2001 merger with Texaco. Darryl and Betty Callahan established the endowment in 2011, and she was appointed to the Oregon State University Board of Trustees in 2013.

**Eric H.I. and Janice Hoffman Faculty Scholar in Civil and Construction Engineering**

Meghna Babbar-Sebens
Assistant Professor | Civil and Construction Engineering

Babbar-Sebens’s research involves water resources and environmental systems analyses. Her research program develops and employs multiple approaches to improve the understanding of higher-order human-environment interactions and support human-computer collaboration for integrated, adaptive, and sustainable management of complex water-based systems.

Eric Hoffman (78), the grandson of Hoffman Construction’s founder. He joined the company in 1984 and has served on the OSU Foundation Board of Trustees since 1991. Janice Hoffman (70) has worked in marketing and as a volunteer for many organizations. They established the endowment in 2011.

**Glenn Willis Holcomb Structural Engineering Professorship**

Solomon Yim
Assistant Professor | Civil and Construction Engineering

Yim’s research focuses on the interactions between, road, soil, and structures in the marine environment. He led a multidisciplinary wave slamming expansion project at Oregon State’s C. S. Frankland Wave Research Laboratory. Oregon State is the only university in the United States to have a specialized wave laboratory.

The professorship was established in 2011 through an estate gift from Col. Roy C. Edgerton (68). The endowment honors one of Edgerton’s professors, Glenn Holcomb, who taught civil engineering at Oregon State for more than 30 years. Edgerton was a World War II veteran and served in the U.S. Army Reserve until 1974. He spent his career with the Oregon Highway Department and the Transportation Research Board.

**Cecil and Sally Drinkward Professorship in Structural Engineering**

Christopher Higgins
Professor | Civil and Construction Engineering

Higgins is an expert in bridge structures who has researched steel, concrete, composite, hybrid, and polymer materials to a variety of load conditions and stresses that can cause bridges to fail. His research on reinforced concrete bridges for the Oregon Department of Transportation helped save state taxpayers $50 million.

**Richard and Gretchen Evans Professorship in Humanitarian Engineering**

Kendra Sharp
Professor | Mechanical, Industrial, and Manufacturing Engineering

Sharp is engaged in the areas of sustainable energy for developing countries, emphasizing international engineering research and education. She is director of the Humanitarian Engineering Program and program coordinator for the College of Engineering Peace Corps Master's International.

Richard (66), Industrial Engineering, and Gretchen (69), Elementary Education, Evans endowed the Evans’ Professorship in Humanitarian Engineering with their 5.1 million gift. As a response to growing interest among engineering students to make a lasting, positive impact on the world, the Evans family gifted their designated Oregon State Humanitarian Engineering program.

**Kearney Faculty Scholar in Civil and Construction Engineering**

André Barbosa
Assistant Professor | Civil and Construction Engineering

Barbosa’s industry experience in design of buildings and bridges serves as the foundation for the current research, teaching, and training efforts. His research focuses on the development and testing of innovative structural systems, performance-based earthquake/hurricane/pavement/wind engineering, reliability-based engineering assessment and design, and high-performance and high-throughput computing.

Lee Kearney (73) held several executive positions in his 32-year career at Kiewit, one of the largest construction and mining firms in North America. The Kearneys served on the Oregon State’s College of Engineering’s Top-25 Campaign. Lee also serves on the College of Engineering Advisory Board and the OSU Foundation Campaign Steering Committee. Kearney is a member of the OSU Foundation Board of Trustees.

**Kearney Professorship of Engineering**

Scott Ashford
Dean | College of Engineering

Ashford is an international expert in earthquake preparedness and recovery. His research focuses on enhancing public safety, reducing potential economic losses from earthquakes and coastal hazards. His latest efforts are targeted at improving the resilience of rail and transportation infrastructure in the Pacific Northwest.

**Miles Lowell and Margaret Watt Edwards Distinguished Chair in Engineering**

Jason Weiss
School Head and Professor | Civil and Construction Engineering

Weiss is internationally recognized for his work in concrete pavements and pavements. He is currently researching crack tracking, improving durability, and making concrete more sustainable. As head of the School of Civil and Construction Engineering, Weiss is leading efforts to improve the resilience of aging infrastructure.

Prudence Edwards Denney and Miles John Edwards established the chair to honor their parents. Miles Lowell Edwards (24), who held more than 50 patents, invented the world’s first artificial heart valve in collaboration with cardiac surgeon Albert Starr. The Starr-Edwards valve is still widely used today. Margaret Edwards (27) wrote or co-authored more than a dozen novels, poetry collections, and social histories.

**Michael and Judith Gaulke Chair of Electrical Engineering and Computer Science**

Michael and Judith Gaulke Chair of Electrical Engineering and Computer Science

**James Sweeney**
Assistant Professor | School of Electrical Engineering

Sweeney is an internationally recognized expert in neuromuscular assessment and design, and high-performance and high-precision computing.

