IRA A. FULTON SCHOOLS OF engineering
ARIZONA STATE UNIVERSITY

Engineering the Future

Spring 2016

quick take

10 things you should know about the Fulton Schools of Engineering

1. **We build engineers**: more than a discipline, engineering is a mindset, a way of looking at the world. Students in the Fulton Schools of Engineering are part of a community of problem solvers, people who are passionate about designing and making innovative and entrepreneurial solutions.
2. **We've reinvented the first-year experience for students** — introductory engineering classes engage students in projects like creating solar cars or testing buildings during seismic activity.
3. At E2, our innovative program for incoming freshmen, **our new students are engineers from day one** — thinkers, makers, builders, inventors — participating in team-building games like toxic transport and boat building promote team building and problem solving skills. E2 also introduces incoming students to our peer mentors. Peer mentoring is integral to the set of attributes and principles that create the Fulton Difference.
4. **We foster an entrepreneurial mindset.** Teams of students who got their start in the Engineering Projects in Community Service — or EPICS — program at ASU have gone on to major international student competitions including the Microsoft Imagine Cup, the Dell Social Innovation Challenge, College Entrepreneur of the Year from Entrepreneur Magazine and Coolest College Startup from Inc. magazine.

   Aspiring entrepreneurs can find like-minded students in our new Startup Center. The center offers signature entrepreneurship and innovation courses, workshops, expert mentoring, new venture competitions, and more.
5. **Fulton Schools of Engineering researchers are leading world-class research centers including two national Engineering Research Centers, QESST and CBBG.**

   Established in 2015, the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) will work to expand the emerging field of biogeotechnical engineering with advances in geotechnical engineering that promise solutions to some of the world's biggest environmental and infrastructure development challenges.

   Established in 2011, the National Science Foundation/ Department of Energy funded Quantum Energy and Sustainable Solar Technologies (QESST) Engineering Research Center brings together industry, academic and government partners worldwide to find affordable, accessible energy solutions and further education efforts in photovoltaics.

   The Fulton Schools of Engineering is also a partner on two Engineering Research Centers, Nanotechnology Enabled Water Treatment Systems center, or NEWT, led by Rice University and FREEDM Systems, led by North Carolina State University. NEWT is developing compact, mobile, off-grid water-treatment systems that can provide clean water to millions of people who lack it and make U.S. energy production more sustainable and cost effective. FREEDM is developing a more secure, sustainable and environmentally friendly electric grid.
6. **In our state-of-the-art labs, you'll find faculty and students — including undergraduate students engaged in research** — working on engineering solutions to challenges in health, energy, security, sustainability and education.
7. **The Fulton Schools of Engineering offer a dedicated career center** that provides coaching to students from day one all the way through job searches for alumni. We host biannual career fairs in February and October and an annual Career Exploration Night geared toward freshmen. The Fulton Schools Career Center connects students to internships, co-ops and job opportunities.
8. **We have more than 60 engineering student organizations and teams** engaged in activities from rockets to robots — a great way to get hands-on experience, make connections with industry and have fun. Our student teams enter and win national competitions.
9. **You're never too young to be an engineer** and our outreach and summer programs engage thousands of K-12 students each year in robotics, programming, solar energy, rocketry, mobile apps and more.
10. **Enrollment has grown to nearly 19,000 students** from all 50 states and 121 countries — and the Fulton Schools have attracted a record number of incoming freshmen in each of the last five years, making the largest engineering school in the U.S. in terms of undergraduate enrollment. One out every five students at ASU is a student in the Fulton Schools.

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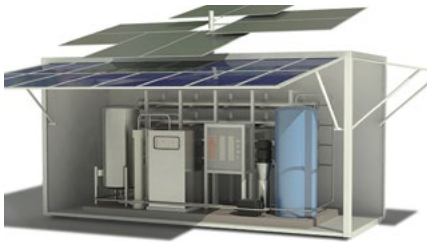
On the cover from CBBG: Specimens of sand cemented by enzyme-induced carbonate precipitation (EICP) reinforced with natural sisal fibers enhance strength and ductility.

inside



building engineers: data snapshot

Focused on student success

18,993 fall 2015 enrollment

3,076 degrees granted 2014-2015

2,797 fall 2015 first-time freshmen

30% of Barrett, the Honors College students are in the Fulton Schools

24 undergraduate programs ▪ 32 graduate programs ▪ Two campuses plus online

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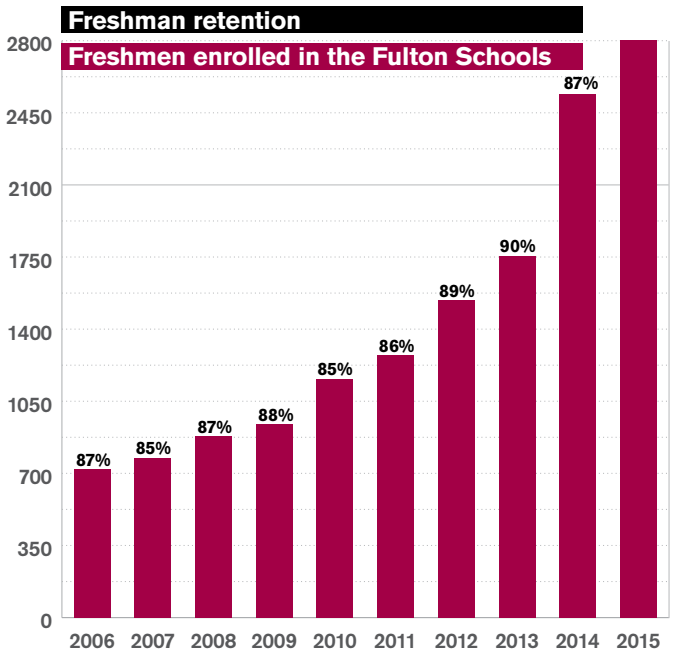
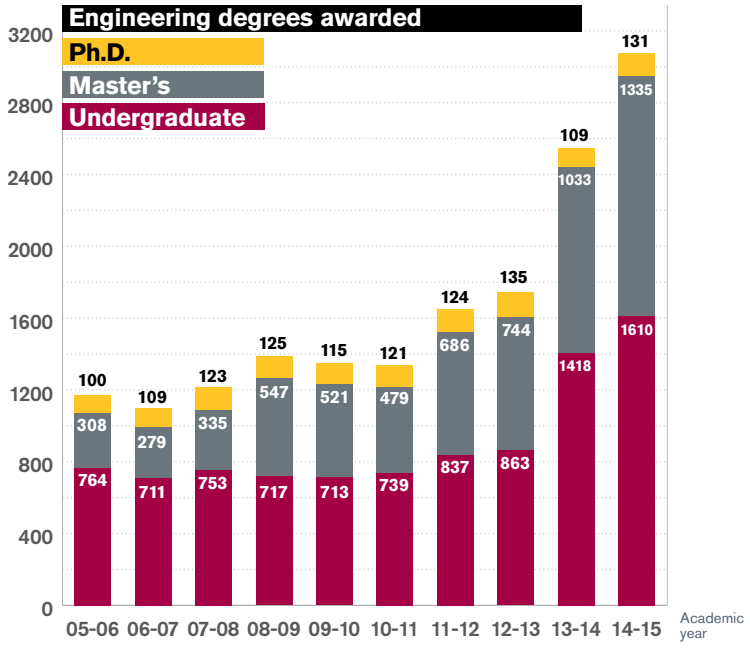




GenLabs opening fall 2016

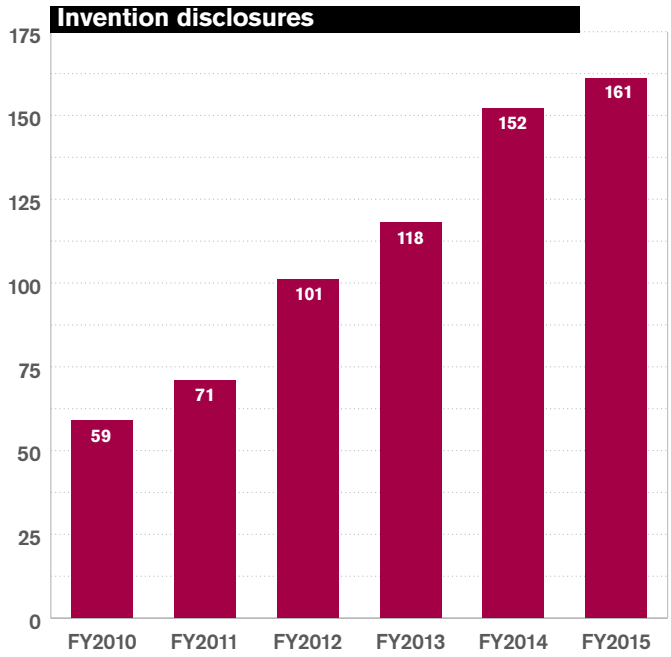
Use-inspired research

Palo Verde Main 2.0 opening fall 2017

$89.33M research awards

$89.06M research expenditures

1,000+ undergraduates conducting research



New facilities

New Engineering Residential Community on the Tempe campus opening fall 2017; Generator Labs opening fall 2016 in Engineering Center. Other new facilities include: College Avenue Commons, eSpaces, Brickyard Mezzanine and Interdisciplinary Science and Technology Building 4.

We are leading critical national initiatives

QESST NSF-DOE Engineering Research Center with partners MIT, Caltech, Georgia Tech and others

CBBG NSF Engineering Research Center with partners Georgia Tech, New Mexico State and UC Davis

Partner on two NSF Engineering Research Centers: NEWT with Rice University, Yale and UTEP and **FREEDM Systems with NC State University**, Florida State University, Florida A&M University and Missouri S&T

Five NSF I/UCRCs (Industry/University Cooperative Research Programs): PSERC, Connection One, SenSIP, WET and Center for Embedded Systems

Two NSF IGERTs (Integrative Graduate Education and Research Traineeship)

Six MURI awards (Multidisciplinary University Research Initiatives); 11 total since FY2005

$18 million from USAID to establish the U.S.-Pakistan Centers for Advanced Studies in Energy (USPCAS-E) to improve power production in Pakistan

HEEAP, Higher Engineering Education Alliance Program (Intel, Siemens) $20M cash and more than $50M in-kind donations by academic, government and industry partners

30 young investigator awards from NSF CAREER, AFOSR YIP, DARPA YFA, NASA and NIH Directors/ Development over the past three years

Restoring the environment and improving infrastructure

Edward Kavazanjian

ASU leads the way in biogeotechnical engineering

Arizona State University will lead a new National Science Foundation (NSF) Engineering Research Center to pioneer advances in geotechnical engineering that promise solutions to some of the world's biggest environmental and infrastructure development challenges.

The consortium of university, industry and government partners has been awarded $18.5 million to establish the Center for Bio-mediated and Bio-inspired Geotechnics (CBBG) to expand the emerging field of biogeotechnical engineering.

CBBG's researchers will focus on "nature-compatible" approaches to boosting the resiliency of civil infrastructure, improving the effectiveness of environmental protection and ecological restoration methods, and developing ways to make infrastructure construction and natural resource development operations more sustainable.

The center's university partners are the Georgia Institute of Technology, New Mexico State University and the University of California, Davis. Engineers and scientists at those institutions will collaborate with ASU researchers to investigate the use of natural underground biological processes for engineering soil in ways that reduce construction costs while mitigating natural hazards and environmental degradation.

CBBG's director is ASU Regents' Professor Edward Kavazanjian. He is a member of the National Academy of Engineering and the Ira A. Fulton Professor of Geotechnical Engineering in the School of Sustainable Engineering and the Built Environment (SSEBE).

ASU is now one of only two universities in the country currently leading two NSF-funded Engineering Research Centers.

"This is our second NSF Engineering Research Center award in about four years. This is very rare and it reflects our unique culture that supports the kinds of multi-investigator and multi-institution teams needed to tackle these exciting areas of research at the intersection of many engineering and science disciplines," said Kyle Squires, dean of the Fulton Schools.

"This center has emerged from an idea Ed Kavazanjian has been conceptualizing and promoting in his professional community for the past several years, and it is great to see it come to fruition," Squires said. "Solutions born from the center will change how we build on and in the earth, and educate a workforce capable of putting research into industry practice."

Student intern Nathalia Souza Domingos da Costa, left, works with doctoral student Alizee Jenck in Edward Kavazanjian's lab.

