ASU Thrive

ARIZONA STATE UNIVERSITY
VOLUME 21 NUMBER 2

ENGINEERING SPECIAL ISSUE

5 GROWTH AREAS FOR PHOENIX

Wearable tech, internet of things, automation and robotics, water and renewable energy

DATA DEFENDERS

The researchers who are working to protect your information

The future is now. And it starts here.

Arizona State University

Arizona State University partners exclusively with Liberty Mutual to help you save $782 or more a year on auto and home insurance.[1]

Join thousands of satisfied customers with Liberty Mutual Insurance.[2]

Discounted Rates—You could save up to $782 a year on auto insurance and receive additional discounts on home insurance.

Exceptional Service—Whether you're in an accident or just need some advice, know we'll always be on call for you.

Superior Benefits—Enjoy a number of superior benefits, such as 24-Hour Claims Assistance, Accident Forgiveness[3], Roadside Assistance[4] and Better Car Replacement.™[5]

Liberty Mutual INSURANCE

ASU Alumni
Arizona State University

For a free quote, call 888-680-5644
or visit LibertyMutual.com/ASUalumni
Client # 9697

This organization receives financial support for offering this auto and home benefits program.

[1] Average combined annual savings based on countrywide survey of new customers from 1/1/15 to 1/29/16 who reported their prior insurers' premiums when they switched to Liberty Mutual. Savings comparison does not apply in MA. [2] Based on Liberty Mutual Insurance Company's 2014 Customer Satisfaction Survey in which more than 81% of policyholders reported their interaction with Liberty Mutual service representatives to be "among the best experiences" and "better than average." [3] For qualifying customers only. Accident Forgiveness is subject to terms and conditions of Liberty Mutual's underwriting guidelines. Not available in CA and may vary by state. [4] With the purchase of optional Towing & Labor coverage. Applies to mechanical breakdowns and disablements only. Towing related to accidents would be covered under your Collision or Other Than Collision coverage. [5] Optional coverage in some states. Availability varies by state. Eligibility rules apply.

Valid through May 7, 2018.

We have big challenges to solve, so why think small?

The official publication of
Arizona State University
Spring 2018, Vol. 21, No. 2

MANAGING DIRECTOR
Jill Andrews '97 BS, '03 MPA

SENIOR DIRECTOR
Lindsay Kinkade

DIRECTOR, NEWS AND STRATEGIC COMMUNICATIONS
Penny Walker

ART DIRECTOR
Heidi Easudes

PHOTOGRAPHY DIRECTOR
Andy DeLisle

EDITORIAL
Stephen Des Georges '14 MA
Lori K. Baker '85 BA
Craig Smith '99 MBA
Jessica Hochreiter '06 BFA
Stephanie Mabee '91 BA
Pete Zrioka '13 BA
Terry Grant

PRODUCTION
Cathy Skoglund '96 BS
Joel Lobaugh '17 BAS

ADVERTISING SALES
John Davis 480-965-5051

ASU Thrive magazine
PO Box 875011
Tempe, AZ 85287-5011
480-727-5440
asuthrive@asu.edu
magazine.asu.edu

ASU Thrive is printed on paper that is certified to the Forest Stewardship Council® (FSC®) Standards.

MIX
Paper from responsible sources
FSC® C008955
www.fsc.org

At Arizona State University, we take seriously our responsibility to enhance the economic health and vitality of the communities we serve. We've even put this in our charter.

But for this to happen on a grand scale, we cannot do it alone. Business leaders and economic developers must recognize the untapped potential available to them at a top research university.

As the leader of a large-scale engineering school brimming with innovations, I see this potential every day. I see our faculty providing leadership and partnership across the university to pursue challenges and make discoveries that will change the future and, more immediately, change the entrepreneurial and business landscape of the greater Phoenix area.

The Ira A. Fulton Schools of Engineering is a passionate and motivated incubator of talent and ideas. You can see it percolating among students and faculty, in classrooms and research labs, and between us and our industry partners.

We are advancing across a broad range of areas, and in this special issue you will learn about water innovation, wearable technologies, automation and robotics, internet of things, renewable energies and more. We are the Phoenix metropolitan area's ready-made R&D lab, with the people, energy and ideas to make it happen. We set goals together. We share our discoveries. We rejoice in the success of others.

Ira Fulton likes to remind us that "Every great city has a great engineering school at the center of it." We embrace this ambition. We are not only inspired by it, we are motivated to keep pushing ahead.

There are few more satisfying accomplishments than improving the economic health of the communities where we live and serve. We look to our community partners and our vast alumni network to share in this mission and help us achieve what I know is a shared goal.

– Kyle Squires, Dean and Professor,
Ira A. Fulton Schools of Engineering

ASU Thrive (USPS 024-438; ISSN 1940-2929) is published quarterly by the Arizona State University Enterprise Marketing Hub, PO Box 875011, Tempe, AZ 85287-5011, 480-727-5440. Subscriptions are sent to all ASU alumni. For detailed information about alumni memberships, visit alumni.asu.edu/upgrade. Periodicals postage is paid at Tempe, Arizona, and additional mailing offices. Postmaster: Please send address changes to ASU Thrive, Attention: Circulation, PO Box 875011, Tempe, AZ 85287-5011.

On the cover
Alexandra Fernandez, an undergraduate student in engineering, investigates the Desert Tortoise robot, which was designed and built at ASU.

Engineering contacts

Kyle Squires, Dean
kyle.squires@asu.edu

Paul Westerhoff
Vice Dean, Research and Innovation
p.westerhoff@asu.edu

Robin Hammond
Director, Fulton Schools Career Center
robin.hammond@asu.edu
480-965-1265

David Wahls
Director of Development
david.wahls@asu.edu
480-727-0827

Malcolm Green
Associate Director, Corporate Engagement
malcolm.green@asu.edu
480-727-3739

Karl Theisen
Associate Director, Business Engagement
karl.theisen@asu.edu
480-965-4104

engineering.asu.edu

COVER PHOTO: BRANDON SULLIVAN

FIND

111 00100000 01010100 01101000 01110010 01101001 01110110 01100101 01000001
001 01110010 01101110 00100000 01110100 01101111 00100000 01010100 01101000
011 01010101 00100000 01001100 01100101 01100001 01110010 01101110 00100000
010 01101001 01110110 01100101 01000001 01010011 01010101 00100000 01001100

Go

Calendar of events

Populate your agenda with upcoming event highlights on ASU's campuses. 4

Summer camps: Register students grades 1-12 for STEM camps on campus. 6

Secure

Data defenders

How ASU researchers are working to protect your data. 8

Update: News on transportation, defense and materials research. 13

Access

Redesigning engineering education

From re-engineering curriculum to the invention of doctorate programs, Ira A. Fulton Schools of Engineering is at the center of an education revolution. 18

Security tips Ways to protect your data.

Nakul Chawla is a computer science major and a self-proclaimed blockchain enthusiast.

Tooker House was built to allow students to see the inner workings of the building.

Inside Tooker House

A virtual tour of a building designed from the ground up for engineering students. 22

Update: News on energy. 25

Accelerate

The future is now

Research — when it's paired with industry — will continue to transform the Valley of the Sun's future. 28

Corridors of innovation: Mapping the hot spots for growth in Phoenix. 38

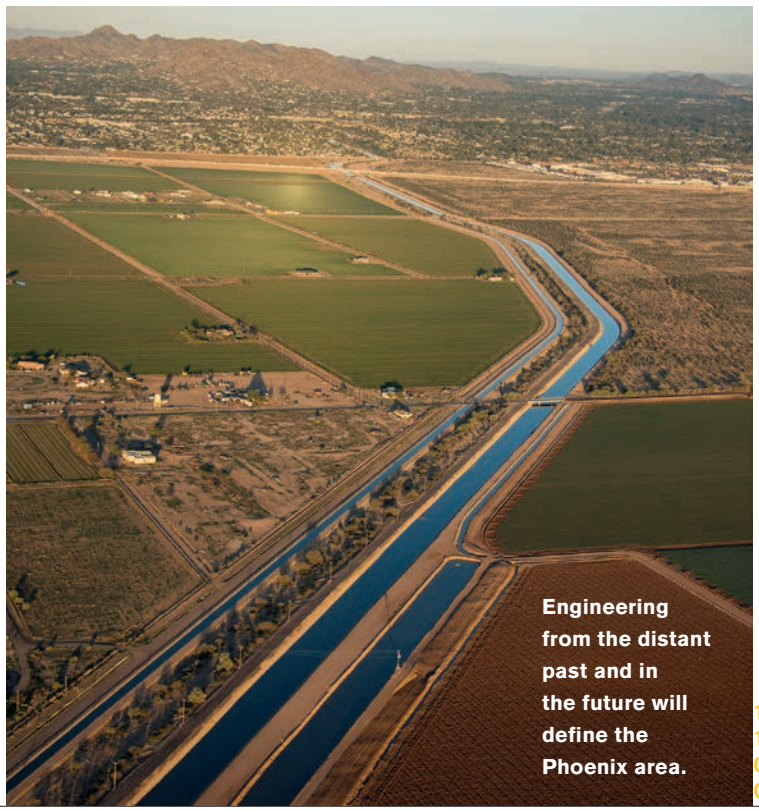
BRANDON SULLIVAN; JAROD OPPERMAN/ASU

youtube.com/asu

facebook.com/arizonastateuniversity
facebook.com/asualumni
facebook.com/arizonastatesundevils

twitter.com/asu
twitter.com/asu_alumni
twitter.com/thesundevils
twitter.com/asuyoungalumni

Team "Pickled Water People" jumps with excitement after their Lego robot, Flynn, completes its final



Engineering from the distant past and in the future will define the Phoenix area.

JAROD OPPERMAN/ASU; COURTESY OF SALT RIVER PROJECT; JESSICA HOCHREITER/ASU

pinterest.com/arizonastate

soundcloud.com/asualumni

itunes.asu.edu

alumni.asu.edu/linkedin

Mar. 2018

Barrett and O'Connor Center launch in D.C.

To celebrate the new home of ASU in Washington, D.C. — a building designed to house global- and public policy-focused university programs in our nation's capital and put students and researchers in close proximity with policymakers — a mid-March weeklong series of events will showcase ASU research, initiatives and thought leadership. Talks will be hosted in the new Ambassador Barbara Barrett and Justice Sandra Day O'Connor Washington Center.

The renovated building at 1800 I Street NW in Washington, D.C.

'The Importance of University Researchers Partnering With Mission-Focused Government Agencies'

This panel is hosted by the Ira A. Fulton Schools of Engineering. Nadya Bliss, director of ASU's Global Security Initiative, will serve as moderator as government panelists share their thoughts on the successes, challenges and importance of working with academic institutions to meet their missions.

March 12–20. Barrett and O'Connor Center launch, 1800 I St. NW, Washington, D.C.

washingtondc.asu.edu

'How Will Self-Driving Cars Reshape Our Cities?'

How will regulation and governance affect the next wave of test vehicles with no driver at all?

Of interest to engineers working in the realm of autonomous vehicles, this panel discussion is hosted by Future Tense (a partnership between Slate, New America and ASU). Presenting Phoenix as a case study on how autonomous vehicles might alter urban design in the future, this event highlights both Phoenix's role as a hub of new tech development and ASU's commitment to playing a part in a more purposeful, democratic design of our future. Experts will look at the range of regulatory and governance hurdles standing in the way and more expansive, long-term thinking about how different cities might look as a result of the transportation revolution.

March 12–20. Barrett and O'Connor Center launch, 1800 I St. NW, Washington, D.C.

washingtondc.asu.edu

'Devils Invent' hackathon

Pulling an all-nighter is a college rite of passage. Here, Devils Invent encourages students to use a weekend-long sprint to develop their entrepreneurial mindset as well as engage their engineering and design skills. In this hackathon, participants have 48 hours to invent a solution to a challenge submitted by community and industry partners. The challenge is revealed Friday, and the teams' solutions will be judged a short two days later.

March 23–25. Generator Labs, Tempe campus.

entrepreneurship.asu.edu/event/devils-invent-tempe-1

Free

Apr.

‘Artificial Intelligence: On the Edge of Health Innovation’

How can artificial intelligence improve the health care system while protecting patient privacy? That’s the focus of this event by Systems Imagination and ASU’s Health Entrepreneur Accelerator Lab, bringing together tech giants, innovators, students and local researchers.

April 6, 11 a.m.–5 p.m. A.E. England Building, Downtown Phoenix campus. entrepreneurship.asu.edu/events

Free

The next big thing

At Innovation Showcase — an annual exhibit — students demonstrate collaboration with industry partners to push the envelope and create solutions to meet industry and societal needs.

April 27. Sun Devil Fitness Center, Polytechnic campus. poly.engineering.asu.edu/innovation-showcase

Free **Family**

The possibilities of soft robotics

In the Engineering Dean’s Distinguished Lecture, Harvard Professor George M. Whitesides will explore robots based on starfish, worms and octopi, providing big opportunities in materials and polymer science.

April 4, 2:30 p.m. College Avenue Commons 101, Tempe campus.

Free

‘Ask an Innovator’

At the Live @ Generator Labs: Ask an Innovator series, ASU students learn from successful entrepreneurs and startup CEOs, developing their skills in a setting designed to encourage dialogue.