**John and Jean Loosely Faculty Fellowship**

John (49) and Jean (48) Loosely established the fellowship in 1995. John joined Round Rock Wiring Company in 1975, and the Loosely purchased the company 10 years later. With John as chief executive officer and Jean managing finances, the company expanded over time, increasing their staff from 20 to 200 employees by the time they sold the business in 2005.

**Erdem Celik Faculty Fellowship**

Erdem Celik
Assistant Professor | Civil and Environmental Engineering

Erdem Celik joined Oregon State after serving as a technical consultant for Sensys Networks Inc., a leading provider of wireless traffic detection and integrated traffic data systems. His research specializes in sustainable pavement materials and structures, energy-efficient pavement design strategies, and infrastructure health monitoring using wireless sensor networks.

**Meghna Babbar-Sebens**
Assistant Professor | Civil and Construction Engineering

Babbar-Sebens’s research involves water resources and environmental systems analyses. Her research program develops and employs multiple approaches to improve the understanding of higher-order human-environment interactions and support human-computer collaboration for integrated, adaptive, and sustainable management of complex water-based systems.

**Erdem Celik**
Assistant Professor | Civil and Environmental Engineering

Erdem Celik joined Oregon State after serving as a technical consultant for Sensys Networks Inc., a leading provider of wireless traffic detection and integrated traffic data systems. His research specializes in sustainable pavement materials and structures, energy-efficient pavement design strategies, and infrastructure health monitoring using wireless sensor networks.
Endowed Positions and Professors

Linus Pauling Chair in Chemical Engineering

Philip Harding
Chemical, Biological, and Environmental Engineering

Harding focuses on undergraduate student success, helping students develop skills in communication, organization, project management, and leadership. Prior to holding the Pauling Chair, Harding spent 10 years in product development at Hewlett-Packard.

Peter (‘55) and Roxal Johnson established the Pauling Chair in 1997 in appreciation for what he called a “good, solid education” at Oregon State and to invest in future students. As president and owner of Teltrix, Inc. Johnson developed the method that is now used by every battery manufacturer in the United States for making battery separator envelopes.

Hal Pritchett Chair in Construction Engineering Management

David Trejo
Professor | Civil and Construction Engineering

Trejo’s expertise is in construction materials design and development. His research background includes investigating, testing, assessing, and evaluating mechanisms of deterioration for materials and structural systems such as pipes, walls, foundations, bridges, and water tanks.

The chair honors Professor Emeritus Hal Pritchett, who taught at Oregon State for 45 years and who was instrumental in establishing the Construction Engineering Management program in 1969. Originally funded by 120 engineering alumni and industry partners, the endowment nearly doubled in 2010 with commitments from Mike (‘76) and Terri Phelps and the Beavers Charitable Trust.

Henry W. and Janice J. Schuette Endowed Chair in Nuclear Engineering and Radiation Health Physics

José Reyes
Professor | Nuclear Science and Engineering

Reyes has earned an international reputation for cutting-edge research in developing passive safety nuclear reactors and the use of MRI technology to track toxins in environmental cleanup and other industrial applications.

Hank (‘50) and Janice Schuette established the endowment in 2013 to advance research in nuclear power and meet future energy demands. Together, they build Wolfsen, Inc., into an international leader in designing, manufacturing, and installing systems that turn waste wood from the lumber industry into electricity.

James R. Welty Professorship in Thermal-Fluid Sciences

James Liburdy
Professor | Mechanical, Industrial, and Manufacturing Engineering

Liburdy’s expertise is in fluid mechanics and thermal management systems for electronics and other applications. His research emphasizes fundamental aspects of technology development and technology transfer to industry.

Jim (‘54, ‘62) and Sharon Hastings-Welty (‘79) created the professorship in 1997 with the goal of keeping Oregon State at the forefront of critical technologies such as inkjet printing, microscale energy conversion processes, electronic equipment cooling, and property measurements related to electronic equipment design.

Tykeson Faculty Scholar in Energy Systems Engineering

Robin Feuerbacher
Assistant Professor | Mechanical, Industrial, and Manufacturing Engineering

Feuerbacher has more than 25 years of experience working in the private energy industry. His research focuses on human factors engineering in the health care and energy industries. He was inducted into the Academy of Distinguished Engineers at Oregon State University in 1999, and is in the program lead for the Energy Systems Engineering degree.

A $250,000 gift from the Tykeson Family Charitable Trust established the first endowed faculty position at OSU-Cascades in 2010 and helped launch its Energy Systems Engineering degree program.

Tom and Carmen West Faculty Scholar

Brian Paul
Professor | Mechanical, Industrial, and Manufacturing Engineering

As co-director of the Microproducts Breakthrough Institute, Paul has pioneered new manufacturing methods for reducing the costs of microchannel arrays, nanomaterials, and liquid-deposited thin films.

Professor Emeritus Tom West (‘76) spearheaded establishment of Oregon State’s manufacturing engineering degree program and the highly successful Manufacturing Engineering Co-op Program that would later evolve into MECOP/CECOP. West and his wife Carmen, a longtime manager at Hewlett-Packard, established the endowment in 2012.