CBBG's researchers will endeavor to either employ or emulate natural processes in developing innovative methods and technologies for engineering geotechnical systems.

"In billions of years of evolution, nature has come up with some very elegant solutions to the problems we want to solve," Kavazanjian said. "By employing or mimicking these natural processes we should be able to devise some of our own elegant solutions."

Much of CBBG's work will concentrate on developing bio-based methods of strengthening soils as a way to produce more solid ground for building foundations and to prevent erosion that threatens human health, the environment and infrastructure systems.

Researchers, for instance, will explore the use of microbial organisms to help stabilize soils. Certain kinds of microbes produce an enzyme that can cause calcium carbonate to precipitate in porous soils, thereby hardening the ground, making it more resistant to erosion, and providing a stronger foundation for construction.

Calcium carbonate precipitation can also be used in lieu of Portland cement to stabilize pavement subgrades and to create "bio-bricks," soil particles that are bound together into building blocks for infrastructure construction.

Innovations in soil stabilization

Other efforts will involve attempting to figure out how to equal the performance of trees in their natural ability to stabilize soil against erosion and to provide support against wind and other loads through their root systems.

"The best man-made soil-reinforcing elements and foundation systems we have developed are not as efficient as trees at stabilizing soil. We want to be able to design soil-reinforcement and foundation systems that work like tree root systems," Kavazanjian said.

Researchers will also seek to devise technologies that match some of the subterranean earth-moving and stabilization capabilities of burrowing insects and small mammals.

"Ants are a hundred times more energy-efficient at tunneling than our current technology. They excavate very carefully and their tunnels almost never collapse," Kavazanjian said. "If we could do what ants can do, we could make underground mining much safer."

New methods of environmental restoration

Similarly, he said, if engineers could design a probe with sensor technology and guidance systems that effectively digs and tunnels through soil like a mole, it would significantly improve subsurface exploration and characterization.

Such an accomplishment would lead to construction of stronger and safer roadways, bridges, dams, power plants, pipelines and buildings, and more efficient and effective oil-drilling and mining operations.

"We want to reproduce the beneficial effects that biological and biogeochemical processes can achieve, accelerate them, and then employ them on larger scales," he said.

Progress in biogeotechnical technologies and engineering could also lead to significant improvements in methods of cleaning up environmental contaminants and restoring land denuded by erosion or industrial-scale resource extraction.

Advances could also produce better ways to fortify structures and landscapes against the destructive forces of earthquakes, including methods for combating the soil liquefaction that results from strong earthquakes and can severely destabilize large swaths of land.

Impressive impact on geotechnical engineering earns Kavazanjian ASU Regents' Professor honor

Edward Kavazanjian, the Ira A. Fulton Professor of Geotechnical Engineering in the School of Sustainable Engineering and the Built Environment, is among this year's cohort of ASU Regents' Professors, the highest distinction bestowed on faculty members of Arizona's state universities.

The title honors achievements in scholarship, research, creative endeavors and public service that have earned national or international distinction.

Students have benefited from the experiences that have made Kavazanjian a foremost expert in such areas as the analysis, design and construction of solid-waste landfills and containment sites, environmental restoration of hazardous sites, and techniques for reducing the impacts of earthquakes and soil erosion on buildings and infrastructure systems.

He is the director of the recently established Center for Bio-mediated and Bio-inspired Geotechnics (CBBG), a National Science Foundation (NSF) Engineering Research Center. Its goal is to expand the applications of the emerging field of biogeotechnical engineering — which uses or emulates natural biological processes for soil engineering.

Collaborative efforts will achieve global reach

A range of expertise across engineering and science disciplines will be needed to better understand the nature of the biogeochemical processes on which the center's work will focus. In addition to Fulton Schools of Engineering faculty members, ASU's team includes researchers from the university's School of Earth and Space Exploration, the School of Life Sciences and the Mary Lou Fulton Teachers College.

Environmental protection and restoration aspects of the research will be directed by Rosa Krajmalnik-Brown, an associate professor in SSEBE and one of the center's co-principal investigators.

"Being selected by NSF for the CBBG ERC is a game changer for civil engineering at ASU. It will showcase our leadership capabilities and our world-class faculty and programs," said G. Edward Gibson Jr., director of SSEBE.

"I'm excited that we will be able to focus on an emerging area of geotechnical engineering in a transdisciplinary way, bringing together experts in an array of fields. Their collaborations will yield possibilities for significant advances in the sustainability of the world's built environments," Gibson said.

The potential global impacts of CBBG's work has attracted more than a dozen companies to sign on to the center's industrial affiliates program to lend support to the research.

In addition, 15 universities from around the world — including some in Europe, Asia and South America — are expected to collaborate with CBBG on research and educational programs.

A number of agencies that manage large public infrastructure systems — including the Arizona and New Mexico transportation departments, the Los Angeles Department of Water and Power and the Port of Los Angeles — have also agreed to collaborate with the center on research and field-testing.

Education outreach key to center's mission

The CBBG's mission also extends to expanding education in geotechnical science and engineering, as well as promoting diversity within the profession.

The center's deputy director, Claudia Zapata, an associate professor in SSEBE, in collaboration with Professor Wilhelmina Savenye in the Mary Lou Fulton Teachers College, will oversee implementation of an education outreach and diversity program aimed at K-12 schools, community colleges and university undergraduates.

The program is to include development of geotechnical engineering educational material for undergraduate and graduate courses.

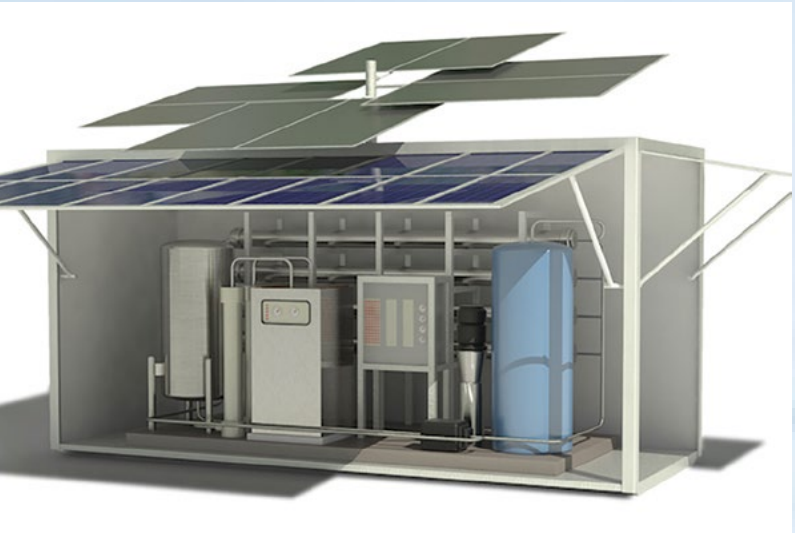
Mentoring, internship and professional development programs will be part of the center's efforts to train a workforce equipped with the skills to put CBBG's research into practice in industry.

Initial NSF funding that will support the new center for five years amounts to the nation's largest single investment in geotechnical research, Kavazanjian said.

NSF support can be extended for a second five-year period, but after that time the center would be expected to become a self-supporting enterprise.

NEWT

Nanotechnology Enabled Water Treatment Systems



NEWT's water-treatment systems will be compact enough to fit on the back of a tractor-trailer. Credit: NEWT/Rice University

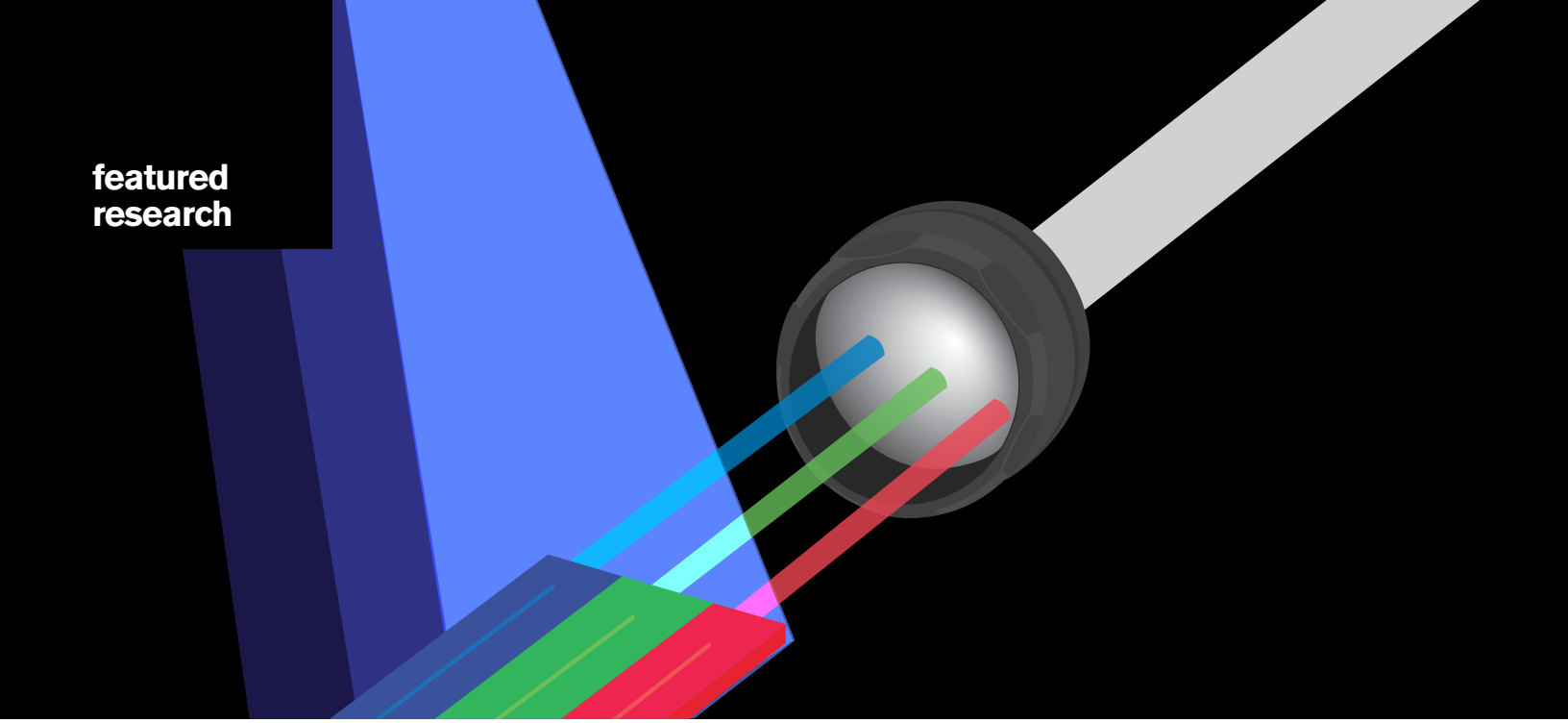
Rice, ASU, Yale, UTEP awarded coveted engineering research center

New center will transform economics of water treatment

No other resource is as necessary for life as is water, and providing it safely and universally is a grand challenge inextricably linked to public health, energy production and sustainable development.

Arizona State University and a consortium of industry, university and government partners have been awarded $18.5 million to establish The Nanotechnology Enabled Water Treatment Systems center, or NEWT, a prestigious National Science Foundation Engineering Research Center to develop compact, mobile, off-grid water-treatment systems that can provide clean water to millions of people who lack it and make U.S. energy production more sustainable and cost effective. ASU researchers, led by NEWT Deputy Director and Professor Paul Westerhoff, have been allocated $3.2 million for their role in the center.

NEWT will be led by and based at Rice University in Houston, Texas. It is funded by a five-year renewable NSF grant. NEWT brings together experts from ASU, Rice, the University of Texas at El Paso and Yale University to work with more than 30 partners, including Shell, Baker Hughes, UNESCO, the U.S. Army Corps of Engineers and the National Aeronautics and Space Administration (NASA).



featured research

ASU engineers demonstrate the world's first white lasers

More luminous and energy efficient than LEDs, white lasers look to be the future in lighting and Li-Fi, or light-based wireless communication

While lasers were invented in 1960 and are commonly used in many applications, one characteristic of the technology has proven unattainable. No one has been able to create a laser that beams white light.

Researchers at Arizona State University have solved the puzzle. They have proven that semiconductor lasers are capable of emitting over the full visible color spectrum, which is necessary to produce a white laser.