First and third Thursdays, 6–8 p.m. Generator Labs, Tempe campus.

entrepreneurship.engineering.asu.edu/innovation-initiatives/live-generator-labs-speaker-series/

Free

Commercialization counsel

Discuss technology evaluation and marketing, intellectual property and licensing.

By appointment at the Biodesign Institute. Email Kyle.Siegal@azte.com.

Free

The future of talent

The annual ASU+GSV Summit is the industry catalyst for elevating dialogue and driving action around raising learning and career outcomes through scaled innovation. The 2018 keynote speakers include former President George W. Bush; Angela Lee Duckworth, author of “Grit: The Power of Passion and Perseverance”; and Patty McCord, former chief talent officer at Netflix and author of “Powerful: Building a Culture of Freedom and Responsibility.”

April 16–18. Manchester Grand Hyatt, San Diego. asugsvsummit.com

Ticketed

Hoolest Performance Technologies, made up of three ASU engineering students, won the grand prize in 2018.

Sept.

Breakout ideas at the ASUio

Bold ideas that change the world require inspiration — and perseverance. The ASU Innovation Open, or ASUio, demands both. Collegiate entrepreneurs must demonstrate hustle and a breakout idea in this intense competition with a grand prize of $100,000, funded by Avnet.

Applications open in September. Finals held in February. winasu.io

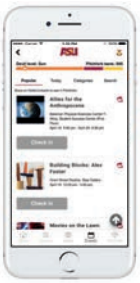
Free

Hire the best

Your company’s next employee of the year might be sitting in an ASU classroom right now. The Fall Career Fair connects employers and students and alumni. Companies are also invited to join the Fulton Schools’ Corporate Affiliates Program and host events on campus.

Fall fairs begin in September. career.engineering.asu.edu

Free



Check in at events to earn Pitchforks and rewards!

Try the Sun Devil Rewards app for event listings, news, games and more. Download link at sundevilrewards.asu.edu.

A new podcast for your commute

Can’t make it to an ASU event? Tune into the new ASU podcast, Thought Huddle, which features thinkers and doers from ASU and the wider community. thoughthuddle.com

Thought Huddle

See outreach.engineering.asu.edu/events for Ira A. Fulton Schools of Engineering events.
See asuevents.asu.edu for additional ASU events.

GO

Fulton Summer Academy

Robots, coding, apps, solar and beyond

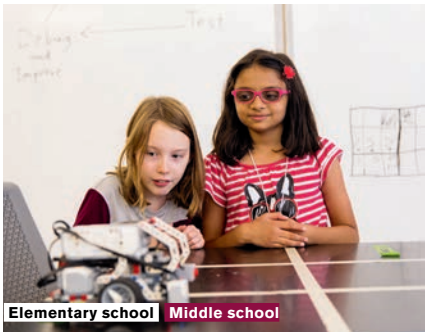
Through participation in Fulton Summer Academy, students grades 1–12 get the opportunity to experience life on campus and take part in instructor-led engineering design challenges and activities. Using best practices in hands-on STEM activities, students are engaged and empowered to seek out other STEM opportunities beyond their experience at ASU.

We offer a variety of programs — including half-day camps, full-day camps and overnight camps — there is something for everyone.

Learn more

Registration and information is available at outreach.engineering.asu.edu

Camp Solaris Prime
Your mission: Colonize the planet Solaris prime using only renewable energy sources.



FIRST Lego League
Learn the basics of programming, and design robots to complete tasks.

Get with the Program: g ain a fun, basic understanding of coding — valuable for creating games and engineering projects.

The Art of Invention: Build chain-reaction STEAM machines using design thinking and creative problem solving.

Robotics Camp (7Up and 9Up)
Construct robots, learn programming and participate in a robotics challenge.

App Camps
There's an app for that — and you build it!

Game Camp
Why just play video games when you can learn to create and produce your own?

SEE@ASU: Spend a week on campus visiting research labs, and learn about undergraduate opportunities.

ASU PHOTOS

00001 01110010 01101110 00100000 01110100 01101111 00100000 01010100 01
10011 01010101 00100000 01001100 01100101 01100001 01110010 01101110 00
10010 01101001 01110110 01100101 01000001 01010011 01010101 00100000 01

v: to protect; make safe; to obtain something

Secure

SECURITY FORECAST

Data can be an incredible

resource, like the local meteorological data collected by this weather station on the Tempe campus and made available to researchers and weather wonks alike on the Center for Negative Carbon Emissions' website. Data can also be a source of risk if not handled correctly — a situation ASU engineers are hard at work to solve.

Center for Negative Carbon Emissions Executive Director Allen Wright and software engineer Yun Ge check on the weather station atop ISTB4 that is used by researchers at the ASU center.

PETE ZRIOKA/ASU

Security tips Ways to protect your data.

Tip Protect your email and other accounts with two-factor authentication.

Tip Prior to travel, remove any sensitive data from mobile devices.

Tip Turn off Bluetooth when not using your computer.

Tip Practice good internet hygiene when using public Wi-Fi by avoiding sites requiring you to enter sensitive information.

Tip Back up your computer to an encrypted external hard drive or an online backup service ... or both.

Marcus Jones, a finance student, is a co-founder of Blockchain Innovation Society, a student-led organization focused on four primary pillars: education, development, investing/trading and consulting.

DIGITAL HEROES

The data defend-ers

We've all got information coming out of our ears — and our phones, our social accounts and our wallets — and ASU researchers are working to protect it.

Story by BOB YOUNG
Photos by BRANDON SULLIVAN

In today's fast-moving, high-tech world, we leave digital footprints nearly everywhere we go, our sensitive personal information is under attack from those who want to track our habits or steal our identities, and there are those seeking to influence our thinking through misinformation such as "fake news" on social media platforms.

Students and research faculty at ASU's School of Computing, informatics, and Decision Systems Engineering, one of six schools in the ira A. Fulton Schools of Engineering, are exploring a wide

Fact ASU biosecurity researchers are using brainwaves and signals from the heart to create cryptographic keys.

Tip Changing default security settings on routers is a first step to protecting smart home devices.

Tip Secure smart security systems with WPA2 and by encrypting admin tools.

Tip Scrutinize permissions (like location) requested by apps installed on each mobile device.

Tip Locking your mobile device by enabling biometrics and activating remote wipe options provides an added layer of protection.

Fact Bitcoin, the original cryptocurrency, launched in 2009.

Jeremy Liu, who studies computational mathematical sciences, is a co-founder of Blockchain Innovation Society and part of the Blockchain Education Network.

range of cybersecurity issues, including social media analysis, data security on the web and mobile devices, data forensics and the use of blockchain technology — the technology that underlies digital currencies such as Bitcoin and Dash.

"Everything electronic that we touch, even physical objects we touch like our cars, any of our transactions, our searches, even our use of a g pS device, leaves a digital footprint," says Sandeep g upta, director of the School of Computing, informatics, and Decision Systems Engineering. "Computing is embedded in microwave ovens, refrigerators and other appliances — even toys.

"Everything is connected through the internet of Things. And for every device that is connected, somebody is collecting data from it, applying machine learning and doing analysis on the data. That's how they make money — by collecting your data.

"Mining for data is like mining for oil. Data is the oil. people want to sell you things. They want to understand you — how you work, how you vote. They can learn a lot of things about you."

g hazaleh Beigi, a fourth-year doctoral student in ASU's Data Mining and Machine Learning Lab, points out that president Donald Trump signed a measure in April 2017 that repealed internet privacy rules, allowing internet service providers to sell the personal data of people without their explicit consent.

"We're working on a defense which could manipulate the browsing history so we can help users protect themselves," says Beigi. "if the data does get published, we know it can't be mapped to the real identity of the users."

"Mining for data is like mining for oil. Data is the oil. People want to sell you things. They want to understand you — how you work, how you vote. They can learn a lot of things about you."

— SANDEEP GUPTA, DIRECTOR OF THE SCHOOL OF COMPUTING, INFORMATICS, AND DECISION SYSTEMS ENGINEERING AT ASU

it's the kind of research that g upta says has made ASU "a powerhouse in cybersecurity research and education."

n ot surprisingly, there is a robust job market for cybersecurity analysts like the ones ASU's Fulton Schools is turning out.

The U.S. Bureau of Labor Statistics projects that demand for cybersecurity analysts will increase by 28 percent through 2026, and lists the median annual salary for cybersecurity analysts in Arizona at $93,975. The unemployment rate in the cybersecurity field? Zero.

"Students who graduate from our programs are hired by the top companies in this area," g upta says. "They are in high demand."

Using biosignatures to secure data

Securing data and authenticating the identity of users is a challenge, according to g upta.

"Think about the autonomous cars that you see everywhere nowadays," he says. "We're going to have software-controlled driving with multiple chips. if somebody launches a bug, it could cause an accident."

The focus of g upta's research is on biosecurity — using signals from the human body, such as brain waves and the electrocardiographic signals from the heart — to create cryptographic keys to secure data.

"Like a fingerprint is unique, heart signals are unique," he says. "And from these signals you can generate unique cryptographic keys that can be used for authentication within a network as well as to encrypt data in a way that it can be secure.

"We have also developed a technique for compressing this data for lifelong storage. Everybody's body generates a lot of data, and some people might like to store it for later if trouble arises."

But like those autonomous automobiles, g upta says an electronic device embedded in the body can also be susceptible to a computer attack, so part of his research is aimed at protecting systems for embedded devices.

"it has to be secure, right?" he says, adding, "people want more functionality and flexibility, and it has to be programmable. We want to have remote access, which is good, but it can be exploited."

Fighting misinformation on social networks

Students in professor Huan Liu's Data Mining and Machine Learning Lab are delving into areas that are as fresh as today's headlines — including the detection of "fake news" on social media.

Kai Shu, a doctoral candidate in the lab, is researching methods for

To learn more about ASU's work on digital security, please visit the School of Computing, Informatics, and Decision Systems Engineering at cidse.engineering.asu.edu.

detecting fake news and tracking it. Fake news is just the latest entry in the larger misinformation game that includes spreading rumors, bias, urban legend and spam — always with an agenda.

"it has become widespread because people can initiate it and amplify it on social media," Shu says.

"it's challenging because the spreaders of misinformation try to behave like something they're not," says Liang Wu, another doctoral student in the lab. "They disguise themselves and make friends with regular users. Our statistics show that all of the [fake news] spreaders have at least one regular user friend and for more than 90 percent, the majority of the friends are regular users. They spread legitimate content until you trust them, then they spread misinformation."

Their hope, he explains, is for regular users to amplify the spread of misinformation. To accelerate the amplification, spreaders often utilize "bots" — software programs that mimic social media users.

One study conducted by ASU students determined that almost 10 percent of active users in a topic were actually bots. And those bots generated nearly 40 percent of the content.

"Our goal is to suspend all the bot accounts, and we devised a learning algorithm to improve bot detection," Wu says. "We keep patching the algorithm by adding another classifier until all the bots are detected."

Blockchain to the rescue

One of the latest innovations in cybersecurity is blockchain technology, which produces a ledger that anyone involved in a computer ecosystem can access. it is the technology that underlies digital currency, allowing transactions that are transparent and trackable without the use of a third party, such as a bank.

But Dragan Boscovic, director of ASU's Blockchain r esearch Laboratory, says emerging blockchain technology has the potential for many more applications.

"Think of blockchain as just a distributed database which does not necessarily need a central authority to be managed and secured," Boscovic says. "So in that context, it is really good for any application that has a need for sharing data across different entities; for instance, a supply chain. You can track where goods are, the sources of those goods and their status.

"Every participant in a transaction is a check on everyone else in that ecosystem. So it is very difficult to cheat because everybody else can see it."

He says ASU's research — much of which is being funded by Dash, the digital currency company that was launched in the phoenix metro area — includes "applications in law, in civil engineering, managing water rights, tracking data records.

"We have partners in a wide range of industries," he says. "We have partners in supply chain, in manufacturing, financia businesses, data-hosting businesses, insurance businesses, even in the semiconductor business."

Whenever he speaks to potential partners these days, Boscovic says, the talk invariably focuses on blockchain.

"They would like to understand what we're doing and how they can get involved."

Putting on the detective hat

inevitably, despite the best efforts to secure data, breaches occur. That's where forensic analysis comes into play.

"We're building systems that are more secure and improving defenses, but at the end of the day you're going to be attacked and your data will be compromised," says Adam Doupé, associate director of ASU's Center for Cybersecurity and Digital Forensics. "So what do you do after that?

"You need a detection system to know you've been attacked or that your data has been compromised. if you don't have that, you don't even know you need to start the forensic process."

Once a breach is detected, analyzing how it occurred is still a challenge, especially with evolving technology such as the cloud.

"One thing we're really interested about is the forensic process when data isn't on a hard drive of a laptop or desktop," Doupé says.

To give students hands-on experience, the program has about 80 laptops loaded with top-of-the-line forensic software, which they can use to solve challenges.

"it is very easy to espouse the theory of such and such vulnerabilities," Doupé says. "But when you actually do it, and put fingers to keyboard and see that you can actually do it and how it works, it opens their minds and improves their skills."

A good offense is only as good as a solid defense.

"You can't be a good defender if you don't know the possible capabilities of the attacker. You have to think like an attacker," he says. ■

Travel

New mapping of how we move – worldwide

A new method to predict human mobility — which can be used to chart the potential spread of disease or determine rush-hour bottlenecks — has been developed by a team of researchers, including one from ASU. Based on empirical data from cellphones and GPS records, researchers found that people are most inclined to travel to "attractive" locations they've visited before, and these movements are independent of the size of a region.