The researchers have created a novel nanosheet — a thin layer of semiconductor that measures roughly one-fifth of the thickness of human hair in size with a thickness that is roughly one-thousandth of the thickness of human hair — with three parallel segments, each supporting laser action in one of three elementary colors. The device is capable of lasing in any visible color, completely tunable from red, green to blue, or any color in between. When the total field is collected, a white color emerges.

Cun-Zheng Ning

The Fulton Schools researchers published their findings in the July 2015 issue of the journal Nature Nanotechnology.

Cun-Zheng Ning, professor in the School of Electrical, Computer and Energy Engineering, authored the paper, "A monolithic white laser," with his doctoral students Fan Fan, Sunay Turkdogan, Zhicheng Liu and David Shelhammer. Turkdogan and Liu completed their doctoral degrees after this research.

The technological advance puts lasers one step closer to being a mainstream light source and potential replacement or alternative to light emitting diodes (LEDs). Lasers are brighter, more energy efficient and can potentially provide more accurate and vivid colors for displays like computer screens and televisions. Ning's group has already shown that their structures could cover as much as 70 percent more colors than the current display industry standard.

Another important application could be in the future of visible light communication in which the same room lighting systems could be used for both illumination and communication. The technology under development is called Li-Fi for light-based wireless communication, as opposed to the more prevailing Wi-Fi, using radio waves. Li-Fi could be more than 10 times faster than current Wi-Fi, and white laser Li-Fi could be 10 to 100 times faster than LED based Li-Fi currently still under development.

"The concept of white lasers first seems counterintuitive because the light from a typical laser contains exactly one color, a specific wavelength of the electromagnetic spectrum, rather than a broad-range of different wavelengths. White light is typically viewed as a complete mixture of all of the wavelengths of the visible spectrum," said Ning, who also spent extended time at Tsinghua University in China during several years of the research.

In typical LED-based lighting, a blue LED is coated with phosphor materials to convert a portion of the blue light to green, yellow and red light. This mixture of colored light will be perceived by humans as white light and can therefore be used for general illumination.

Sandia National Labs in 2011 produced high-quality white light from four separate large lasers. "While this pioneering proof-of-concept demonstration is impressive, those independent lasers cannot be used for room lighting or in displays," Ning said.

The most desired solution, according to Ning, would be to have a single semiconductor structure that emits all needed colors. He and his graduate students turned to nanotechnology to achieve their milestone.

The key is that at nanometer scale larger mismatches can be better tolerated than in traditional growth techniques for bulk materials. Semiconductors, usually a solid chemical element or compound arranged into crystals, are widely used for computer chips or for light generation in telecommunication systems. High-quality crystals can be grown even with large mismatch of different lattice constants.

Recognizing this unique possibility early on, Ning's group started pursuing the distinctive properties of nanomaterials, such as nanowires or nanosheets, more than 10 years ago. He and his students have been researching various nanomaterials to see how far they could push the limit of advantages of nanomaterials to explore the high crystal quality growth of very dissimilar materials.

While this first proof of concept is important, significant obstacles remain to make such white lasers applicable for real-life lighting or display applications. One of the crucial next steps is to achieve the similar white lasers under the drive of a battery. For the present demonstration, the researchers had to use a laser light to pump electrons to emit light. This experimental effort demonstrates the key first material requirement and will lay the groundwork for the eventual white lasers under electrical operation.

Advancing OLED technology to more effectively light our world

Despite all the forward technological leaps in modern electronics, our lighting devices still lack optimal versatility, reliability and operational efficiency.

One area of research that promises solutions to these shortcomings is focused on developing advanced organic light-emitting diodes — called OLEDs.

An organic light-emitting diode is a light-emitting diode (LED) that employs conjugated organic molecules to transport electrical charges and emit light in response to the electric current. The typical thickness of a whole OLED is less than one micrometer, which can be transparent and compatible with the flexible substrates.

Work on OLEDs led by Jian Li, an associate professor of materials science and engineering, in the past decade has attracted continuing interest from industry and government.

The most recent support is a grant providing $875,000 over two years from the U.S. Department of Energy to allow Li's lab to expand its research and further develop its collaboration with Universal Display Corporation, a leading developer of electronic display and lighting technologies based on organic materials.

Popular Science picks Fulton Schools innovation as a top world-changing technology

This year ASU electrical engineering professor Cun-Zheng Ning and his research group have been awarded a 2015 Popular Science Best of What's New Award in the engineering category for their breakthrough in demonstrating the world's first white laser.

The editors of Popular Science seek out products and technologies poised to change our world. They review thousands of new products and innovations to choose the top 100 in 10 categories.

"The Best of What's New Awards honor the innovations that surprise and amaze us — those that challenge our view of what's possible in the future," said Cliff Ransom, editor-in-chief of Popular Science. "The award is Popular Science's top prize, and the 100 winners — chosen from among thousands of nominees — are each a revolution in their respective fields."

Li said the energy department considers progress in OLEDs a high priority — a key part of its efforts to help the nation become more energy-efficient, diversify into renewable energy resources and find ways to provide more affordable energy.

The next generations of OLED technology can be expected to enhance the lighting performance in all kinds of solid state electronics — everything from lighting for parks, streets and sports facilities to digital watches, cell phones, television and computer screens, and flexible electronic displays, as well as home, commercial and industrial lighting.

Li's research team is working to develop OLEDs that emit a more operationally stable and pure white light than other lighting technologies.

If successful, the new OLED devices will be less complicated and less costly to manufacture, and offer increased efficiency and longer lifespans because they would need less power to operate. That accomplishment would effectively pave the path to relatively rapid commercialization, Li said.

The new OLEDs would not emit ultraviolet (UV) light, which will not only enable clearer vision but also will prevent eyestrain that often results from continuing exposure to the UV light emitted by current devices. They will also benefit museum and art galleries where UV light actually dulls colors of paintings by causing slow decomposition of the paints and other materials.

Li and his collaborators have generated a significant number of intellectual properties. Nine patents have been issued based on the research and development at ASU, and almost 40 patent applications are pending — which cover the areas of molecular structure design, device architecture, device fabrication method and product prototype design for OLEDs and organic solar cells.

Dan Bliss: Leading a revolution in wireless communications

Associate Professor Dan Bliss is advancing research that aims to usher in a revolution in wireless communications.

His efforts are supported in part by more than $3 million in industry and government grants in communications and sensing for the next two years. Though the specifics of some of these research efforts are protected by proprietary agreements, Bliss' research aims to make our wireless systems more manageable and efficient.

Society is experiencing increasing diversity in wireless needs and consumption, while simultaneously facing questions about how much energy is available.

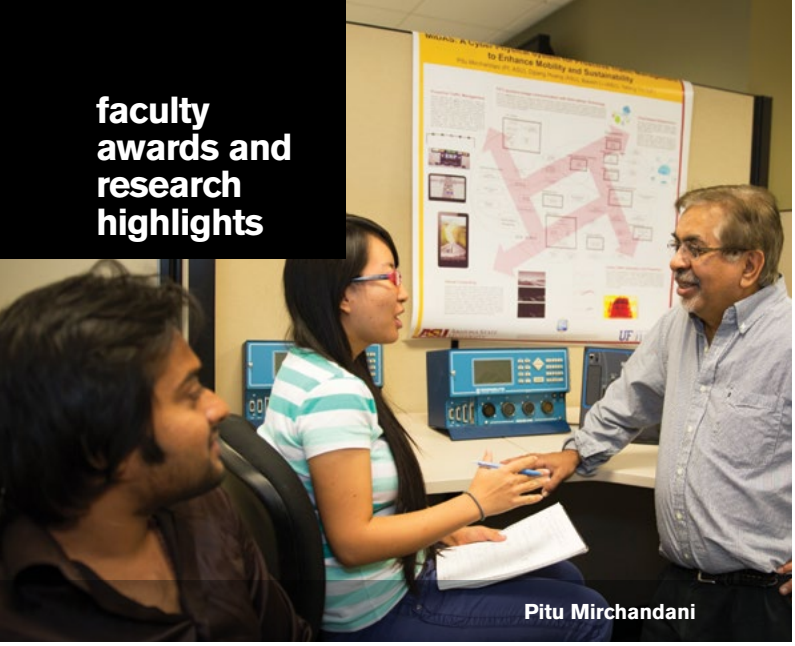
As the Internet of Things (IoT) develops, and as users increasingly desire greater access, reliability, data rates and communications diversity, additional wireless communications will further complicate these overburdened systems.

"This research is relevant to everyone who uses wireless technology," said Bliss, adding that corporate sponsors are interested in funding this research because of the desire to improve wireless information access. It is also relevant to companies that design wireless devices like home networks, smart refrigerators and anyone championing IoT.

"As wireless technology makes more and more contact with everything we do, having wireless systems that improve our quality of life and serve all of us well will become increasingly important," said Bliss.

Dan Bliss, center, works in his lab with students Wylie Standage-Beier and Hanguang Yu.

faculty awards and research highlights



Pitu Mirchandani

Oliver Kosut

Mirchandani named INFORMS fellow for pioneering advances in network traffic control

Research discoveries that help people and systems to make informed decisions have earned Pitu Mirchandani a prestigious honor. In November 2015, Mirchandani, an industrial engineering and operations research professor, was named a fellow in the Institute for Operations Research and the Management Sciences (INFORMS). This is a distinguished honor reserved for very few members — only eight were granted fellow status last year.

He was elected for fundamental research contributions to dynamic and stochastic (randomly determined) networks, location models, adaptive control of transportation systems, and traffic modeling and analysis.

In all of his research areas, Mirchandani's basic goal is to provide appropriate solutions to managing complex systems, enabling decision-makers to make quick planning and operational decisions under conditions with uncertainties and random variations.

Mirchandani is a pioneer in this area, particularly in incorporating advanced modeling and information technologies into transportation and logistics operations.

This involves using computational technologies to inform and guide decision-making in areas such as transportation and power systems, water distribution systems, urban infrastructure planning and development, and healthcare.

In the field of transportation, Mirchandani is known for the development and implementation of the Real-time Hierarchical Optimizing Distributed Effective System (RHODES), which is a self-learning traffic signal control system that observes approaching traffic at intersections using sensors and sets traffic signals in real-time to minimize delays for drivers and the energy consumption of their vehicles.

"This system observes vehicles that are coming and gives the right amount of green light to those directions with the most need," said Mirchandani.

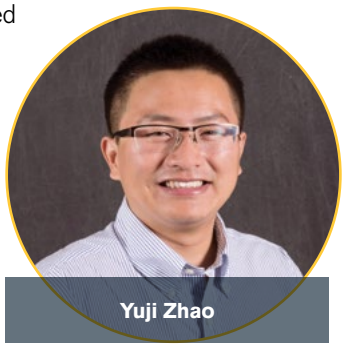
He is also currently developing MIDAS, a cyber-physical system for better managing complex urban traffic that uses smart phones, image-based sensors and a cloud computing platform.

Using math to combat malicious attacks on complex communication and power networks

Assistant Professor Oliver Kosut is using theoretical mathematical insights to combat attacks on communication networks, with an eye toward the fundamental trade-offs between security (degree of protection against attacks) and performance (achievable communication rates among legitimate users). His research focuses on security and stochastic systems and is supported in part by a prestigious National Science Foundation Faculty Early Career Development Program (CAREER) award.

ASU engineer nets NASA early career award for solar cell research

Yuji Zhao, assistant professor of electrical and computer engineering, has been chosen to receive a prestigious Early Career Faculty Space Tech Research Grant awarded by the National Aeronautics and Space Administration (NASA) — a first for the Fulton Schools faculty.



Yuji Zhao

NASA selected eight university-led projects focused on innovative, early stage technologies that address high-priority needs of America's space program. Zhao is working on new technology for high-temperature solar cells to be used in space, where power generation is a critical issue. Zhao is working with a relatively new semiconductor material, gallium nitride, which operates well under high temperatures.

The NASA awards are about $200,000 per year, up to a possible three years of research, for outstanding young faculty.

Sarma Vrudhula

Christiana Honsberg

Vrudhula named IEEE Fellow for advances in energy efficiency

A career dedicated to improving the energy efficiency of digital devices has resulted in Sarma Vrudhula's elevation to a fellow in the Institute of Electrical and Electronics Engineers (IEEE), one of the world's most prominent professional organizations.

Fellow is a distinction reserved for the most prestigious IEEE members and is conferred by the Board of Directors upon engineers with an extraordinary record of accomplishments in their field. Less than one-tenth of one percent earn new fellow status each year.

Vrudhula, a computer science and engineering professor, was selected for his contributions to low power and energy efficient design of digital circuits and systems.

Honsberg presented William R. Cherry Award

Christiana Honsberg, professor in the School of Electrical, Computer and Energy Engineering and director of the Solar Power Laboratory, has been chosen to receive the William R. Cherry Award in recognition of her multiple contributions to the advancement of photovoltaics (PV).

Honsberg was presented the award at the IEEE Photovoltaic Specialists Conference that took place in New Orleans last year.

Honsberg's notable contributions include the pioneering of advanced PV concepts ranging from the development of a generalized thermodynamic theory for determining efficiency limits of solar cells, to making seminal advances in the understanding of intermediate band, interband and quantum well approaches.

She also is a co-inventor of the so-called "Very High Efficiency Solar Cell (VHESC)" and serves as director and lead investigator to the first U.S. multi-institutional Engineering Research Center (ERC) on photovoltaics, Quantum Energy and Sustainable Solar Technologies (QESST), which is jointly supported by the U.S. National Science Foundation and the U.S. Department of Energy.

Read more in Full Circle
fullcircle.asu.edu

2016 CAREER Award Recipients

Candace Chan
Assistant professor in the School for Engineering of Matter, Transport and Energy

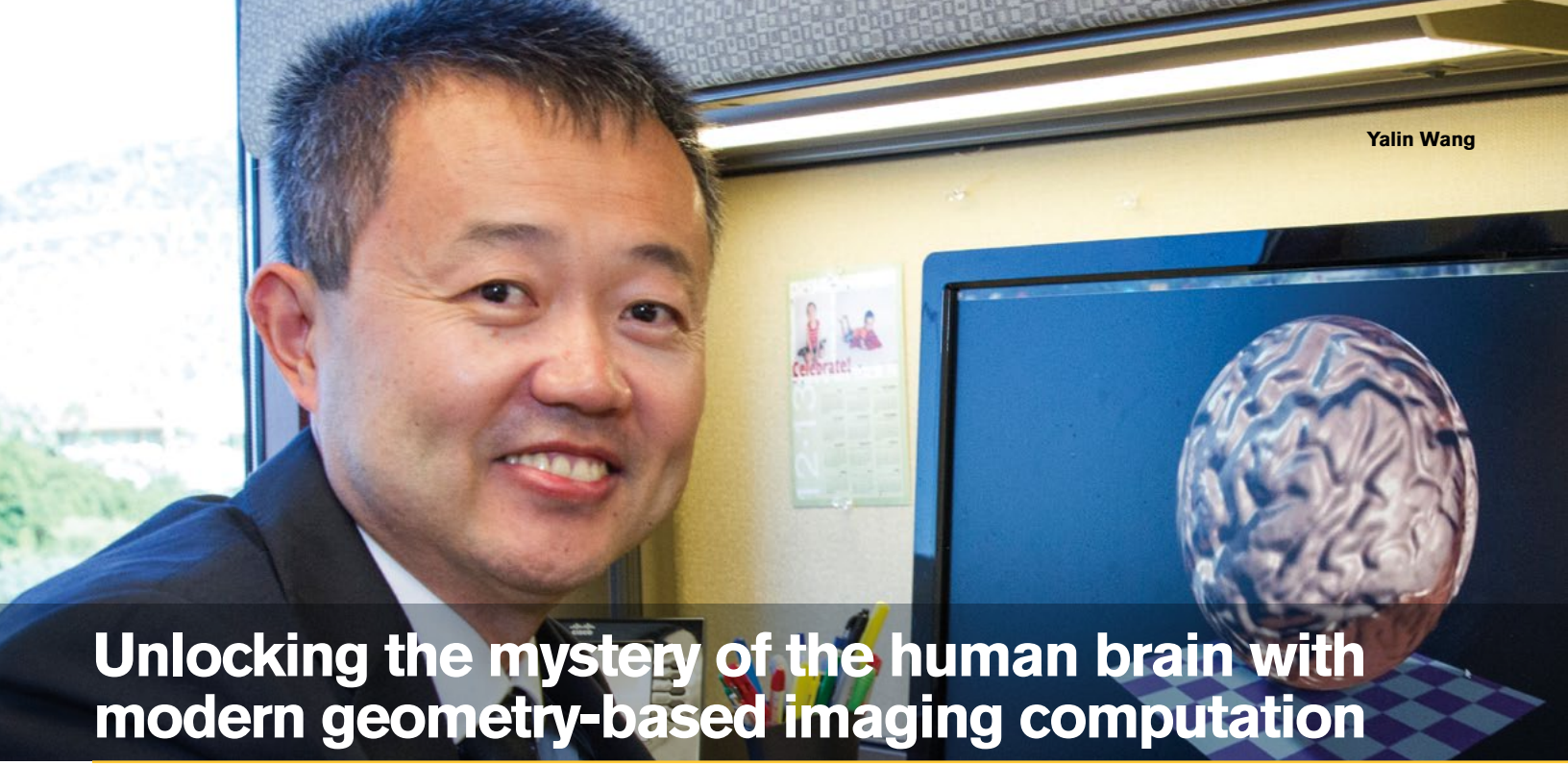
Jennifer Blain Christen
Assistant professor in the School of Electrical, Computer and Energy Engineering

Jingrui He
Assistant professor in the School of Computing, Informatics, and Decision Systems Engineering

Ximin He
Assistant professor in the School for Engineering of Matter, Transport and Energy

Sefaattin Tongay
Assistant professor in the School for Engineering of Matter, Transport and Energy

Shimeng Yu
Assistant professor in the School of Electrical, Computer and Energy Engineering



Yalin Wang

Unlocking the mystery of the human brain with modern geometry-based imaging computation

According to the Alzheimer's Association, the number of people age 65 and older with Alzheimer's disease may nearly triple, from 5.1 million to a projected 13.8 million by 2050, barring the development of medical breakthroughs to prevent or cure the disease. To help tackle this problem Assistant Professor Yalin Wang is developing computational software to monitor and understand the structural changes related to Alzheimer's disease. His research is supported by six research grants from the National Science Foundation, National Institutes of Health and Arizona Alzheimer's Consortium. He has published 45 journal papers, three book chapters and hundreds of conference papers and abstracts on his work.

Kaushal Rege

Laser technology, nanomaterials combine to offer promising body tissue repair technique

Kaushal Rege, an associate professor of chemical engineering, has been using gold nanorods as a key ingredient in a new kind of body tissue sealant. The new technique uses lasers to seal body tissue that has been separated by surgical incisions or torn by injury. The technique could in many cases improve on or at least supplement conventional stitches and sutures used in tissue repair. Rege's progress has brought support from the National Institutes of Health (NIH), most recently an R01 grant to provide $1.6 million over three and a half years to expand his research and development in this area.

Mikhail Chester

ASU study: Cities need to limit parking to decrease automobile use and encourage public transit

A research project led by Arizona State University, in partnership with UCLA and Georgia Tech, suggests that if burgeoning cities wish to decrease automobile use to relieve congestion, reduce air pollution and encourage public transit they need to develop strategies to reduce the number of parking spaces. Los Angeles currently offers 3.3 million spaces for each of its 5.6 million vehicles. The study, led by Assistant Professor Mikhail Chester, is published in the November online issue of the Journal of the American Planning Association.

ASU engineers working to protect nation's energy delivery systems from cyber attacks


Anna Scaglione

Arizona State University is partnering with The University of Illinois on a $28.1 million national research program to develop cybersecurity tools and standards to protect the country's electricity infrastructure from attacks, called the Cyber Resilient Energy Delivery Consortium (CREDC). Under the leadership of Professor Anna Scaglione and Fulton Entrepreneurial Professor Gail-Joon Ahn, ASI will work with 11 other universities and national laboratories to focus on improving the cyber resiliency of energy delivery systems.


Gail-Joon Ahn


Huan Liu (standing, center), with students.

ASU's TweetTracker helps make sense of social media

Arizona State University's TweetTracker tool helps to track, analyze and understand that activity by identifying the who, what, where and when of social media usage. It also provides visualization capabilities such as graphs and maps to allow the user to understand properties of the events they track, such as which geographic regions are talking about each topic, and who the top users are in the context of the event. TweetTracker was started through a grant from the Office of Naval Research and was built at the Data Mining and Machine Learning Lab led by director Huan Liu, a computer science professor. The TweetTracker team was given the ASU President's Award for Innovation in 2014.


Klaus Lackner


Marco Santello

Quest to boost microalgae growth promises more sustainable energy

Professors Bruce Rittmann and Klaus Lackner will lead a new research project to aid U.S. Department of Energy (DOE) efforts to boost production of microalgae — a promising source for clean, renewable energy.

DOE has awarded ASU a three-year, $1 million grant to fund the Atmospheric Carbon Dioxide (CO_2) Capture and Membrane Delivery project, which will test techniques and technologies in algae cultivation ponds at the Arizona Center for Algae Technology and Innovation (AzCATI). Besides renewable biofuel production, microalgae biomass is being used for a suite of products, ranging from food supplements to feed for mammals and fish to therapeutics and cosmetics.

Study explores hand's complex, skillful movement

A team of researchers, led by Marco Santello, a biomedical engineering professor and director of the School of Biological and Health Systems Engineering, are working to gain a better understanding of the neural mechanisms underlying how we perform and learn dexterous manipulation. The knowledge drawn from this current project could lead to new options in advanced and human-like prosthetics, neuroprosthetics, robotic manipulators and research tools.

The study, a partnership with Andrew Gordon, a professor of movement science and neuroscience and education at Teachers College, Columbia University, and funded by a $650,000 grant from the National Science Foundation (NSF), will focus on the specific force used in the fingertip in relation to the position of the finger.

Engineering global energy solutions

Professor Clark Miller presented a three-day workshop in Islamabad on energy policy and leadership for NUST and UET students.

In January 2016, Arizona State University welcomed 24 exchange graduate students, the first cohort in a partnership with leading Pakistani engineering universities dedicated to researching and developing solutions for Pakistan's energy needs.

Led by ASU, the U.S.-Pakistan Centers for Advanced Studies in Energy (USPCAS-E) is a collaboration sponsored by the U.S. Agency for International Development (USAID) and Pakistan's Higher Education Commission. An $18 million award supports the project — the largest ASU has ever received from USAID.

In partnership with the National University of Science and Technology — Islamabad (NUST) and the University of Engineering and Technology in Peshawar (UET), the project aims to address energy needs unique to Pakistan as well as develop relationships between government, industry and academia to inform sustainable policy. In doing so, the project's goal is to fully unlock Pakistan's economic potential through an educated and involved workforce.

"This program is designed to further outreach, so our research and our work goes beyond the lab," said Sayfe Kiaei, director of USPCAS-E and a professor of electrical engineering in the Ira A. Fulton Schools of Engineering. "We're looking at affecting positive change in the world through engineering."

Currently, Pakistan faces a host of energy problems; chief among them is that demand for energy exceeds the supply. To mitigate this, planned blackouts routinely leave thousands of Pakistanis without power for hours at a time. In addition to an unreliable supply, electricity can be very expensive due to the reliance on imported fuel sources. Though Pakistan uses merely 5 percent of its total hydroelectric power and solar power remains largely untapped, many of the imported sources are nonrenewable, such as diesel and coal.

These are all problems that ASU is poised to aid in addressing, according to Hassan Zulfiqar, communications and outreach specialist for USPCAS-E.

"Since ASU is helping lead the transition to a future powered by renewable energy, especially solar, it is currently perfectly positioned to help both the partner Pakistani universities in realizing their impact in energy-related policy development, research, scholarship, teaching and workforce development," he said.

During their time at ASU, the students are tackling a variety of projects, from batteries and fuel cells to energy policy and more energy-efficient buildings.

"Students will get to learn research techniques and ways to take on problems more systematically while working on the latest issues and projects in the field," said Kiaei. "It is also a cultural exchange, and I hope it will bring them together closely with students here. It's easy to have a limited view of some parts of the world when you only hear bad news from there. This program provides a different perspective, and allows someone to see the students coming here have the same values and are trying to make a difference, just like the students at ASU."

Warda Mushtaq, a graduate student from NUST, has enjoyed her ASU experience thus far.

"I think we were all a little shocked at how huge ASU is and just how much research goes on here," she said of her initial reaction to the university. "I knew coming here that ASU was a top-ranked research school, but it's one thing to read about it and another to walk through the labs and see the variety of research going on."