Real-world examples of individual travels and collective movements. A brighter line indicates a stronger flu .

Transportation

Predicting our future needs

Figuring out how we use transportation resources today and considering how we may use them in the future is a complex game. Ram Pendyala, professor of transportation systems, is at the center of these trade-offs. His research team's models attempt to account for all transportation circumstances and needs, factoring in driving patterns, mass transit use, demographics, economics, rider and driver profiles, and emerging technologies, while considering the potential for future changes. Pendyala is the director of ASU's Tier 1 transportation center, one of only 20 in the U.S., called "Teaching Old Models New Tricks" (TOMNET). The center is sponsored by the U.S. Department of Transportation.

"There are a lot of unknowns as to how [electric and autonomous vehicles] are going to disrupt transportation systems and networks."

– RAM PENDYALA, ASU PROFESSOR OF TRANSPORTATION SYSTEMS

Air quality

Can we remove carbon dioxide from our air faster than we make it?

With carbon dioxide levels at an all-time high of 400 parts-per-billion in the Earth's atmosphere, ASU researchers Klaus Lackner and Bruce Rittmann's carbon capture technology work is addressing a critical environmental need. They are leading a project to aid U.S. Department of Energy efforts to create renewable biofuels that recycle carbon dioxide from the atmosphere.

Concrete that lasts — a solution at scale

Roughly 40 percent of the nation's roads and major highways are not considered to be in good condition, and about 70,000 U.S. bridges are structurally deficient. In collaboration with researchers at UCLA and in Europe, Narayanan Neithalath, professor of structural engineering and materials at ASU's School of Sustainable Engineering and the Built Environment, has experimented with a waxlike material mixed into concrete that allows it to better expand and contract and handle temperature fluctuations.

Supply chains and system solutions

Mikhail Chester, an ASU assistant professor of transportation infrastructure, studies life-cycle assessment of systems, including vehicles, infrastructures and fuels. When looking at the environmental impact of travel, his research considers the massive supply chains and infrastructure needed to operate one car. "When we include all of those components, we see that the footprint of a transportation mode is significantly larger than just the tailpipe," he says.

Defense

Keeping U.S. defense systems in shape and mission-ready

Aerospace tech weathers the harshest of environments as each mission necessitates. Researchers at ASU are advancing the ability to provide reliable estimates of the structural health and predict potential wear and tear in aerospace systems. Aditi Chattopadhyay, a professor of mechanical and aerospace engineering and director of ASU's Adaptive Intelligent Materials and Systems Center, is leading the project.

Her team is using advanced sensor data, information management, computer modeling and algorithms to develop damage diagnosis and prognosis techniques. The project's co-leaders are Antonia Papandreou-Suppappola, a professor of electrical engineering, and Pedro Peralta, a professor of mechanical and aerospace engineering.

"Our team has specific expertise in material, structural, mechanical, electrical and systems engineering, and extensive experience in collaborative research projects under Department of Defense sponsorship," Chattopadhyay says.

$5.7 billion

combined cost of corrosion for Navy and Marine Corps ships and aviation between 2010 and 2012

Engineers at ASU are tackling research to aid the performance and safety of the U.S. Navy's aging fleets. Assistant Professor Kiran Solanki and his collaborators champion an approach that doesn't look at corrosion in isolation, instead studying both the effects of corrosion and the microstructural influence of fatigue and fracture. "When you have material deformation, such as during fatigue, and corrosion happening simultaneously in structural materials, you have the worst-case scenario," says Solanki.

Controlling robotic drones with the mind is one ASU research project taking flight.

Drones

Controlling drones with the mind

A researcher at ASU is working with increasing complexity to control multiple robotic drones using the human brain. A controller wears a skull cap (at left) outfitted with 128 electrodes wired to a computer. The device records electrical brain activity. If the controller moves a hand or thinks of something, certain areas light up. "I can see that activity from outside," says Panagiotis Artemiadis, director of the Human-Oriented Robotics and Control Lab and an associate professor of mechanical and aerospace engineering.

If the user is thinking about decreasing cohesion between the drones — spreading them out, in other words — "we know what part of the brain controls that thought," he says.

His work on controlling multiple machines wirelessly is part of a trend in robotics and space exploration.

DEANNA DENT/ASU NOW

Nanotechnology

Academia, industry and government align efforts in 4-D materials science

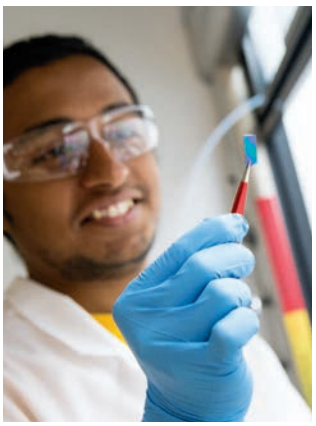
The foundation of materials science and engineering is the understanding of a material's structure and how that affects properties and performance. The Center for 4D Materials Science aims to build on that foundation by enabling researchers to observe those properties and performance in real time. Headed by Fulton Professor of Materials Science and Engineering Nik Chawla and funded by a collaboration among ASU, Zeiss Microscopy and the Office of Naval Research, the center houses state-of-the-art equipment that can achieve resolution at the nanometer scale.

These tools allow researchers to model and characterize materials' changes under different stimuli, such as mechanical, thermal and electrical.

Chawla says, "Our work in the 4-D area has been quite timely because, for the first time, we can visualize, study and quantify the changes in structure in a material in real time."

"Typically, the day we ship a new machine, we know more about it than anyone else in the world. Six months later you're doing things with it we couldn't possibly do. And if we don't stay collaborative with you, we'll go out of business."

— JIM SHARP, PRESIDENT, ZEISS MICROSCOPY



2-D materials research at ASU impacts energy conversion and information tech advancements.

JESSICA HOCHREITER/ASU

2-D batteries

Higher-performing and wearable, too? Batteries for the future of tech and wearables

At the intersection of photonics, wearable materials and technology, Assistant Professor Sefaattin Tongay and his colleagues are designing a new class of 2-D materials that can outperform traditional materials used in energy, flexible electronics and photovoltaics, photonics and optics.

Improving 2-D materials' distinctive properties could lead to improvements in lighting technologies such as light-emitting diodes (LEDs), as well as batteries, cellphones, flexible electronics, biosensors and the photovoltaic cells used to convert sunlight into energy. Tongay's exploration imagines a future when solar batteries are embedded in clothes, devices can replicate artificial photosynthesis, and electronic circuits can be twistable and foldable.

Homeland security

DHS taps ASU to lead Center for Excellence

Going through screenings at the airport can be unpredictable, frustrating and time-consuming. What many passengers don't realize, though, is that Transportation Security Administration screenings also are quite expensive. Finding cost-effective ways to keep airports and flights safe is one of the many challenges the U.S. Department of Homeland Security faces daily.

To that end, DHS has turned to ASU researchers for help developing advanced tools that will improve operations in DHS organizations, including the TSA, U.S. Coast Guard, Federal Emergency Management Agency and Customs and Border Protection. DHS has selected only a small number of universities across the country to lead research efforts in its Centers of Excellence.

"That DHS chose ASU for this Center of Excellence speaks to ASU's commitment to impactful, use-inspired research," says center director Ross Maciejewski.

The center is housed jointly in ASU's Ira A. Fulton Schools of Engineering and the Global Security Initiative.

Opportunity engineered by you

First-generation students. Under-represented students: It takes all voices and fresh perspectives to design and build the future we need.

When you give to engineering at ASU, you support a diverse and inclusive community. **We don't always see our generous donors, but you're always in the picture.**

Arizona State University

CAMPAIGN ASU 2020

Together, our potential is limitless
GiveTo.ASU.edu/engineering

01000001 01010011 01010101 00100000 01001100 01100101 01100001 01110010 01101110
01101000 01110010 01101001 01110110 01100101 01000001 0101001010000001 01010011 0
01110010 01101110 00100000 01110100 01101111 00100000 01010100 01101000 01110010

v: to be able to reach, approach, use or enter; to obtain, examine or retrieve

Access

A NEW APPROACH

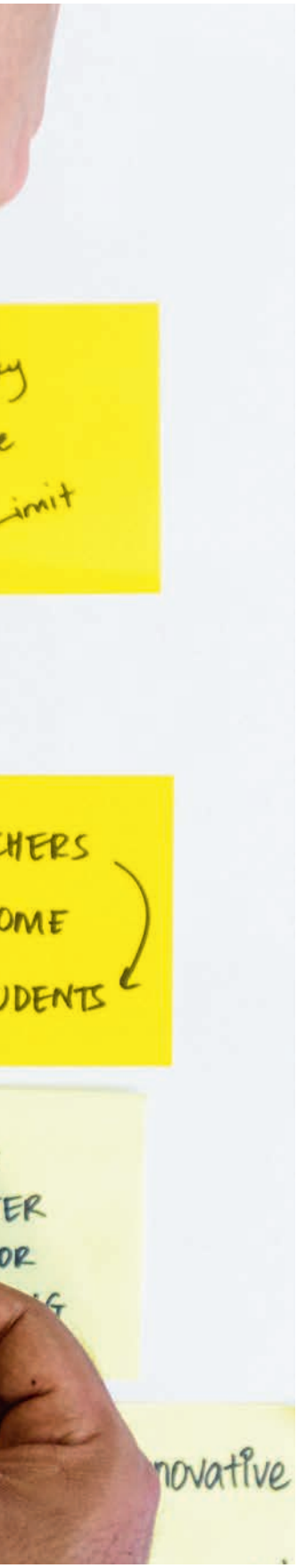
You hear a lot about next-gen technology. To get there, the Ira A. Fulton Schools of Engineering is focusing on the next generation of engineers — where they'll come from, how they learn and even how they live.

The aviation programs at ASU's Polytechnic School offer students a range of flight simulators, air traffic control simulators and hands-on learning opportunities.

Redesigning education

"By empowering and rewarding risk-taking, making and additive innovation among faculty and students, we create a culture of change agents."

— ANN MCKENNA, ASU PROFESSOR AND DIRECTOR OF THE POLYTECHNIC SCHOOL



ASU is doing for education what engineers do on projects — assessing the context, embracing complexity and building a robust future.

The ira A. Fulton Schools of Engineering at ASU is redesigning engineering education, transforming department structures and faculty reward systems to stimulate comprehensive change in policies, practices and curricula.

These changes, in turn, are creating a learning environment that values risk-taking, making, innovation and creativity among its students and faculty.

As part of the n ational Science Foundation's r evolutionizing Engineering Departments program, the team is building a foundation to expand upon proven innovations in the project-based sequence. The premise is that students learn complex theories better when they are actively engaged in applying the concepts to solve real-life problems.

"Engineering schools have done a great job introducing students to project-based learning in first-year courses and implementing it in senior projects, but teaching of the core curriculum has remained relatively unchanged," says Ann McKenna, ASU professor and director of the polytechnic School, one of the six Fulton Schools of Engineering.

The research team uses lean startup business practices, the mapping of existing systems and community engagement to gather input to revolutionize undergraduate engineering education.

ASU is reshaping what the university engineering experience looks like in person and around the world, from the intentional inclusion and support of underrepresented groups to the deep study of classroom reinvention and cloud computer labs.

"ASU is one of the unique places in the world of academia where a school of engineering, as one of its main research themes, focuses on education and education improvement," says Jim Middleton, professor of aerospace and mechanical engineering.

improving education requires knowing a whole lot about the various people you are endeavoring to motivate and educate — a core challenge being tackled by the new engineering education systems and design doctoral program.

The program focuses on deep exploration and analysis of "education ecosystems" in all of their multifaceted complexity. Such ecosystems encompass the many intertwined factors that shape various individuals, groups, communities and societies, explains Associate professor Jennifer Bekki, chair of the program based at the polytechnic School. ■

NICOLE NERI/ASU

ASU Assistant Dean of Engineering Education Tirupalavanam g anesh (second from left) works with students (from left) Judicael Tombo, n ikki Lopez, r omonte Moore, Lovepreet Singh, Evelyn Holguin and Emanuel g arcia.

Engaging programs

Reaching out to a new generation

"What if students don't even know what an engineer does? What if you don't know that people like you are engineers, and you, too, can aspire to become one?"

— TIRUPALAVANAM GANESH, ASU ASSISTANT DEAN OF ENGINEERING EDUCATION

Engineering has a bit of an invisibility problem, says ASU education researcher Tirupalavanam g anesh.

"Engineers do things that impact a lot of everyday life, but you don't see engineers portrayed in movies, video games or on TV and the other things that are shaping youngsters' views of the world," says g anesh, an associate research professor and the assistant dean of engineering education.

A result is that many bright and motivated young students — and their parents — aren't including engineering on the list of potential careers.

g anesh's mission is to change that, especially for those within groups whose young adults have not pursued higher education or careers in the field in significant numbers — a largely untapped talent pool, he says.

Since 2011, enrollment of first-generation engineering students at ASU has grown more than 150 percent, bringing new ideas, perspectives and experiences into engineering education.

This material is based upon work supported by the National Science Foundation under Grant No. 1744539. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

New projects support awareness of engineering as career path

ENGINEERS FROM DAY ONE includes high school, community college and ASU students, developing engineering awareness and an identity tied to the discipline of engineering.