Growing up with routine power outages, working to secure a stable supply of electricity for Pakistan is one reason Mushtaq was drawn to her work in photovoltaics. Pakistan has incredibly high solar insolation, or the amount of sunlight hitting a given area, meaning its potential for solar energy is enormous.

"My research is focused on fabrication of low-cost photovoltaics, so it's available to everyone in Pakistan, from our largest city to the smallest villages," she said.

Though she just arrived, one thing Mushtaq looks forward to taking back to Pakistan is the research approach she's found here at ASU.

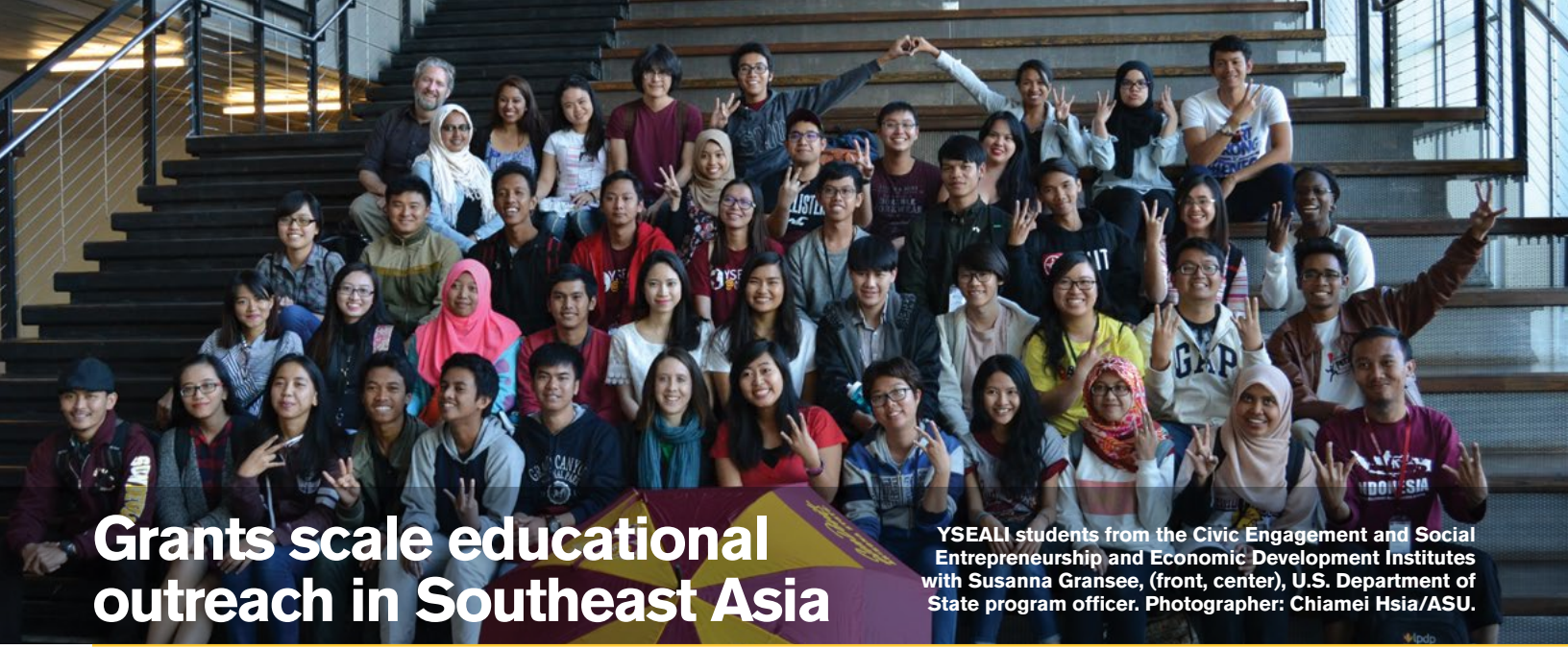
"I've always thought the focus of all research should be on how something is going to affect your community, what the real-world application is," said Warda Mushtaq. "I see a lot of that kind of purpose-driven research here, and that's something I look forward to applying back home."

The program will continue to bring exchange students to ASU each semester through 2019.

"Both the U.S. and Pakistani governments recognize that a country's prosperity and quality depends upon the quality of education," said Zulfiqar. "Hence USAID is investing in USPCAS-E to help produce skilled graduates with the knowledge and dispositions required to make them productive and contributing members of society."

USPCAS-E is part of an overall $127 million investment by USAID in Pakistan, the U.S.-Pakistan Centers for Advanced Studies program. In addition to ASU and partners' energy-focused work, U.S.-Pakistan Centers for Advanced Studies in Water (USPCAS-W) as well as Agriculture and Food Security (USPCAS-AFS) are underway. USPCAS-W, led by the University of Utah and Pakistani partner Mehran University of Engineering and Technology aims to address water-related issues and USPCAS-AFS, spearheaded by University of California, Davis and partner University of Agriculture in Faisalabad work toward solutions for food and agriculture problems in Pakistan.

Warda Mushtaq, a graduate student from National University of Science and Technology–Islamabad



Grants scale educational outreach in Southeast Asia

YSEALI students from the Civic Engagement and Social Entrepreneurship and Economic Development Institutes with Susanna Gransee, (front, center), U.S. Department of State program officer. Photographer: Chiamei Hsia/ASU.

The Ira A. Fulton Schools of Engineering take pride in producing graduates that benefit from innovative and hands-on curricula, collaborative campus workspaces and impactful student programs.

Why not promote these breakthroughs in engineering education across the globe? Recent grants will further initiatives in the Fulton Schools that aim to do just that.

These grants enable exciting possibilities: bringing the next generation of Southeast Asia's engineering and technology leaders to ASU to think about social change; sending teams of Fulton Schools students to Vietnam to work with local students on engineering-based problems; and creating collaborative maker spaces for hands-on learning in Vietnam.

The Office of Global Outreach and Extended Education (GOEE), seeded within the Fulton Schools, is leading these efforts with grants from the U.S. Department of State and the United States Agency for International Development (USAID).

Developing leaders to spark international social change

A $500,000 grant from the U.S. Department of State will bring 44 academic fellows, all high-achieving undergraduate students from Southeast Asia, to Tempe, Arizona, to attend two Arizona State University-hosted institutes as part of President Barack Obama's signature program: the Young Southeast Asian Leaders Initiative (YSEALI).

The grant was awarded to a collaborative team from ASU's Ira A. Fulton Schools of Engineering and the College of Public Service and Community Solutions.

Launched in 2013, YSEALI is strengthening ties between the U.S. and Southeast Asia, and sparking innovation and initiatives that foster social change within the region.

"We're working with the U.S. government to bring students to ASU where they can develop skills that will prepare them to become future leaders and ambassadors within their home countries," said Jeff Goss, who is the principal investigator of the grant, the executive director of GOEE and an assistant dean in the Fulton Schools.

At the Social Entrepreneurship and Economic Development Institute, hosted by the Fulton Schools, the students will shadow successful community organizers, learn tools for effective communication and leadership, explore the key elements of human-centered design, and develop entrepreneurial ideas and business models.

During the institute, the YSEALI Fellows will network with Fulton Schools' students in classes, student organizations and student projects to promote long-lasting collaboration.

"This provides our students the opportunity to consider engineering in a global context and to engage in the implementation of the YSEALI student projects," said Goss.

Each YSEALI Fellow will generate a project proposal that will serve as the blueprint for a social change initiative relevant to his or her home country. At the end of the institute students will travel to Washington, D.C. to demonstrate the skills and knowledge they gained by presenting their capstone proposals to the U.S. State Department. They will also attend seminars and meet with McCain Fellows and diplomatic leaders at the McCain Institute.

"When [the YSEALI students] return to their home countries they will know social entrepreneurship and economic development 'best practices' and will have developed skills to help them transform their ideas in to actions that can benefit society," said David Benson.

Benson, a senior lecturer in the Fulton Schools, will serve as the academic director for the Social Entrepreneurship and Economic Development Institute with support from program coordinator Chani Clark.

Exporting new curricula, makerspaces to Vietnam

The Fulton Schools are also expanding activities in Vietnam through the Building University-Industry Learning and Development through Innovation and Technology (BUILD-IT) Alliance, which brings universities, government and industry partners together to stimulate innovation in Vietnamese higher education. A $5.8 million grant from USAID and $8 million in investments from more than 20 industry partners support this initiative.


Sherry Boger

The BUILD-IT Alliance is the latest advancement in a series of initiatives led by the Fulton Schools aimed at improving engineering education in Vietnam.

In 2009, GOEE first connected with Vietnam through a partnership with Intel that included a $100,000 grant for faculty in the Fulton Schools to develop an interdisciplinary graduate curriculum in the Semiconductor Packaging and Manufacturing specialization — with the goal of exporting this knowledge abroad. The grant enabled faculty to develop this expertise within ASU, then to impart their knowledge through a series of curriculum development workshops for faculty in countries in Asia, including Vietnam.

In the six years since the original partnership, additional grants totaling more than $25 million from founding partners Intel and USAID, and other industry, academic and government partners have supported a transformative national higher education collaboration — the Higher Engineering Education Alliance Program, known as HEEAP — in which ASU is leading the redesign of top-technical universities in Vietnam through improved teaching methods, a leadership institute focused on strategic change and accreditation, and training, coaching and mentoring both at ASU and across Vietnam.

"With the BUILD-IT Alliance we're furthering this impact by introducing new and innovative curricula approaches to faculty members in Vietnam that span a variety of STEM disciplines," said Goss.

This includes sharing some of the Fulton Schools' most innovative and successful student programs and initiatives, such as the Engineering Projects in Community Service (EPICS) and eProjects programs, and the eSpace model.

"We intend to create a bilateral collaboration of curricula — and students — between the Fulton Schools and Vietnamese technical universities," said Goss.

As part of the BUILD-IT Alliance the Fulton Schools will construct two collaborative makerspaces in the Vietnamese cities of DaNang and Ho Chi Minh City for students to design, build and test products, services and other inventions, better preparing them to become the next generation of engineers, scientists and technologists to positively impact the social and economic development of Vietnam. "These are spaces where students go to build and work as real engineers — from collaborating on hands-on projects with industry sponsors to developing their own inventions," said Goss.

"ASU has been leading the program to achieve key objectives and today [Intel is] hiring quality students who have benefited from the improved instruction, curricula and labs."
— Sherry Boger, Intel

These makerspaces are similar to eSpaces: innovative and hands-on learning spaces for freshman engineering students on ASU's Tempe campus.

The spaces will also provide a place for collaboration between Vietnamese and visiting Fulton Schools students, particularly students in the EPICS program, which organizes teams of undergraduate students to design, build and deploy systems to solve engineering-based problems for various communities and not-for-profit organizations.

"Next year we expect to send ASU EPICS teams to Vietnam where they can tackle engineering problems relevant to the local community alongside Vietnamese students," said Goss.

Transforming higher education in Vietnam

The BUILD-IT Alliance was proposed by GOEE in response to USAID's call for concepts to stimulate innovation in Vietnam's higher education system through public-private alliances. Universities and non-governmental organizations across the nation submitted proposals. This is the third Global Development Alliance grant that the Fulton Schools have received.

The BUILD-IT Alliance will function within a dynamic ecosystem of students, faculty, industry and government collaborators. In addition to introducing new student learning platforms, makerspaces for hands-on engineering education and curriculum improvements across Vietnam, the alliance aims to implement institutional policy change.

This agenda will be advanced through semi-annual events hosted by visiting ASU faculty and staff that include executive leadership training and a forum geared toward women.

Sherry Boger, vice president and general manager of Intel Products Vietnam, said, "HEEAP has proven to be an outstanding example of the powerful difference that can be made with a strong public-private partnership."