HERMANAS is a community colleges event that promotes STEM educational pathways to encourage Latinas to explore attending college.

YOUNG ENGINEERS SHAPE THE WORLD Known as YESW, this program serves high school girls, with mentors guiding planned exploratory activities, stereotype confrontation, industry mentorship and ASU site visits.

ENGINEERING PROJECTS IN COMMUNITY SERVICE This social engagement program with high schools has grown to include community colleges, pairing students with local partners in need of engineering design solutions. EpiCS@ ASU is supported by ASU in the Chandler, Mesa, phoenix and Tolleson school districts.

ENGINEERING FUTURES supports first-generation students navigating the university, from the beginning of their studies through student cohorts, support systems with first-generation junior and senior counselors aiding in the development of engineering identity, as well as retention advisers to monitor progress.

BRANDON SULLIVAN

NICOLE NERI/ASU

Virtual computer labs

When ASU Associate Professor Dijiang Huang's enrollment rapidly increased from 20 to more than 100 students in one class, a physical computer lab was no longer feasible.

He created a cloud-based virtual lab and entrepreneurial venture that emulates physical computers and network connections to form any computer network configuration needed for exploring cybersecurity problems and solutions.

ThoTh Lab is entirely browser-based. instructors can create any configuration of computer network and monitor student progress and performance.

"Diverse thoughts are critical to solving some of the most pressing grand challenges that exist in society today."

— JEAN ANDINO, ASU ASSOCIATE PROFESSOR OF CHEMICAL ENGINEERING

Andino was named the 2017 Educator of the Year in Higher Education by the Society of Hispanic Professional Engineers.

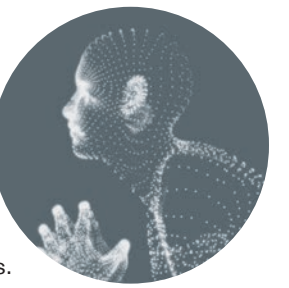
Psychology

Better engineering for humans, by humans

To successfully design for the diversity of the human experience, engineers must understand people — their clients as well as themselves — in addition to technology.

"We're a group of psychologists in an engineering school, and i think that makes us a unique resource in the way we think about things," says r od r oscoe, ASU assistant professor of human systems engineering.

"We think that human systems engineering has the potential to be really engaging to the students who are here to solve real problems, change the world and improve the world," he says. "Doing these things involves not only strong technical knowledge and skills, but a good understanding of the 'people side' of real-world challenges. Students are more engaged and persistent when they have a passion and a purpose."



"There is no reason to either love or hate mathematics outside the experiences we have in and out of school, along with the cultural attitudes. [In our research] we are focusing on understanding and then changing the learning experiences of students to be more effective, inclusive and personally satisfying."

— JIM MIDDLETON, PROFESSOR OF AEROSPACE AND MECHANICAL ENGINEERING

INSIDE TOOKER HOUSE

ASU's Tooker House is more than a dorm. it's a focal point for the student experience, integrating living and learning environments.

The seven-story, 1,600-person coed residential community includes classrooms, makerspaces, seven social lounges, seven study lounges, six academic success centers and technology-enabled features — like finding out when the laundry room is free via Bluetooth.

its design allows students concentrating on their work to look up and make an immediate connection. Or just chat with a teacher between classes or over a meal.

JAROD OPPERMAN/ASU

“Everything in here is built with the mindset of engineers. If you look at the ceilings, they look like they’re unfinished, but this is the finished product. They know engineers want to see not just the surface, but what’s beyond the surface.”

— BRADLEY BOLIN, ASSISTANT DIRECTOR, ASU RESIDENTIAL LIFE

Take the virtual tour
engineering.asu.edu/tooker-house

INSIDE TOOKER HOUSE

"Tooker House is a community, from the open plan to the way peer mentors engage with residents."

– DANIELLE SOSIAS, FIRST-YEAR PROGRAMS SR. COORDINATOR

"Peer mentoring is a program built with the mindset of helping students unlock their potential to be successful in their school, career and life journeys."

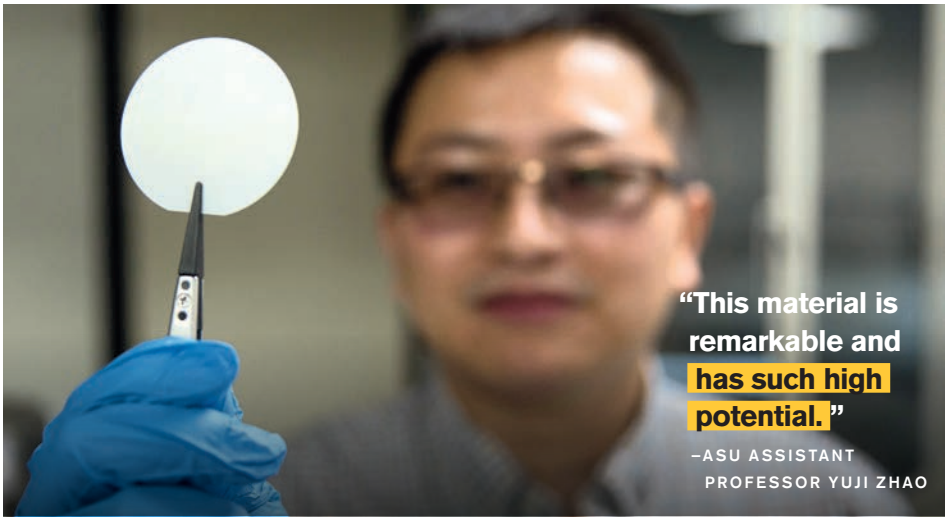
– ERIN HUBER, ASU PEER MENTOR AND MECHANICAL ENGINEERING SENIOR

JAROD OPPERMAN/ASU

"The microgrid boot camp is an intensive one-week period that provides student veterans with experiences in designing, modeling, integrating, operating and maintaining microgrids."

– NATHAN JOHNSON, ASU ASSISTANT PROFESSOR OF ENGINEERING AND MANUFACTURING ENGINEERING, POLYTECHNIC SCHOOL; DIRECTOR, LABORATORY FOR ENERGY AND POWER SOLUTIONS

A group of 20 students spent spring break learning about microgrids — small groups of electricity sources that provide power and operate independently from the existing grid.



Solar research

Improving next-gen materials for solar cells

Gallium nitride might just be the key to creating high-performance solar cells capable of operating under extremely high temperatures. Electrical engineering Assistant Professor Yuji Zhao is exploring and employing the properties of gallium that make it an excellent candidate for use in LEDs, lasers and high-power and high-frequency devices. Zhao notes that some have called gallium nitride the next silicon — the ubiquitous material that serves as an integral component of many of our electronics, from computer chips and solar cells to transistors and integrated circuits. Gallium nitride could prove to be superior to silicon, and Zhao's work is paving the way toward faster, more efficient and higher-powered devices of all kinds.

No internet, no power, no problem: ASU solar library is the answer

Portable, solar-powered, Wi-Fi-ready digital library devices called SolarSPELL — Solar Powered Educational Learning Library — are helping expand access to education and technology in remote places around the world.

Laura Hosman, an ASU assistant professor with a joint appointment in the Fulton Schools and the School for the Future of Innovation in Society, has created a way to deliver a digital library that doesn't depend on existing internet connectivity — rather, it comes with its own Wi-Fi hotspot.

With her innovative SolarSPELL device, all that is needed to access the information is an internet-capable device, such as an iPad, laptop or smartphone. Basically, it's a self-powered plug-and-play kit, portable enough to fit into a ruggedized, weatherproof backpack serving up an offline library in the form of a website that is already being used in the Pacific Islands in an ASU partnership with the U.S. Peace Corps.

Hosman has traveled with ASU students to the Pacific Islands (including Vanuatu, pictured), where they worked with Peace Corps volunteers.

COURTESY OF NATHAN JOHNSON; PETE ZRIOKA/ASU; COURTESY OF BRUCE BAIKIE

TEMPE | DOWNTOWN PHOENIX | POLYTECHNIC | WEST | SUN DEVIL MARKETPLACE

ASU SPRING GEAR

WWW.SUNDEVILBOOKSTORES.COM

Supplies are limited! Come visit any of our five Campus Stores or Shop Online:
sundevilbookstores.com

Select items are Sun Devil Marketplace exclusives.
College and 7th Street | Across from Snooze and Postinos

SUN DEVIL CAMPUS STORES

The official stores of Arizona State University

01101000 01110010 01101001 01110110 01100101 01000001 01010010 01000001 01010011 01010101 00100000
01110010 01101110 00100000 01110100 01101111 00100000 01010100 01101000 01110010 01101001 01110110
01010101 00100000 01001100 01100101 01100001 01110010 01101110 00100000 01110100 01101111 00100000

v: to speed up or move faster; to progress more rapidly than usual

Accelerate

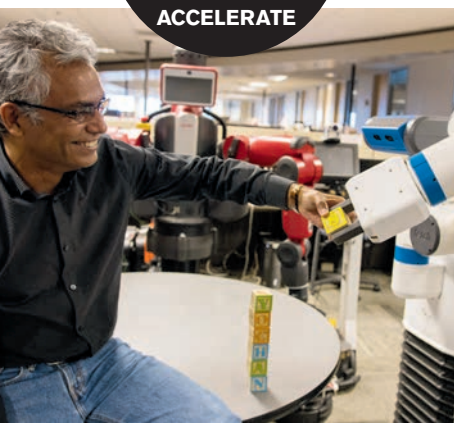
BRIGHT SPOTS

Success comes to those who relentlessly chase it.

It comes to those willing to try, fail and try again. Phoenix is attracting more of those risk-takers than ever, and the future they're chasing will be here faster than you think.

Associate Research Professor Govindasamy Tamizhmani (with a student at his Photovoltaic Reliability Laboratory at the Polytechnic campus) studies the feasibility of using backsheets to boost performance and reliability of solar modules.

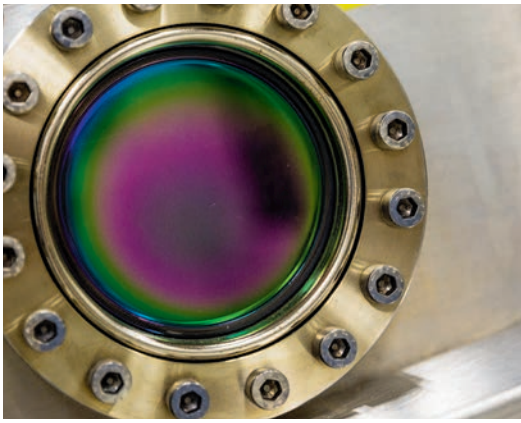
JESSICA HOCHREITER/ASU

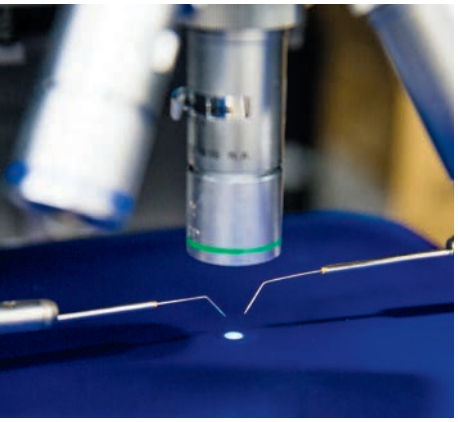


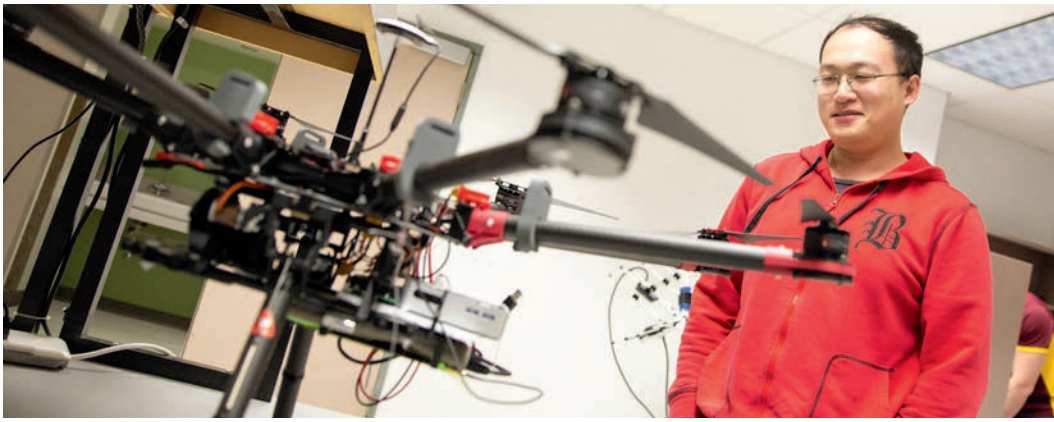
5 growth areas for Phoenix and the engineers who are making it happen

Story by SCOTT SECKEL

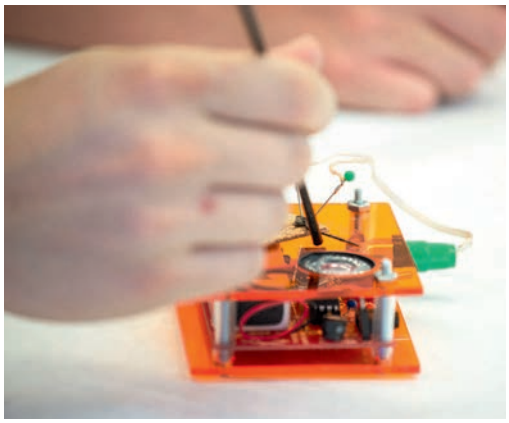
The future is now

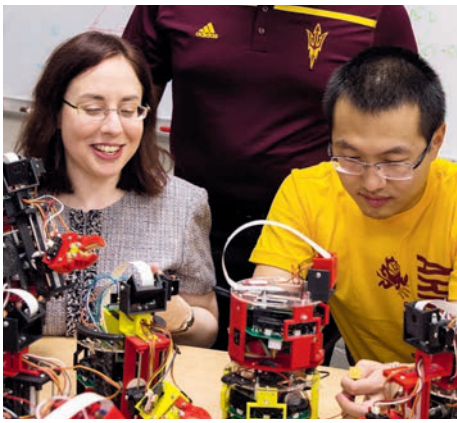


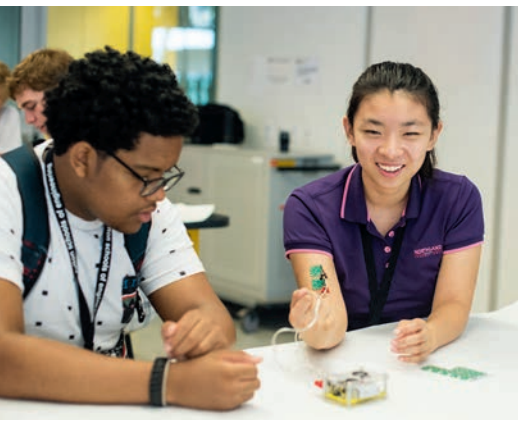




MARCO-ALEXIS CHAIRA/ASU; NORA SKRODENIS/ASU; JESSICA HOCHREITER/ASU







Engineering created modern Phoenix.

More than 500 years ago, the Hohokam excavated about 500 miles of canals so crops could be grown in the desert. The current 131-mile-long canal system is almost entirely laid out on top of the ancient network. Roosevelt Dam was built to hold spring runoff and control the Salt River so it didn't whip around the Valley floor like a snake in a shoebox. And, although not invented in Arizona or by a Phoenician, Willis Carrier's air conditioning made the area attractive to millions after World War II.

JESSICA HOCHREITER/ASU; HAYDEN TAYLOR/ASU; COURTESY OF SALT RIVER PROJECT

Engineering turned one of the most inhospitable places on Earth into the fifth-biggest metropolitan area in the country, and engineering research — when it's paired with industry — will continue to transform the Valley of the Sun's future.

As human knowledge doubles every 13 months, change happens faster and faster. Greater Phoenix is uniquely positioned to seize upon discoveries that are happening at Arizona State University, especially at the nation's largest engineering school with more than 450 faculty and researchers in six multidisciplinary schools. Companies can benefit from a relationship with the university as innovations and advancements move outward.

"Unsurprisingly, where there's a hot research field, there's also a serious interest to an industry," says Kyle Squires, dean of the Ira A. Fulton Schools of Engineering.

Academia and industry have different strengths. They complement each other, but they also cancel out each other's weaknesses. A huge part of science is poking around in the dark, seeing what works and what doesn't. Businesses simply can't afford to run into too many dead ends before the money runs out.

"We're allowed to go try things which are probably going to work, but often don't, and that's OK," says ASU Associate Professor Dan Bliss, director of the Center for Wireless Information Systems and Computational Architectures. "Certainly in industry some startups do this, but it is problematic because you invest a fair amount of money and you make a mistake, and you don't get to do that too many times.

"You have to explore lots of ideas before you find the right ideas to work, so academia and ASU in particular is well-suited to doing these sorts of research tasks. Cooperation and teaming between ASU and various industrial entities would provide just the right combination of skills to complement each other," adds Bliss.

From basic research to developing an idea for a solution all the way through to commercialization and delivery to the market is a huge space. On one end you have academics trying to identify early solutions. At the other end are companies. Because of time and budget constraints, industry can impart its innate sense of urgency to academia.

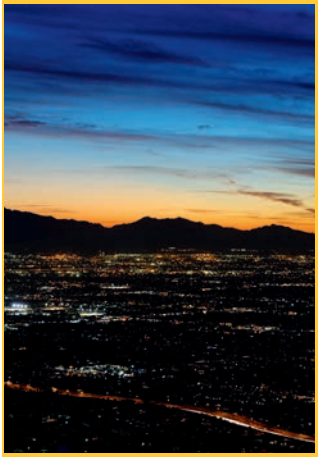
"What industry can provide academia is more than capital and a conduit to deliver solutions," says William Tyler, associate professor of biological and health systems engineering.

Besides ideas and research, industry gains other advantages by working with a university.

Benchmark Electronics designs and manufactures electronics. When they began the search for a new home, the organization had a number of criteria. An affordable cost of living, solid infrastructure and a world-class airport were all

"Even broader than talent, it's now about university alignment on research, and ensuring that we have technology road maps that are embedded within companies."

—CHRIS CAMACHO, PRESIDENT AND CHIEF EXECUTIVE OFFICER OF THE GREATER PHOENIX ECONOMIC COUNCIL



important, but the company moved to the Phoenix area specifically to be near ASU. Company leaders wanted proximity to a major university that was willing to collaborate and work with them.

Chief Executive Officer and President Paul Tufano says of the benefits: “ASU surpassed our expectations. What does that mean? When I think about that, I think about it on three different levels. Clearly having a student population that is obviously well-educated and trained and will be a pipeline for our engineering development needs is critical. We established two new design centers, one in high-speed circuit design and (radio frequency) and another in (internet of things) integration, and so our ability to be close to a research institution that allowed us to advance those things, as well as the potential to get faculty to work with us and/or some of their grad students, we found that to be very beneficial.”

Right now there are 318 companies looking at the metro Phoenix market. What all have in common is a craving for bright minds, says Chris Camacho, president and chief executive officer of the Greater Phoenix Economic Council, the region’s leading economic development organization. The nonprofit assists businesses interested in coming to the Valley.

Tech companies need the university talent pipeline to drive research and development outcomes. They “want to be more engaged with our post-secondary system so we can drive more commercializable (intellectual property) here in greater Phoenix,” Camacho says. “Industry relies on

Growth and research strength

Top 1%

of world’s most prestigious universities

—Times Higher Education, 2018

The Times rankings of the top universities places ASU in the top 1 percent of some 20,000 higher education institutions across the globe. The only universal measure of its kind, it recognizes excellence across research, teaching, knowledge transfer and international outlook.

#1 in the U.S. for innovation

For the third straight year, U.S. News & World Report ranks ASU No. 1 on its “Most Innovative Schools” list, ahead of No. 2 Stanford and No. 3 MIT. ASU again tops the peer-reviewed survey of college presidents, provosts and admissions deans around the country, each choosing up to 10 colleges or universities making the most innovative improvements.

Top 10% A ‘Best’ global university

According to U.S. News & World Report, ASU is among the top 10 percent of more than 1,200 universities across 60 countries that have been specifically recognized for their “Global Research Reputation.” Among those joining ASU in the top 10 percent are MIT, Stanford and Harvard.

Fastest-growing

ASU is one of the country’s fastest-growing research universities over the last 10 years among those with $100 million+ in annual research expenditures.

ASU is in the top 10 in the U.S. for total research expenditures

among institutions without a medical school, ahead of Caltech, Carnegie Mellon and Princeton.

1 of 2 in the U.S.

ASU is one of two universities in the U.S. to lead two NSF Engineering Research Centers.

Assistant Professor Zachary Holman (right) and Professor Yong-Hang Zhang (not shown) have created a monocrystalline cadmium telluride solar cell that could result in more efficient solar panels worldwide.

higher education more than ever.

Camacho continues, "Even broader than talent, it's now about university alignment on research, and ensuring that we have technology road maps that are embedded within companies. We need universities that are nimble enough and value-add enough to drive existing research capabilities to the next stage to ultimately help companies grow and scale research development."

Brains and visions of the technologies that will exist decades in the future are what industry wants and what ASU can provide in spades.

"We're an engineering college," Squires says. "Our most valuable commodity that we produce for people outside are graduates who can go in and do things. They'll go into Honeywell, Intel, Raytheon, Medtronics — you can go down the list — but increasingly into small startups, the new companies that are attracted here and you have young talent with the right skill set to take a nascent, really interesting, beginning-to-thrive entrepreneurial culture and get it to the next level. I think that's important for our future here."

"Our ability to be close to a research institution that allowed us to advance, as well as the potential to get faculty to work with us ... we found that to be very beneficial."

—PAUL TUFANO, PRESIDENT OF BENCHMARK ELECTRONICS

Ideas, via research, are the other valuable commodity produced on campus.

"We need to not only think about the technologies that drive near-term innovation but also look 15 to 20 years into the future," says Squires. "As I love to point out, if you don't have faculty advancing the foundational research ideas that identify where a given field is going to be 20 years from now, you're never going to get there. Impact occurs across the entire spectrum — from blue-sky thinking that takes the long view to technology advances over the near-term that are critical to enhancing competitiveness."

John Graham has a bird's-eye view of the Valley. The president and CEO of Sunbelt Holdings — a real estate development and investment company — Graham chairs the Partnership for Economic Innovation, a collective

JESSICA HOCHREITER/ASU

Research leading to business outcomes

Economic development

$8.9 billion

wages paid to ASU graduates in Arizona as of 2015.

Commercialization

ASU named one of the nation's top universities for commercializing tech

–The Milken Institute lists ASU as one of the fastest-growing and one of the top universities for tech transfer, ahead of Harvard, Duke, Johns-Hopkins, USC and UC Berkeley.

Major NSF research centers:

Quantum Energy and Sustainable Solar Technologies (QESST)*

Center for Bio-mediated and Bio-inspired Geotechnics (CBBG)*

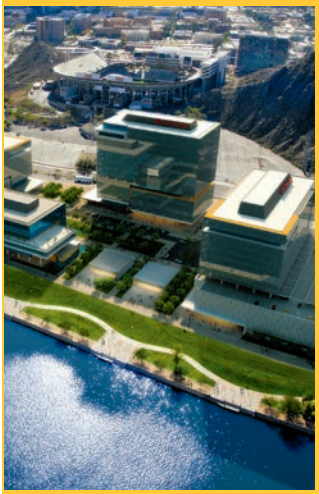
Building Reliable Advances and Innovation in Neurotechnology (BRAIN) Center

Nanotechnology Enabled Water Treatment Systems (NEWT)

***ASU is the lead institution**

"ASU is making it much more user-friendly for the outside to reach in and fi ure out both how to access important things at ASU and work with the school."

—JOHN GRAHAM, PRESIDENT AND CEO OF SUNBELT HOLDINGS



The Novus Innovation Corridor encompasses 330 acres adjacent to Tempe Town Lake and ASU's Tempe campus.

of community leaders dedicated to fulfilling regional economic opportunities. He also sits on the boards of a number of Valley institutions. He says ASU's efforts to partner with industry are paying off, but unheralded.

"What I've seen, especially under the leadership of Dean Squires, is really a strong effort to reach out to the business community and to the technology infrastructure that's in our community to find more collaborative ways to work together, not only with the impressive growth of the engineering school online and in the classroom, but the fact that through his efforts he has reached out so intentionally and effectively to the rest of the community," Graham says.

"I think a lot of people, for whatever reason, don't know that this is going on or that it's available. ASU is making it much more user-friendly for the outside to reach in and figure out both how to access important things at ASU and work with the school, so I think it's something that the more it's talked about, the more specific relationships that are talked about, the better it is for everybody."

With some 350 tenured/tenure-track faculty, the Fulton Schools of Engineering covers a very broad area of research strengths. Here are the five areas with significant growth potential for ASU and for the Valley.

Growth area 1: Wearable technologies

Health care is beginning to look to engineering as heavily as it has looked to organic chemistry. In the future, health care will involve something you put on as much as it will swallowing a pill. That may

PHOTO COURTESY OF SUNBELT HOLDINGS

take the form of a blood-pressure monitor you wear on your wrist or a necklace to conquer insomnia, the latter being one of Tyler's inventions.

Tyler explains the idea of wearable tech: "You have the choice as a consumer — Do you want to try this (external device) to relieve pain and anxiety, or do you want to go have your back cut open and have some electrodes put in? You have the choice. This one costs $200, and the other $30,000."

Getting from concept to market — what Tyler calls the Valley of Death — with wearable technologies can take as long as 48 months. Pharma has a really big Valley of Death, because of all the testing and the safety and the unknowns and the targets.

"Because (wearables) are safe, you can iterate really quickly on testing cycles," Tyler says. "It's like, 'Hey look, we developed this solution.' We're going to test it in 10-15 people, hint of the concept, develop that through proof of concept, and then you can start to span that Valley of Death much quicker. That's really where wearables have an advantage, because you can deliver solutions to the market much faster."

Growth area 2:
Internet of things

"When you take a look at the explosion of radios with which we interact every day, this is going to be a big deal for industry," Bliss says. "Currently on my body I have eight radio systems on me. Every device we interact with has multiple radio systems that interact with everything else."

This is a significant opportunity for industry, because of the sheer number of devices that will exist.

"ASU nurtures students, bringing out their incredible talent and inspiring them to reach their goals."