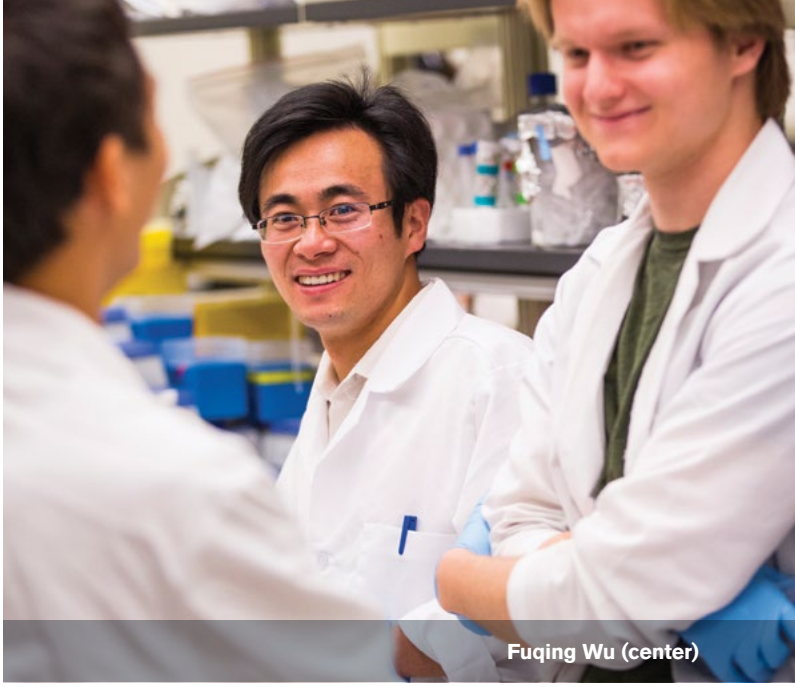
Since 2002, GOEE has partnered with international academic institutions, governments and corporations to design professional development programs — giving Fulton Schools faculty a way to directly influence the professional development of a global network of engineers.

Since 2010 more than 4,700 faculty, institutional leaders and quality assurance professionals — 27 percent females — have received training through HEEAP.

"The HEEAP Consortium and its projects like BUILD-IT are attractive because they span many different sectors," said Goss. "Businesses are involved because they benefit from the workforce success, universities benefit from improved student learning and retention, and all of these things attract government support because they improve society."

student successes

Pablo Guimerá Coll


Fuqing Wu (center)

QESST Scholar wins NSF Perfect Pitch Competition

Pablo Guimerá Coll, a doctoral student in materials science and engineering, brought home a first place win and $5,000 cash prize from the National Science Foundation Engineering Research Centers' Perfect Pitch Competition. Coll is a scholar in the Quantum Energy and Sustainable Solar Technologies (QESST). It is the first time QESST has won this prize awarded for concise and persuasive public speaking.

The Perfect Pitch Competition was held at a Capitol Hill Reception in Washington, D.C. where Coll gave a 90-second elevator speech and produced a single slide on the topic: "Sound Assisted Low Temperature Wafering for Silicon Modules."

Electrical challenge: ASU team excels in construction competition

A team of students from the Del E. Webb School of Construction came up with a viable, comprehensive plan for the electrical engineering tasks involved in construction of an Intelligent Transportation System — in just 15 hours — to win a second-place prize in a student construction management competition. Almost 200 students from top construction schools around the country made up the teams from 30 schools that participated in the competitions at the recent Associated Schools of Construction (ASC) Midwest Region conference in the Chicago area.

NASA Fellowship boosts engineering graduate student's research project

A fellowship from the National Aeronautics and Space Administration (NASA) will enable hydrosystems engineering doctoral student Tiantian Xiang to expand her examinations of hydrological processes in North America's monsoon region. Her research goal is to provide insights on how to improve water resources management in semi-arid regions such as the U.S. Southwest and northern Mexico. She is among 70 of 400 applicants chosen to receive the fellowship that provides $30,000 per year, plus $6,000 to be split for student and university expenses.

Promising biomedical research earns Wu prestigious fellowship

Graduate student Fuqing Wu has received a predoctoral fellowship from the American Heart Association.

The two-year award will support Wu's research in the lab of Xiao Wang, assistant professor of biomedical engineering. The funded research aims to use synthetic biological approaches to engineer gene networks regulating stem cell differentiation, which could eventually help promote regenerative therapies for damaged heart muscle.

He is working toward operating his own lab in the future and is expected to graduate with a with a doctoral degree in 2017.

Sun Devil Racing Development earns additional awards

An off-road vehicle constructed by students in Sun Devil Racing Development, the student chapter of the Society of Automotive Engineers (SAE) on ASU's Polytechnic campus, has earned several SAE Baja Collegiate Design Series awards. In May, the team's vehicles earned a 10th overall award at a national SAE competition in Maryland, followed by an 8th overall award from an international SAE competition in Portland, Oregon. Both competitions brought together hundreds of teams to test their vehicles' performance across criteria including hill climbing, acceleration, rock crawling and maneuverability.

Work on energy-conversion system earns engineering students best research paper award

The best student research paper award at this year's American Society of Mechanical Engineers (ASME) Power & Energy Conference went to mechanical engineering doctoral students Andrey Gunawan and Nicholas Fette. The winning paper detailed their research into the feasibility of incorporating a system into automobiles that would convert thermal energy (waste heat) from exhaust systems into electricity to help power the vehicles. In addition to receiving $2,500 and travel reimbursement for the cost of attending the conference, the paper will be published online in Energy-Tech magazine.

Kristopher Maham's life as a college student is anything but traditional

He is a U.S. Air Force veteran, husband, father of two girls and a first-time undergraduate student at the age of 37 in Arizona State University's Ira A. Fulton Schools of Engineering. Now he is further distinguishing himself through a prestigious internship with the National Aeronautics and Space Administration (NASA).

Maham, an electrical engineering student, will spend one semester each year interning on-site at NASA's Kennedy Space Center in Cape Canaveral, Florida, for the duration of his undergraduate studies. His work focuses on power production and distribution used by the various facilities at the center. He is part of the Construction of Facilities Department, which ensures that the center's facilities are capable of supporting NASA's missions, including that they are kept safe, secure, environmentally sound and operated efficiently and effectively.

"Our current projects focus on major upgrades to the safety and reliability of the center's power substations, as well as expanding an on-site solar power plant, more than doubling its current capacity," Maham said.

These projects will secure the center's energy needs as NASA continues to develop and deploy the next generation of space travel and exploration systems. Maham is working closely with a mentor to ensure these projects meet the required specifications as they transition from design to construction.

From avionics technician to electrical engineering student

While efforts promoting space travel might be a new realm for Maham, air travel is not. He served in the Air Force as an avionics technician on fighter aircraft for nearly 18 years until taking advantage of an early retirement program in 2014. Originally from Minot, North Dakota, Maham was stationed at Luke Air Force Base in Glendale, Arizona, for five years and decided to return to Arizona after his retirement because it was a good location for his family.

"I enrolled at ASU because of the reputation the Pat Tillman Veterans Center has for transitioning vets back to civilian and student life," said Maham. He also knew the Fulton Schools' programs are highly rated.

Initially interested in aerospace engineering, Maham decided to pursue electrical engineering because the career choices are more in line with his interests in electronics and renewable energy systems.

"Electrical engineering seems like the best way to leverage my avionics experience from the Air Force," he added. He is also pursuing a minor in engineering management. Maham is hopeful that his internship at NASA will convert to a permanent position.

Kristopher Maham, an electrical engineering undergraduate, at the Kennedy Space Center in Cape Canaveral, Florida, where he is an intern in a NASA Pathways Program. Photographer: Bonni McClure/NASA

"I would also like to pursue opportunities that allow me to stay in the Phoenix area, possibly with other aerospace companies or in the solar power industry," he said.

He also intends to pursue graduate studies at ASU.

Veterans resources key to successful transition

Maham said transitioning from military service to academics has not been easy.

"I could not be doing it without the support of my family and the assistance of the Tillman Center," he said.

The biggest challenge is relearning how to study and balance school and other obligations. Having school-age children adds to the balancing act. But Maham said it has been a bonding opportunity with his daughters, as he and the girls usually do their homework at the same time.

"Unfortunately, they can't help me with my homework as much as I help them with theirs," he said.

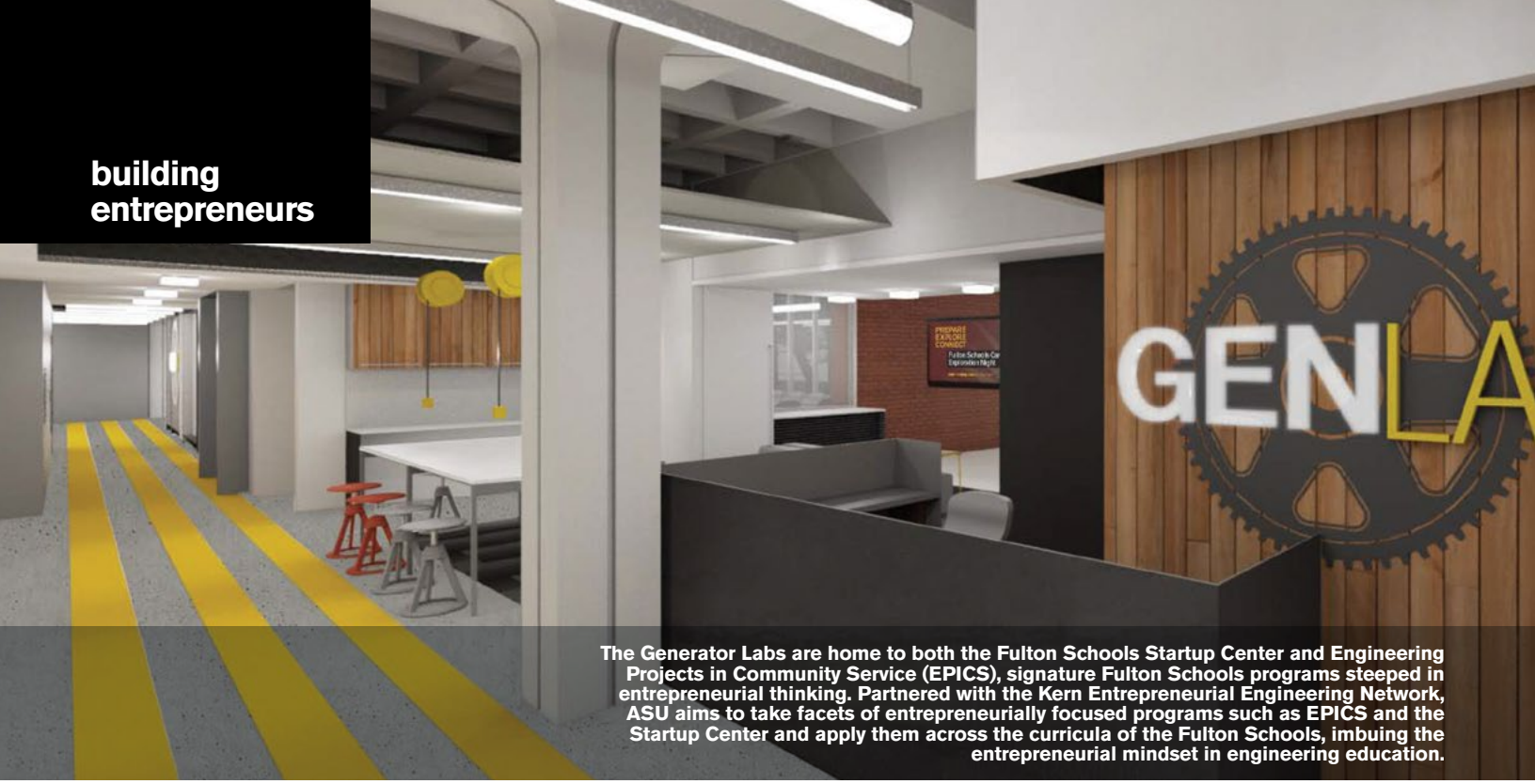
He encourages fellow veterans to take advantage of benefits from the GI Bill — which, in addition to providing scholarships and grants, has enabled Maham to enroll as a full-time student and to pay his tuition and bills without additional employment.

Maham learned about the NASA internship from a posting on the Facebook page of the Tempe chapter of the Student Veterans of America.

He feels his military experience helped him land the job.

"I am still just thrilled to have been accepted. I'm still relatively early in my engineering education, but my military skills can benefit NASA now," he said.

Maham was accepted into the Intern Employment Program that is part of NASA's Pathways Programs, which were established through an executive order by President Barack Obama in 2012. The programs serve to bolster a mission-focused workforce for the Kennedy Space Center, which is NASA's Center of Excellence for both launch and payload processing systems.



The Generator Labs are home to both the Fulton Schools Startup Center and Engineering Projects in Community Service (EPICS), signature Fulton Schools programs steeped in entrepreneurial thinking. Partnered with the Kern Entrepreneurial Engineering Network, ASU aims to take facets of entrepreneurially focused programs such as EPICS and the Startup Center and apply them across the curricula of the Fulton Schools, imbuing the entrepreneurial mindset in engineering education.

ASU enters partnership to imbue entrepreneurial mindset in engineering education

Arizona State University recently received a $2.86 million grant from The Kern Family Foundation, launching a partnership dedicated to furthering the entrepreneurial mindset in engineering education on a mass scale.

The philanthropic grant is part of a two-year project headed by the Ira A. Fulton Schools of Engineering that aims to create a standard for training engineering faculty in the entrepreneurial mindset on a national level, as well as develop a model entrepreneurially minded engineering program within a public research university.

To do so, ASU partnered with, and will draw upon resources from, the Kern Entrepreneurial Engineering Network (KEEN). KEEN is a collaboration of 24 colleges and universities committed to graduating engineers with an entrepreneurial mindset so they can create personal, economic and societal value through a lifetime of meaningful work. KEEN defines the entrepreneurial mindset as a combination of three key attributes: curiosity, connections, and creating value.

Since its creation in 2005, KEEN has built an extensive network of institutions collaborating to develop educational approaches to instill the entrepreneurial mindset. However, this is the network's first time partnering with a public institution.

"To date, we've worked exclusively with private institutions," said Doug Melton, a program director for The Kern Family Foundation. "We looked at private institutions as being more nimble and receptive to change, but we're extremely pleased to find ourselves working with such a progressive public institution as ASU."

"ASU is committed to being a leader in entrepreneurial education and to fostering unparalleled, adaptive learning environments where the entrepreneurial mindset is woven seamlessly throughout all we do," said Michael Crow, president of Arizona State University. "We are thrilled by our shared dedication to entrepreneurial learning with The Kern Family Foundation and by their selection of ASU as their first public partner institution."

ASU has long been a leader in entrepreneurially minded learning, with a range of programs, resources and classes to empower students. University-wide resources such as the Startup Accelerator, Edson Student Entrepreneur Initiative and the Startup School provide support for transdisciplinary collaboration, while school-specific classes and programs teach students how to employ entrepreneurial thinking to a given career or field. The Fulton Schools alone have two undergraduate degrees and three masters' programs that specifically reinforce the entrepreneurial method.

"Instilling the entrepreneurial mindsets in both our students and faculty is one of the defining features of the Fulton Schools, which makes us a natural fit for this partnership," said Kyle Squires, dean of the Fulton Schools. "We're eager to combine the existing resources of KEEN with our own approaches to create lasting change in engineering education."

Partnering with a large institution such as ASU will accelerate that sort of change, granting access to infrastructure capable of influencing engineering education on both a local and national, said Melton.

"It's important to note that this project is not just about ASU," said Ann McKenna, director of the Polytechnic School and the principal investigator on the project. "This has to be about making connections within KEEN and other national efforts to partner and leverage the existing resources to create a sustainable model to support engineering faculty in entrepreneurial thinking at a national scale."

The model of training for engineering faculty McKenna plans to build will draw on best practices of faculty development. In particular, the model will embed a collaborative approach and use modern technologies to enable faculty to form communities of practice. The model will not only draw from the existing resources within KEEN, but also provide a platform to coordinate those activities and pedagogical approaches. McKenna notes that it's vital this model works on a local, university level as well as a national one.

"Scalability is key," said McKenna. "For this to work, it needs to be reasonably applicable on a large scale. We're looking to find the value propositions that would engage all types of engineering faculty at different types of institutions. Lecturers, pre-tenure, tenured faculty — they will all be looking for something different to advance their specific goals, and we want to find what it is that will keep them interested in this collaborative approach to training."

While McKenna endeavors to develop a platform to bring the entrepreneurial mindset to engineering faculty, the other component of the project aims to instill the mindset in students. In doing so, the goal is to create the model entrepreneurially minded public research institution. Spearheading this aspect of the project are co-principal investigators Jim Collofello, Scott Shrake and Brent Sebold.

"Our goal is not to turn all our engineering graduates into entrepreneurs, but that all of our graduates will, indeed, possess the entrepreneurial mindset that is essential for engineers working in all types of organizations," said Collofello, senior associate dean of Academic and Student Affairs. "The attributes of the entrepreneurial mindset are essential for innovative solutions to today's engineering challenges."

Shrake and Sebold, directors of Engineering Projects in Community Service (EPICS) and the Fulton Startup Center, respectively, aim to take facets of their entrepreneurially focused programs and apply them across the curricula of the Fulton Schools.

"With the support of KEEN, we've been given a unique opportunity to challenge instructors and faculty to continually improve and purposefully innovate their curriculum," said Shrake.

"This partnership with The Kern Family Foundation is significant on many levels," said R. F. "Rick" Shangraw Jr., CEO of the ASU Foundation, an organization whose mission is to cultivate the partnerships and private support that enable ASU to achieve excellence in its programs.

"On one level, ASU will be able to scale its model of infusing entrepreneurial thinking throughout university curricula. But on another level, the partnership will enable ASU to continue to transform higher education and create the adaptive, capable, entrepreneurial learners who are prepared to thrive in the 21st century economy and enact positive change in the world," Shangraw said.

Engineering Smiles, an EPICS@ASU team, is a group of undergraduate engineering and architecture students designing and creating a mobile dental unit to provide much needed access to dental care for underserved populations in the U.S. and Central America.

Student entrepreneurs participating in the eSeed Challenge gather with Tom Prescott (bottom row, fourth from left), the program's benefactor.

Revving up student startups

Fulton Schools Startup Center helps students launch their ventures

You have an idea to launch your own venture. It could be a new technology, product or service for profit or social betterment. But how do you put your idea into action?

The Fulton Schools Startup Center was launched this year to empower all undergraduate and graduate students to advance their entrepreneurial ideas.

"The center supports student entrepreneurial teams that form in classes, residence halls and labs, whose members have aspirations of pushing their innovations beyond the walls of the university," said Director Brent Sebold. "It was created to marshal the entrepreneurial talent and resources that exist across all six Fulton Schools."

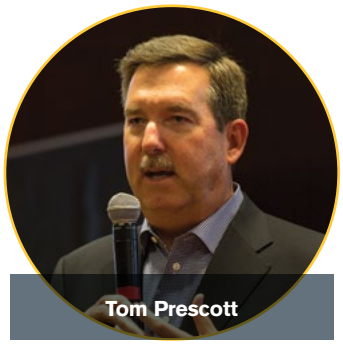
According to Sebold, Fulton Schools has the highest number of students engaged in entrepreneurial efforts at the university when compared with other schools and colleges, yet did not have a formal center to align and collectively promote student ventures.

The Startup Center offers signature entrepreneurship and innovation courses, workshops, new venture competitions, expert mentoring and other curricular and extracurricular events that expose students to the concepts of technology innovation and marketplace impact.

"The center supports all nonprofit, more-than-profit and for-profit student-led enterprises that may or may not be linked to a community or industry partner or formal ASU class," Sebold said.

These enterprises may be seeded within the Engineering Projects in Community Service (EPICS) program, FSE 100 Introduction to Engineering labs, the Grand Challenge Scholars Program, tech entrepreneurship classes, the Polytechnic School's Technological Entrepreneurship and Management program and applied learning/project courses and capstone classes across all Fulton Schools.

The center's premier program is the eSeed Challenge, which is part of ASU's Innovation Challenge program. It enables students to win up to $6,000 in seed funding and an all-expenses paid innovation retreat to advance their entrepreneurial ventures.



Tom Prescott

This semi-annual competition aims to strategically develop early-stage student ventures that have the potential to compete at higher-level entrepreneurship competitions locally, nationally and globally.

The eSeed Challenge is supported by a $100,000 gift from alumnus Tom Prescott and his wife Joan Prescott, to advance entrepreneurship within engineering. Prescott is the former CEO and director of Align Technologies, Inc.

Fluidic Energy: ASU start-up attains global reach

Cody Friesen's alternative research team at Arizona State University set out to create an energy storage breakthrough that would dramatically reduce costs and eliminate toxic and rare metals in batteries. The solution was found by innovating a way to make zinc-air batteries rechargeable — a solution that launched Fluidic Energy Inc. as a private company now set to power 500 remote Indonesian islands.

The "500 Island Project," one of the largest rural electrification projects in the world, will employ Fluidic's unique, sustainable energy system to provide electricity to 1.7 million people in 325,000 households — many of which have never before had a reliable energy source. Fluidic's partnership with Caterpillar Inc. and PT Perusahaan Listrik Negara (PLN), Indonesia's state-owned electric company, was announced in October.

The micro-grid network being deployed in Indonesia is a "much smarter grid" than those currently in use, explains Friesen. "It's a stand-alone system, which makes it ideal in remote locations like the islands of Indonesia. We use solar technology to recharge the batteries, and we've eliminated the toxins associated with diesel generators and lead."

More important, the system is reliable in an environment where reliability is critical. "It can withstand hot climates and heavy usage loads without the deterioration you find in lead-based batteries or the high costs associated with diesel," Friesen emphasizes. "When you are on a remote island, you can't just plug in to a larger power grid."

Friesen, an ASU associate professor whose work allowed him to found Fluidic, says he was headed elsewhere after completing his doctorate at MIT in 2004. But "some interesting things" were happening at ASU, where he'd earned his bachelor's degree in materials science and engineering in 2000, intrigued him.

"President Michael Crow was talking about shaking up the academic model to go solve big world problems," he points out. "ASU was creating new models for expanding academic impact into the marketplace." So Friesen joined the faculty at the School for Engineering, Matter, Transport and Energy (SEMTE). The Office of Knowledge and Enterprise Development (OKED) and Arizona Technology Enterprises (AzTE) helped Fluidic Energy to spin-out, and the company has now raised about $150 million in equity financing from investors.

In 2009, ASU and Fluidic were awarded a joint $5.1 million grant from the Department of Energy's Advanced Research Projects Agency-Energy (ARPA-e), which funds high-potential, high-impact energy technologies. In 2011, Fluidic was granted a second ARPA-e project, this time $3.75 million, to focus on aspects of making the batteries grid-capable.

The process of developing of a new, sustainable source of energy began broadly. "How do we store energy at a lower cost while improving reliability and sustainability," is the question that launched the journey, Friesen recounts. Ultimately, it became clear that an old technology, zinc-air batteries, could be a lower-cost, safer alternative to lead acid batteries or diesel generators.

"For a long time people had been creating Rube Goldberg devices, complex approaches attempting to solve the problem of rechargeability in zinc-air batteries. We wanted an elegant solution that would result in retaining the ultra-low cost basis of this technology space while also enabling extremely long life," Friesen says.


Cody Friesen

But there were challenges. "There were two major components to making zinc-air batteries feasible: First, solve the dendrite problem — dendrites form ice-like spikes around the electrodes and, when they migrate, they can short out the battery; and second, find an alternative to water-based electrolytes so the batteries are stabilized and rechargeable."

In late 2007, Friesen and his team developed a hierarchical anode that blocks the dendrites from causing a short. Once the team solved the stabilizing and recharging issues by developing advanced ionic fluid electrolytes instead of water-based, the team had a highly reliable, sustainable, clean technology ready to develop for the market.

And develop they did. Fluidic has been delivering batteries to thousands of sites across Southeast Asia and Latin America for the past five years, and is recognized in the industry as the long-duration energy storage leader.

This was made possible by a team of "rock stars," says Friesen. "Our first two employees, Joel Hayes and Dave Miller, really set the trajectory. We quickly added a set of remarkable scientists and engineers, Todd Trimble, Ph.D., Grant Friesen, Ramkumar Krishnan, Ph.D., who is the current CTO, Kurt Kenzler and Curtis Burt."

Fluidic's batteries deliver a longer cycle between recharges, providing up to 24 hours of energy compared to the one hour or so from lead-acid or lithium batteries. And, the 500 Island system's remote monitoring setup allows technicians to identify poorly performing cells and take them offline for maintenance.

The company, which provides on-site training to installation and service personnel, has established manufacturing facilities in Indonesia.

"The support we've received from the entire ASU community, from former Fulton Schools Dean Paul Johnson to current Dean Kyle Squires to OKED and AzTE, has been phenomenal," says Friesen. "Many of my colleagues who've watched ASU thrive over the past ten years are in awe."

Carolina Tostado, a biomedical engineering alumna and engineer at W. L. Gore & Associates, supports students and recruitment efforts by representing Gore at the Fulton Schools' career exploration event for freshmen.