—BILL AMELIO, PRESIDENT AND CEO, AVNET

Hoolest Performance Technologies, with three ASU engineering students, won the $100,000 investment prize at the ASU Innovation Open, beating a pair of finalist ventures from MIT and a pair of ASU entries as well. Avnet sponsors the event.

Strong faculty cultivates excellent student work

Nation's largest producer of future engineers

178% increase in student enrollment over the past 10 years

21,206 students in fall 2017

#10 most technology graduates hired by top 25 technology companies

–Business Insider and HiringSolved Survey, 2017

"The telecom industry now exceeds $1.6 trillion. If you take a look at the number of human users, we're over a billion now," Bliss says. "When you take a look at the path to expansion, it's going to be mostly nonhuman users. These are all the internet of things devices. Those in industry that figure out how to provide the capabilities we want are going to be the winners. And financially it's going to be a big deal."

Growth area 3:
Automation and robotics

Spring Berman is an assistant professor of mechanical and aerospace engineering who studies the modeling, analysis, control and optimization of robotic swarms.

"Automation and robotics promises to increase productivity and efficiency for a lot of

MARCO-ALEXIS CHAIRA/ASU

Over the last 10 years, ASU has become one of the nation's leading producers of elite scholars.

1,840 National Merit Scholars

1,296 National Hispanic Scholars

23 Goldwater Scholars

185 Fulbright Scholars

1 Rhodes Scholar

1 Churchill Scholar

5 Marshall Scholars

5 Truman Scholars

ASU faculty members collectively rank No. 2 in nation for NSF awards

ASU faculty earned 14 National Science Foundation early-career awards in 2017, ranking second in the U.S. among all universities and among the top three for engineering schools, ahead of Stanford, UC Berkeley and Carnegie Mellon.

Prestigious engineering faculty memberships in national academies

35 IEEE Fellows

7 National Academy of Engineering members

3 National Academy of Construction members

4 National Academy of Inventors members

75 NSF CAREER awardees since 1995

First in the U.S.

to create a fully online accredited electrical engineering undergraduate degree

Top 5 in the U.S.

for interdisciplinary science total research expenditures

ahead of MIT, UCLA and Carnegie Mellon

#23 in the U.S.

among top public university undergraduate and graduate engineering programs

along with University of Florida, University of Pittsburgh and Iowa State

– U.S. News & World Report

industries," Berman says. "Another advantage is that the robots can be used for tasks that are repetitive or dangerous or could be hazardous for a person to do.

"There's a lot of effort not only in developing the robots themselves and the technologies, but also understanding how they can interact with human operators to get the best of both worlds, so the uniquely human capabilities of supervision and decision-making and the fact the robot can do repetitive tasks can increase productivity and human comfort."

Growth area 4: Water innovation

In a 2017 survey of 1,500 companies, 95 percent said water is important — and they were not getting any help with it, says Paul Westerhoff, an ASU Regents' Professor and vice dean for research and innovation for the Fulton Schools.

"None of the companies had a really good idea actually how much water affected the bottom line of the product," says Westerhoff. "One of the needs is to clearly understand the value of water in manufacturing, to quantify that for different sectors — how much they rely upon it — and what is their vulnerability to water disruption."

Almost all these companies treat water onsite because tap water isn't of high enough quality for those such as hospitals, restaurants and semiconductor manufacturers. They face the same problems consumers do at home: scaling due to hardness, high salt content and unpleasant tastes and odors. Cooling towers use more water than necessary and sensors become fouled, for example.

"If these companies can come to an area where there are other companies going through similar experiences — 95 percent of these respondents said they wish they had a forum to exchange ideas at a professional level across different sectors," Westerhoff continues. "We can create that forum at ASU, and that will attract companies who care about water conservation and industrial water purification. I think we can expand the types of companies that are located in Arizona ... we are already recognized as being pretty forward leaders in Arizona around water management."

Growth area 5: Renewable energy

ASU has the largest solar research facility in the country. It is the only university in the U.S. where you can make a full-size, commercial solar cell. Solar companies send

their researchers to work with faculty in the labs.

"Solar in particular is an excellent growth area because there is suitable local expertise (in the form of the semiconductor industry) for solar module manufacturing; a unique solar research center (the Quantum Energy and Sustainable Solar Technologies center, or QESST, at ASU) producing the best-trained graduates in the country; and intense sunlight in Arizona that drives local demand," says Zachary Holman, an assistant professor of electrical engineering.

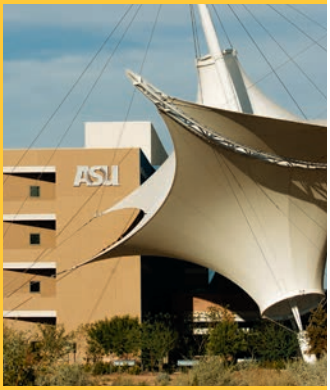
Christiana Honsberg, director and principal investigator at QESST, says collaboration is key.

"Photovoltaics is the poster child for how technology should be done — collaboratively, working with industry and in concert with educators," she says. "We have an opportunity to demonstrate that solar is beneficial to society. It's not about having the next paper published in Nature."

Aligning the economy, university

ASU has been innately entrepreneurial over the last decade. Now, regional economic development and the university need to align more closely, GPEC's Camacho says.

"What I see on the horizon is we need to have economic development and the university aligned to induce more Arizona-based (intellectual property) to be generated," he says. "That's having public resources to support industry-led innovation centers and technology dispositions for things like wearable technologies, health sciences, personalized medicine and even advanced electronics playing to our legacy industry strengths of microelectronics.



"What I see on the horizon is we need to have economic development and the university aligned to induce more Arizona-based (intellectual property) to be generated."

—CHRIS CAMACHO, PRESIDENT AND CEO OF GPEC

"That's where I see the intersection of applied research between universities and economic development, and then, by supporting ideation and the commercialization of those ideas, we will successfully drive our future generation of companies."

These industry/academia partnerships are working, and they're working successfully, Graham says.

"I think the best economic development story in the state — for sure the city — has been ASU under the regime of Dr. (ASU President Michael) Crow," he says. "I think part of why that's the case is that he's done a brilliant job of reaching out to the community, in his words 'embedding' ASU into the community. (A partnership between industry and the engineering schools) is front and center of that type of relationship and part of the reason that ASU and the community have been so successful in those areas."

It has been successful for Benchmark Electronics, and Tufano expects it to continue.

"The partnership with ASU, the interaction with ASU, has been pretty phenomenal in terms of the engagement, the energy level, the desire on the part of all levels of the administration and faculty to participate," says the company president. "It's surpassed my expectations."

Avnet, a full-service electronic component manufacturer, has a significant number of partnerships with ASU and sees great potential as a result.

CEO Bill Amelio explains why: "ASU nurtures students, bringing out their incredible talent, and inspiring them to reach their goals. Our partnership with ASU through the ASU Innovation Open and the Avnet Innovation Lab provides a special opportunity to work side by side with students and early-stage entrepreneurs in advancing new and innovative technologies from idea to design to production." ■

TOM STORY/ASU

PARTNERSHIP FOR ECONOMIC INNOVATION

Proving Industry-Led Intentional Investment Works for Arizona

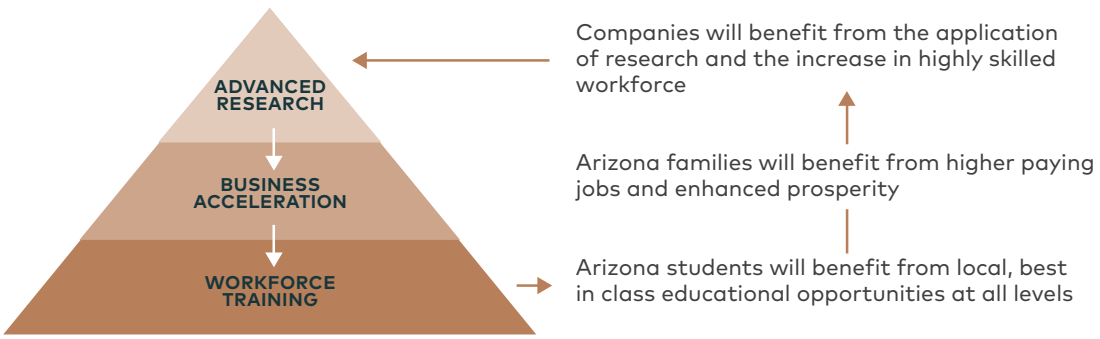
The Partnership for Economic Innovation (PEI) is dedicated to transforming Greater Phoenix into a top global market for innovation and technology, fueled by world-class research institutes, advanced industry workers, and high-tech entrepreneurs.

PEI is proud to partner with the ASU Fulton Schools of Engineering to develop a prototype science and technology center that will demonstrate **the unique value proposition of leveraging public, private, and advanced research assets to create the products industries need to grow and thrive.**

— HOW IT WORKS —

By investing in research, education, and workforce readiness we can capitalize on Arizona's long history of entrepreneurism and innovation.

Industry-led, intentional investment will spur business growth within advanced industries and next-generation growth industries, creating a multiplier affect benefiting our entire region.

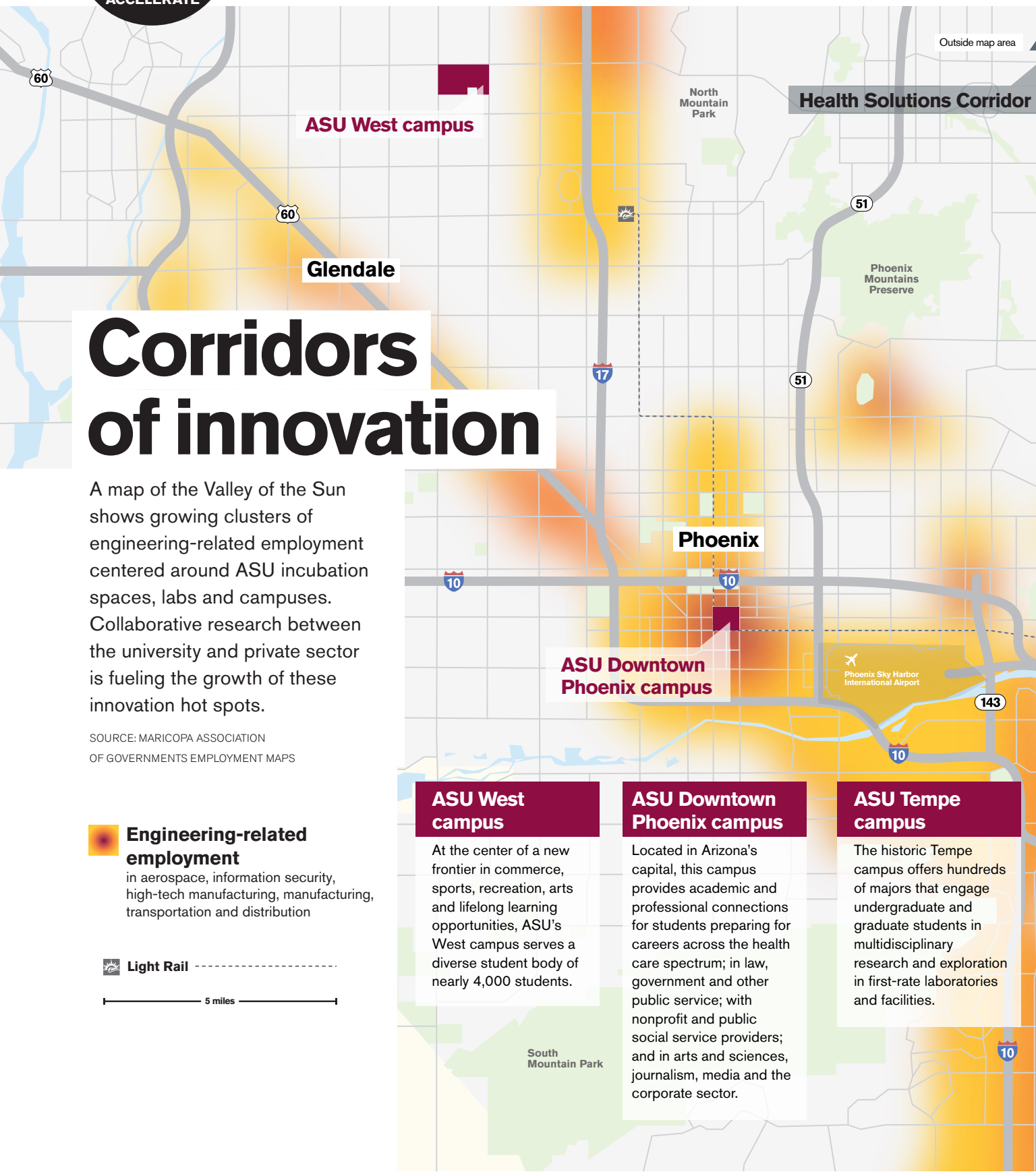


Learn more at www.AZPEI.org

Corridors of innovation

A map of the Valley of the Sun shows growing clusters of engineering-related employment centered around ASU incubation spaces, labs and campuses. Collaborative research between the university and private sector is fueling the growth of these innovation hot spots.