High-tech company W. L. Gore invested in engineering students' success

A great partnership is one that helps both parties to excel in their goals. The Ira A. Fulton Schools of Engineering and W. L. Gore & Associates have one specific goal in mind — to educate and employ world-class engineers who will move Arizona's economy forward.

This partnership began more than a decade ago with a gift from Gore to the Fulton Schools of Engineering and remains vibrant today.

Gore is a technology and science-based enterprise that has a reputation for creating innovative, technology-driven solutions. Healthcare professionals and biomedical engineers respect their contributions in medical devices and implants, while outdoor enthusiasts and material scientists esteem them for producing high-performance Gore-Tex® fabrics.

Co-developing a future work force

Gore's interest in supporting Fulton Schools' students stems from its dependence on a highly skilled work force in Arizona.

"Arizona is our home and for us to stay and thrive we require world-class workers to come out of universities like ASU," said Mike Vonesh, who offers leadership for the technical team in the Medical Products Division.

Founded in Delaware in 1958, Flagstaff, Arizona became the hub of Gore's medical product division in the early 1970s. They recently expanded into northern Phoenix with new manufacturing facilities — making collaborations with ASU even more accessible.

Gore has an open dialogue with Fulton Schools about traits and experiences that the ideal engineering graduate should possess.

"We consider the Fulton Schools our partners. They hear our voice about what skills sets we're looking for in graduating students and are willing to structure curriculum based on the industry's needs," said Vonesh, adding that ASU is uniquely receptive in this regard, which makes its graduates very desirable.

> **"We consider the Fulton Schools our partners. They hear our voice about what skills sets we're looking for in graduating students and are willing to structure curriculum based on the industry's needs."**
> **– Mike Vonesh**

Vonesh serves as an industry representative on the board for the School of Biological and Health Systems Engineering (SBHSE), one of the six Ira A. Fulton Schools of Engineering.

"He offers the industry perspective in terms of the skillset that industries need from engineers and therefore what we should be implementing in our curriculum," said Marco Santello, a biomedical engineering professor and the school's director.

Gore also collaborates with the University of Arizona and Northern Arizona University.

By investing in Arizona's universities Gore is creating a strong work force that helps their company to succeed and returns a dividend to the Arizona economy.

"We don't look at these gifts as philanthropy, but rather as a trusted investment," said Vonesh.

Supporting student success programs

Students in the Fulton Schools benefit from Gore's collaboration through industry involvement in engineering research projects, and support for undergraduate scholarships, student organizations and programs that enhance the student experience.

Gore champions and supports the Fulton Schools Accelerated 4+1 program, which allows students to earn a bachelor's and master's degree in engineering in five years.

They also judge design reviews for the Engineering Projects in Community Service (EPICS) Program. At these reviews students present their team's project before an industry panel for technical feedback, allowing them to further improve the design and implementation of their engineering solutions.

"Gore supports many engineering programs that impact a number of our students," said Margo Burdick, associate director of development in the Fulton Schools.

"Besides their philanthropic support they are very supportive with their time by attending many Fulton Schools' events throughout the year," adds Burdick.

Gore has been particularly involved in supporting biomedical, chemical, mechanical, manufacturing electrical and materials science engineering programs, which are disciplines related to Gore's technological focuses.

Many of Gore's innovations stem from the use of proprietary technology with the versatile polymer polytetrafluoroethylene, which is used in fabrics, products for electronic signal transmission, medical implants, as well as filtration, sealant and fibers technologies for diverse industries.

Gore has been granted more than 2,000 patents worldwide and more than 40 million Gore Medical Devices have been implanted, saving and improving the quality of millions of lives around the world.

Alumni stay involved through partnership

Dozens of Fulton Schools' students have gone on to work for Gore since the collaboration began. A handful of these students remain closely tied to ASU through recruitment and outreach efforts.

Biomedical engineering alumna Carolina Tostado, who graduated in 2012, supports new product development as a quality engineer and is also one of Gore's College Champions for ASU. In this role, she serves as a recruiting liaison between college recruiting and technical associates at Gore and ASU.

"I focus on identifying areas where Gore can partner with the Fulton Schools to enhance the student experience such as funding and support for EPICS projects, undergraduate scholarships and particular research programs," said Tostado.

Tostado regularly attends a variety of events at ASU including the biannual Fulton Schools of Engineering Career Fairs and Career Exploration Night for Freshmen, on-campus interview events, student organizations' meetings, EPICS design reviews and industry panels.

She is joined by additional alumni and current Gore employees Annette Dunn, bachelor's degree in mechanical engineering in 2011, Lindsey Jossund, bachelor's degree in chemical engineering in 2005, and Daniel Dominguez, bachelor's degree in mechanical engineering in 2015.

"In addition to recruiting efforts, we work to identify ways that Gore can connect with students and faculty. Our goal is to build relationships and participate in activities that benefit all three parties: engineering students, ASU and Gore," said Jossund, who works as a technical leader for one of Gore's medical products.

"I am always energized by the innovative work from students on campus," said Dunn, who interned with Gore after her junior year. After two internships at Gore and some time in manufacturing engineering support, she currently works as an engineer in new product development.

"I think it's important to build strong connections between industry and the university to continue to be inspired and help grow top talent," adds Dunn.

Dominguez began working for Gore in 2015 as a process engineer, but his familiarity with the company and their partnership with the Fulton Schools began as a student.

"I interacted with Gore as a student through information sessions, recruiting events, an internship and scholarship support," said Dominguez.

He enjoys making campus visits on behalf of Gore because it is a way for him to help students that remind him of his student-self with professional mentorship and funding.

"Interactions like these are important to me because this is how I paid for school, participated in extra curricular activities and stayed focused on academics," he said.

Tostado shares this commitment saying, "As someone who relied on mentors during college to shape my engineering career, I hope that I can provide some guidance and share opportunities with students that can help them be successful. This makes me feel like I am paying back to my community."

ASU grad Josh Marriott combines art and construction to help honor fallen firefighters

A new memorial dedicated to those who gave their lives fighting fires in Arizona owes some of its visually striking elegance and structural stability to the construction and artistic talents of an ASU alumnus.

Joshua Marriott earned a degree in 2012 in construction management — with a concentration in concrete industry management — from the Del E. Webb School of Construction. The school is part of the School of Sustainable Engineering and the Built Environment (SSEBE).

After graduation Marriott landed a job with the Phoenix-based Southwest division of the McCarthy Building Companies, one of the largest building contractors in the country, where he was asked to contribute to building the Arizona Fallen Firefighters & Emergency Paramedics Memorial on the Wesley Bolin Plaza on the Arizona State Capitol grounds in Phoenix.

The memorial was officially dedicated in October during an annual ceremony to honor Arizona firefighters.

Concrete artistry

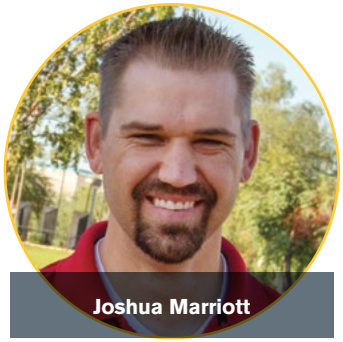
Marriott helped with some of the design and cost estimating for the project, and took the lead on creating and crafting one of the key features of the memorial: a circular concrete slab about 25 feet in diameter with an engraved representation of the Maltese Cross, an international symbol of firefighters' commitment to risk their lives to protect others from the dangers of fire.

The acid-etched engraving project gave Marriott the largest canvas he has yet had to display his expertise in both the technical and aesthetic aspects of concrete construction.

In what has become part hobby, part side-business, Marriott has for years been producing small works of "concrete art" — coasters, trophies, nameplates, award plaques and medallions.

James Ernzen, an associate professor in ASU's construction school, "was the one who first who pushed me into doing some artistic stuff," Marriott said, including the creation of a three-foot concrete pitchfork now on display in the construction school's concrete research lab.

Memorial construction a team endeavor



Joshua Marriott

His involvement in the firefighter's memorial project, he said, has been an exhilarating and educational experience.

"It has taken a big group of people [including more than 30 companies and subcontractors] working together to overcome a lot of the complexities and challenges," he said.

Joe Brunsman, a project director with McCarthy and a 1990 ASU alumnus, has been the memorial project's director of operations.

"It has been exciting to watch the memorial being built … [and] a privilege to be a part of the team building something to honor the memories of these great men and women," Brunsman said.

Recognition of sacrifice

Along with the decorative slab Marriott fashioned, the memorial, which covers about 2,500 square feet, features a 30-foot-high bell tower with a custom-made brass bell and ten life-size bronze sculptures depicting firefighting-related professions.

The memorial is also engraved with the names of more than 100 Arizona wildland firefighters, paramedics, volunteers and professional firefighters who have died in the line of duty, dating back to 1902.

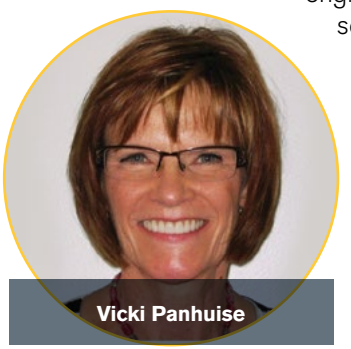
Trees will be planted around the memorial structure to help give the site a peaceful and relatively secluded ambiance. "I really liked being able to combine some artistry with such a creative, high-quality construction project," Marriott said. "But what really makes me feel good about this is being able to do something for people who are very deserving of this recognition of their sacrifice."

Engineer Vicki Panhuise named ASU trustee

Board members serve as advisors to ASU President Michael Crow and the ASU Foundation. The members invest time and resources in the university, and encourage others to do the same. Vicki Panhuise brings 35 years of experience in aerospace manufacturing and engineering for commercial and defense markets to the advisory board.

In November, Panhuise became the President of Testing for National Technical Systems, Inc. (NTS), the leading independent provider of environmental simulation testing, inspection and certification solutions. Headquartered in California, NTS provides the largest network of test labs and engineering service centers in North America.

Panhuise became interested in mathematics and science early in life. As a child of the 1960s she was enamored by space flight and wanted to become an astronaut.


Vicki Panhuise

She first saw potential in pursuing engineering as a senior in high school, but decided to first obtain a bachelor's degree in mathematics from Wells College in Aurora, New York.

She soon found her way to engineering, earning master's and doctoral degrees in nuclear engineering from the University of Missouri-Columbia. Panhuise later earned an MBA from the University of Arizona, which propelled her into senior management and leadership roles at companies such as AlliedSignal Aerospace and Honeywell Aerospace.

While working in aerospace and defense industries for most of her career, Panhuise has been a mentor to many. But in 2004 she became interested in increasing diversity in engineering. In pursuit of that goal she and her husband established the Vicki and John Panhuise Engineering Award in 2003, which supports students in a variety of academic majors who are in need of financial assistance.

"I have a passion for helping women and other minorities to reach their dreams through engineering education," Panhuise said.

Panhuise said she is looking forward to interacting with the students, faculty and other trustees to help in the advancement of the vision of ASU as the New American University.

Construction Management alumnus Ron Fedrick elected to National Academy of Construction

Ronald M. Fedrick, a construction management alumnus, is one of 26 new inductees to the National Academy of Construction, chosen from more than 250 industry leaders who were considered for induction.

The academy recognized him for "leadership in the construction industry through industry organizations."

He has long been devoted to professional construction and engineering organizations and local charitable organizations, though his greatest contribution to the construction industry is to education and training.

Fedrick was a trustee and founder of the Associated Builders and Contractors (ABC) Training Trust Fund, a trustee of the Merit Shop Foundation, and an inductee of the Merit Shop Training Center Hall of Fame. He served as the first Chair of the National Center for Construction Education & Research (NCCER).


Ron Fedrick

He played a key role in negotiating the Memorandum of Understanding between the NCCER and the Associated General Contractors (AGC), leading to a partnership between AGC and ABC to combine training efforts.

Fedrick has been chief executive officer and chairman of the board of Nova Group, Inc., since 1976. Today Nova Group is a preferred U.S. Department of Defense contractor with annual revenues in excess of $65 million.

He is a recipient of the Ted Kennedy Contractor of the Year Award and USA Distinguished Public Service Achievement Award, both from ABC. He has been honored as an Arizona State University Engineering Distinguished Alumni, received the Small Business Association's Dwight D. Eisenhower Award for Excellence, and is the first recipient of the John Lamberson Memorial Low Bidder Award, recognizing his lifelong commitment and success in the construction industry.

Stay connected: engineering.asu.edu/alumni

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