SOURCE: MARICOPA ASSOCIATION OF GOVERNMENTS EMPLOYMENT MAPS



Engineering-related employment
in aerospace, information security, high-tech manufacturing, manufacturing, transportation and distribution

Light Rail

5 miles

ASU West campus

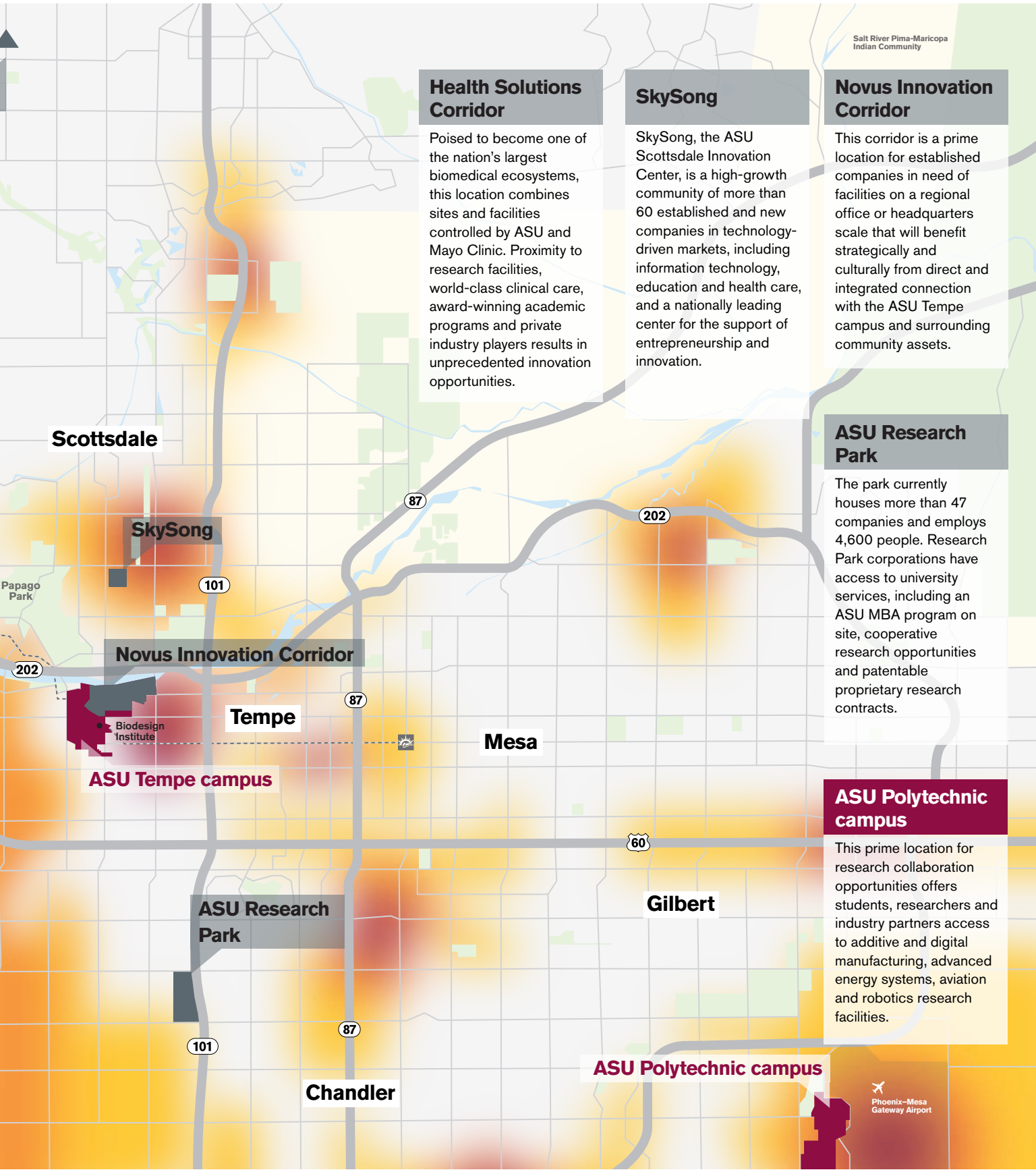
At the center of a new frontier in commerce, sports, recreation, arts and lifelong learning opportunities, ASU's West campus serves a diverse student body of nearly 4,000 students.

ASU Downtown Phoenix campus

Located in Arizona's capital, this campus provides academic and professional connections for students preparing for careers across the health care spectrum; in law, government and other public service; with nonprofit and public social service providers; and in arts and sciences, journalism, media and the corporate sector.

ASU Tempe campus

The historic Tempe campus offers hundreds of majors that engage undergraduate and graduate students in multidisciplinary research and exploration in first-rate laboratories and facilities.



Health Solutions Corridor

Poised to become one of the nation's largest biomedical ecosystems, this location combines sites and facilities controlled by ASU and Mayo Clinic. Proximity to research facilities, world-class clinical care, award-winning academic programs and private industry players results in unprecedented innovation opportunities.

SkySong

SkySong, the ASU Scottsdale Innovation Center, is a high-growth community of more than 60 established and new companies in technology-driven markets, including information technology, education and health care, and a nationally leading center for the support of entrepreneurship and innovation.

Novus Innovation Corridor

This corridor is a prime location for established companies in need of facilities on a regional office or headquarters scale that will benefit strategically and culturally from direct and integrated connection with the ASU Tempe campus and surrounding community assets.

ASU Research Park

The park currently houses more than 47 companies and employs 4,600 people. Research Park corporations have access to university services, including an ASU MBA program on site, cooperative research opportunities and patentable proprietary research contracts.

ASU Polytechnic campus

This prime location for research collaboration opportunities offers students, researchers and industry partners access to additive and digital manufacturing, advanced energy systems, aviation and robotics research facilities.

LINDSAY KINKADE AND HANNAH FREY/ASU

Innovative spaces and programs

GENERATOR LABS

ASU's g enerator Labs is a space occupied by both the Engineering projects in Community Service (EpiCS) program and the eSeed Challenge + Accelerator program. g en Labs provides support and resources for students' entrepreneurial endeavors by way of courses, workshops, competitions and events. Both programs show students how entrepreneurship and engineering can affect the world and are instrumental in helping students build "soft skills" that are not often learned in the classroom, such as planning, pitching, budgeting and funding a project while interfacing with the community, investors or a client.

Generator Labs also hosts events, including Live @ Generator Labs, a speaker series in which CEOs and entrepreneurs share their tips and tricks and connect with like-minded students. They also host Devils Invent, a weekend-long hackathon to design, build and implement innovative solutions to challenging problems.

EPICS: ENGINEERING PROJECTS IN COMMUNITY SERVICE

The Engineering Projects in Community Service program, known as EPICS@ ASU, is an award-winning community service and social entrepreneurship program. Through EPICS, students take a hands-on approach to problem solving while making an impact in the community. Sponsoring partners work with student teams to prototype and solve a challenge in their community or business.

THE ASU INNOVATION OPEN

This event advances university student innovators who aim to develop hard-tech ventures. The ASUio provides critical venture mentorship and funding for student competitors who are launching a hardware enterprise within a wide variety of cutting-edge marketplaces, including but not limited to hardware solutions, IoT and social enterprises with a focus on conscious capitalism. In the challenge, student-led ventures can win prizes from $20,000 to $100,000. Avnet, SRP and OnSemiconductor sponsor this event.

FURI: FULTON UNDERGRADUATE RESEARCH INITIATIVE

As FURI researchers, students solve real-world problems, investigate possible career paths, build a mentoring relationship with a faculty member outside of class, gain a competitive advantage for graduate school or jobs and internships, and gain essential skills for career success. Through this paid opportunity, participants conduct research with a faculty mentor and present their findings at a semiannual FURI Symposium.

EPROJECTS PROGRAM AND CAPSTONES

Through capstone projects and the eProjects program, students work as part of a team to solve a challenge defined by an industry partner. Faculty and industry mentors offer guidance and support throughout the team's project development process. Project results are presented at the end of each semester, for industry partners and the public to attend.

Learn more about ways to connect your business to research and other innovations in engineering at engineering.asu.edu/engage

JESSICA HOCHREITER/ASU

Economic growth

Eliminating barriers in nanomanufacturing

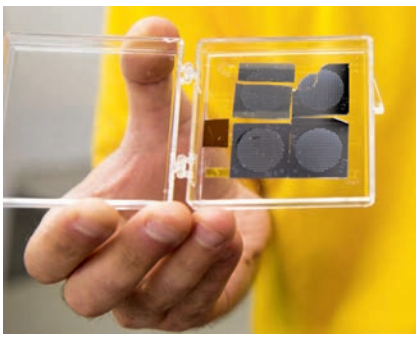
Across Arizona and the United States, advanced manufacturing propels economic growth. Arizona houses more than 150,000 manufacturing jobs and exports more than $20 billion in manufactured goods from defense, aerospace, electronics and optics companies, according to the Arizona Commerce Authority.

"Arizona is a key player in the manufacturing scene," says Bruno Azeredo, ASU assistant professor of manufacturing engineering.

He is leading a research project that aims to eliminate technical barriers that impose limitations on the productivity of manufacturing industries across the state. in particular, he is addressing a major limitation in nanomanufacturing: the inability to pattern — or etch — 3-D features directly into silicon at the nanoscale level.

"Manufacturing systems developed by this project can potentially eliminate barriers in the electronics, photonics and defense industries, all of which are strongly present in Arizona."

— BRUNO AZEREDO, ASU ASSISTANT PROFESSOR OF MANUFACTURING ENGINEERING



Azeredo's research on the fabrication of silicon is due to its potential use in 3-D microscale optical elements, such as the optical gratings used in microscopes and spectrophotometers.

JESSICA HOCHREITER/ASU

Solar and wind

At the frontier of grids, renewables and charging

Mariana Bertoni, an assistant professor of electrical engineering at ASU, is an early-career leader in energy research. Her work and insights on different aspects of the energy sphere — including the future of the power grid, wind and solar energy, and wireless charging — landed her in a select group of 100 young researchers in the Frontiers of Engineering, a n ational Academy of Engineering program. Her contribution is focused on "the progress of solar energy in the last decade, and where photovoltaics is going in terms of widespread implementation and integration," Bertoni says. She highlights the use of data analytics and machine learning in the design of next-generation solar materials.

Additive manufacturing

Adding new strengths

The largest additive manufacturing research facility in the Southwest is taking shape at the polytechnic campus, thanks to a partnership between ASU, Honeywell Aerospace, Concept Laser inc., pADT inc. and Stratasys Ltd.

The center is home to cutting-edge plastic, polymer and metal 3-D printing equipment, along with advanced processing and analysis capabilities that will allow students, faculty and industry partners to stay on the forefront of the rapidly growing additive manufacturing sector.

Additive manufacturing is the process of creating a 3-D-printed object layer-by-layer via computer control.

Clean water

Bringing sustainable water and enterprise to the Middle East

Clean water — and having enough of it — is a worldwide problem. For residents in Lebanon and Jordan, a lack of clean, drinkable water is the most pressing resource problem as the region faces severe water shortages. For refugees living in informal encampments or urban host communities, it's an even bigger challenge.

To compound the issue, the electrical grid is often unreliable or nonexistent in communities that lack clean water access — meaning water purification is unreliable, expensive or out of reach for local populations.

ASU is leading an international consortium to research and develop affordable, portable clean water solutions and business for the Middle East. The university brings expertise in engineering, sustainability and law to the project, which is sponsored by the USAiD Middle East Water Security initiative.

Anthonio Moawad (center), project manager at the r ené Moawad Foundation, and ASU professor r hett Larson (right) discuss the water-quality details of a well under consideration in Qubbe, Lebanon, with a local utility expert (left). This site was being considered as the first for implementation and would provide purified water to people in Bab El Tebbeneh, one of the poorest communities in Lebanon.

ASHLEY ST. THOMAS/ASU

00001 01110010 01101110 00100000 01110100 01101111 00100000 01010
10011 01010101 00100000 01001100 01100101 01100001 01110010 01101
10010 01101001 01110110 01100101 01000001 01010011 01010101 00100

v: to engage in sport or recreation; to perform an action; to act in a performance

Play

FULL STEAM AHEAD

The ASU-led AZLoop team

made it to the final eight at last summer's hyperloop competition sponsored by SpaceX. In February, they received word they had made it to the next competition for the proposed super-high-speed mass transit, so it's game on. The team, which has a running start thanks to last year's work, hopes to focus on levitation and propulsion in the coming months.

Robot hoops
Meet a robot that taught itself to play basketball. 44

Breaking through silos
Where engineering meets life science, sustainability, art and more. 46

Robot rumble
The Arizona FIRST Lego League annual championship. 48

Update
Big steps in prosthetics and brain tech. 51

Mechanical engineering major Himanshu Dave lines up layers for the early hyperloop pod model at the AZLoop workspace on the Polytechnic campus.

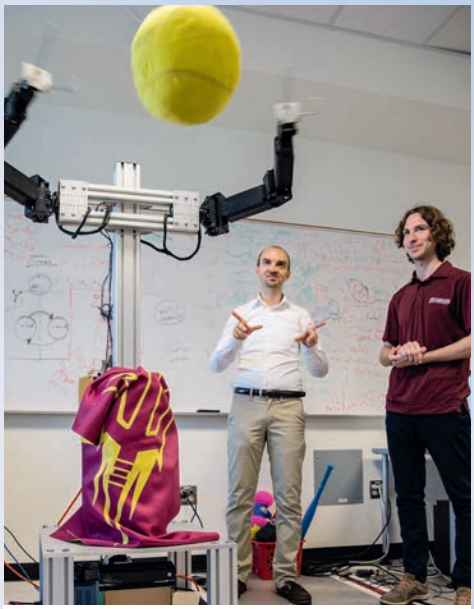
CHARLIE LEIGHT/ASU

Are robots helping or hurting us?

"We are not all going to die because of robots," says Aaron Ames, mechanical and civil engineering professor at the California Institute of Technology. Speaking at the recent ASU-hosted Southwest Robotics Symposium, he noted, "Let's keep these [types of] comments in context. [People who say this] need to learn more about AI and robotics.

"There's tremendous potential to bring AI and control together on robotic systems that will make our lives better, such as improve mobility for the impaired, aid in disaster response and enable space exploration," he said during the symposium.

Adds Panagiotis Artemiadis, associate professor in ASU's Fulton Schools of Engineering, "We are developing ways to talk about our research in the context of helping humans. The majority of the work we do is about enriching lives."



Heni Ben Amor (left), ASU assistant professor of computer science, and Kevin Sebastian Luck, doctoral student, watch their robot toss a ball.

JESSICA HOCHREITER/ASU

Nothing but net

(and one really smart algorithm)

The robot started from scratch,

with no idea what kind of movement would allow it to get the ball into the hoop.

It tried out different movements,

bit by bit figuring out how to improve its movements to get the ball closer and closer to the hoop.

It discovered that sinking the ball

actually required a dynamic motion — and it did all of this with minimal trials.

Plenty of robots can shoot hoops. it wouldn't be news that an ASU robotics expert created a robot that can sink a basketball. What's news is that the robot taught itself to shoot a basketball in a matter of hours, something it would take even an expert programmer days to accomplish.

"We pose the task to a robot, and through trial and error, the robot learns the task on its own, ideally in a limited amount of time," says Heni Ben Amor, who leads ASU's interactive r obotics Laboratory. "You go for lunch, and by the time you come back, it's done."

That's the key to why his team's algorithm is so impressive. "Many of these algorithms require hundreds of thousands of trials before you actually learn something," he says.

Score one for Ben Amor's team — and their hoops-smart robot!

EmergenTech: Hack ASU

ANYA MAGNUSON/ASU NOW

Synthesis Center workshop

Breaking through the silos

To discover something new, sometimes you have to go beyond the walls of the familiar.

Fulton Schools' engineers collaborate with innovative thinkers in — among others — ASU's School of Life Sciences, the School for the Future of innovation in Society and the School of Sustainability to find fresh inspiration and new ways of looking at challenges. its faculty and students even reach across disciplines to explore the intersection of arts and engineering in the School of Arts, Media and Engineering, a collaborative initiative with the Herberger institute for Design and the Arts.

One of the research centers to come out of that initiative is the Synthesis Center, where researchers draw from diverse disciplines in the humanities, engineering and the arts to blend knowledge and know-how to find meaningful ways of animating the worlds in which we live and play (one of its workshops is pictured near left). in particular, Synthesis uses techniques from responsive environments, time-based media, experiential science and non-anthropocentric design theory.

Elsewhere at ASU, the Luminosity Lab is a student-run venture that works on a portfolio of projects that utilize emerging technology to have an impact on society. Luminosity involves engineers from a variety of fields, as well as students who study graphic design, finance, data science and more. The group organized EmergenTech: Hack ASU, a hackathon (pictured on the left page) where students of all majors had 36 hours to form teams and develop a prototype and business concept, finishing with a pitch competition.

"What could be better than bringing together students from various disciplines to apply their creativity and critical thinking skills?" says Sethuraman panchanathan, executive vice president of Knowledge Enterprise Development at ASU. "They will build solutions that may revolutionize public and private industries."

CRAIG SMITH FOR ASU

Robot rumble

KIDS LEARN TECH AND TEAMWORK

Story by ELiZABETH FAr QUHAr
Photos by JAr OD OppEr MAn AnD niCOLE nEri

Competition brings students and mentors together for hands-on STEM fun

Crowded with hundreds of middle school students, the Ventana Ballroom in the Memorial Union at ASU should have been chaotic, but it wasn't. The low roar was the sound of excitement as teams huddled around prototypes of water-related innovations and tinkered with miniature robots made of Lego blocks.

The Arizona Fir ST Lego League 2018 state championship was held Jan. 13-14, with 92 teams and more than 750 young learners qualifying. Sponsored by the ASU ira A. Fulton Schools of Engineering since 2008, the program exposes children ages 9 to 14 to basic principles of science, technology, engineering and math. The kids work as teams building robots, solving problems and learning teamwork.

"We're proud to partner with FLL," says James Collofello, vice dean of academic and student affairs at the Fulton Schools. "We recognize that participation in engaging and fun STEM programs like FLL sparks further student interest in STEM topics and eventual STEM career choices."

The Mogollon Mechanics from Heber, whose base camp was in the middle of the ballroom, were busy testing the programming of their robot as they waited for their turn in the obstacle course trials. "it's really fun, but at the same time it's scary — this is a real competition," says fifth-grader Trevor Western, competing for the first time this year. Veteran Morgon Martineau, a sixth-grader, was sanguine. "The best part is having fun while learning," he says.

"It's really fun, but at the same time it's scary — this is a real competition."

— Tr EVOr WESTEr n, FiFTH-g r ADEr

The students "experience real-life research and the design process."

— TIGER YANG, ASU FRESHMAN MECHANICAL ENGINEERING STUDENT

Jeff Andersen, who coached the Mogollon Mechanics, is a dentist who had no programming experience before getting involved in FLL. He and wife Brooke first learned about the league when their high school daughter went to the world championships of the Fir ST r obotics Competition in St. Louis. They saw an opportunity for kids to get involved, so last year they decided to coach a team. it was such a good experience they formed two teams this year, with Brooke coaching the Mechanical Mustangs. And once the word about the program got out, a third team formed in the Arizona White Mountain communities of Heber and in Show Low/ Snowflake.

Andersen says small towns like Heber don't offer many nonsports after-school activities. FLL gives them academic challenges, leadership skills and opportunities to develop character.

The robot trials are the kids' favorite, but the teams are scored on three more criteria. Teams must research a problem connected to the tournament theme — this year it was water — and present their solution to a panel of judges. n ext, they must explain to a different panel why they built their robot the way they did. Finally, they must show how they embodied FFL's core values.

ASU freshman mechanical engineering student Tiger Yang helped judge the robot design presentations; he was once a competitor. He saw how many volunteers it took to run the program and decided to step up himself. n ow he encourages high school teams to help middle school teams. "They experience real-life research and the design process — they touch everything," he says. "if you can provide a great experience, they will want to go on to the higher levels," and maybe even choose engineering as a career.

Evelyn Holguin, an ASU senior industrial engineering student, judged at the state tournament this year. One of the benefits of programs like FLL, she says, is that it breaks down misconceptions that math and science are "too hard." The project portion of the FLL competition, where teams identify a problem then work out a solution, shows girls who might prefer one of the "helping" professions that engineering helps people, too, she says.

ASU doctoral student Anjali Mulchandani went to many volunteer-run science fairs and competitions growing up.

"The success i've been able to achieve is because of those camps and after-school programs," she says. This year she shared her water expertise with one of the teams, then judged the state tournament on the day her young friends were not competing.

it was especially gratifying to see teams acting out the FLL core values, she says, recalling, "One team, that eventually won an award, helped another team fix its code, even though it made them more competitive."

Brooke Andersen's team of Mechanical Mustangs from Heber learned those soft skills well. They won a g racious professionalism award, partly because they organized a scrimmage for first-time FLL teams in their area.

Technical expertise and helping others: the future of engineering is in good hands. ■

Brain-machine systems

Striving for big steps in prosthetic-hand technology

Professor Marco Santello and his research colleagues want to break through the functionality barriers that still burden people with artificial hands. Santello is the director of the ASU School of Biological and Health Systems Engineering and a neurophysiologist who directs the Neural Control of Movement Laboratory at the university.

Working with researchers at Mayo Clinic, the Italian Institute of Technology and Florida International University, Santello and ASU colleagues Qiushi Fu and James Abbas are applying some of the latest advances in bioengineering, robotics and brain-machine interface systems to develop prosthetic hands that enable users to feel sensations by which they can judge how much or how little force to exert in gripping, lifting, moving and holding particular objects.

With new technologies that directly connect with the body's nervous system, they hope to give artificial-hand users the ability to perform a wider range of normal daily living activities. The challenge is to construct a seamless integration of the nervous system with a myoelectric prosthetic hand, which requires teams of researchers with a broad range of complementary expertise in various branches of engineering, neuroscience and medical science.

ASU research aims to develop advanced prosthetic hands that function and feel natural in use.

JESSICA HOCHREITER/ASU

Neurotechnology

Two brains are better than one

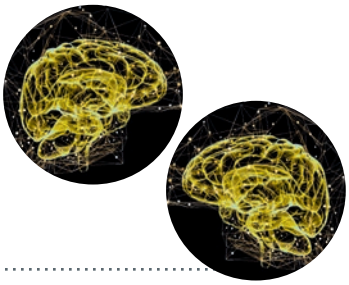
New partnership brings brain tech to market

ASU and the University of Houston have joined forces to form BRAIN (Building Reliable Advancements in Neurotechnology), an Industry-University Cooperative Research Center dedicated to bringing new neurotechnologies and treatments to market.

According to the World Health Organization, eight out of 10 disorders in the three highest disability classes are linked to neurological problems, a figure likely to increase, as the global elderly population is expected to double by 2050.

Eric Maass of Medtronic, one of BRAIN's industry partners, says his company was drawn to the immense talent pool contained within BRAIN.

"This partnership not only benefits Medtronic, but the world," says Maass.



"This team's Imagine Cup project is at the forefront of research aimed at augmenting productivity by making machines work seamlessly with humans."

– SUBBARAO KAMBHAMPATI, ASU PROFESSOR OF COMPUTER SCIENCE AND ENGINEERING, ON THE ÆFFECTIVE ROBOTICS TEAM'S WORK

Stadium data

The internet of things at work making gameday easier

ASU "is setting a new standard for gameday technology on campus. It is remarkable to witness the time, effort and creativity that goes into projects like ASU's Smart Campus initiative."

– Bob Vecchione, Executive Director, National Association of Collegiate Directors of Athletics

Sun Devil Stadium is delivering new levels of engagement, interaction and play on gameday. For the past two seasons Sun Devil Athletics and the University Technology Office have been working on the new Smart Campus initiative, implementing new internet of things (ioT) technologies to enrich the gameday experience. in-game feedback from data sensors gives ASU measures of parking availability, temperature, vibration in the stadium, victory cheer decibels, energy consumption and activity in the Tillman Tunnel.

PARKING LOT AVAILABILITY measures open parking spots to help improve the fan experience and manage traffic flow.

IMAGE COURTESY OF SUN DEVIL ATHLETICS AND ASU UNIVERSITY TECHNOLOGY OFFICE

01100001 01110010 01101110 00100000 01110100 01101111 00100000 01010100 01101101
01010011 01010101 00100000 01001100 01100101 01100001 01110010 01101110 00100000
01110010 01101001 01110110 01100101 01000001 01010011 01010101 00100000 01001100

v: to come together; to build a rapport; to establish relationships

Connect

BUILDING CONNECTIONS

There's a saying

that you can't go home again — but during ASU's annual Homecoming Block Party and Parade, ASU proves the opposite. Each year, Sun Devils of all ages return to celebrate the university's traditions and see its newest additions, such as College Avenue Commons (pictured), designed and built by ASU engineering alumni and current students.

BRIAN BOSSERT/ASU

3 ways: Recruit tomorrow's top engineers today

1. Use this new tool for resume searches and job, internship openings Handshake, ASU's new online system for posting jobs, internships, co-ops and student profiles, connects employers and job seekers. it is also a convenient portal to share company information, register for upcoming events, schedule interviews and volunteer to mentor. eoss.asu.edu/cs/handshake

2. Meet students early in their career g et to know top student talent early through programs like job shadowing, mentoring, internships, co-ops, site visits and summer internships.

3. Share your expertise Throughout the year, industry reps have the chance to meet with targeted groups of students in informal settings, such as Engineering Career Exploration n ight, where more than 3,000 incoming students have the opportunity to talk to more than 300 engineering professionals from more than 100 companies, government agencies and industry.

The Fulton family

Lasting impact

Founders' Day

ira A.Fulton, shown here second from left with son Doug, daughter Lori and late wife Mary Lou, at a Fulton Undergraduate r esearch initiative luncheon at ASU.

The generosity of the Fulton family inspires students, alumni and friends

ira A. Fulton and his family are being honored as the 2018 Founders' Day philanthropists of the Year for their vision, leadership and commitment to advance Arizona State University and the n ew American University. As catalysts for the acceleration of the ira A. Fulton Schools of Engineering and the Mary Lou Fulton Teachers College — along with numerous investments across the university, from athletics to performing arts — the Fulton family inspires students, alumni and friends around the world.

The family's investments have created a living legacy of engagement, support and mentoring. Beyond their contributions of more than $160 million to ASU, the Fulton family devotes time and energy to the advancement of students, faculty and leadership on the campus and in the community.

From their first moments at ASU, students are welcomed by ira and his family, encouraging young learners to take advantage of ASU's resources for success, and sharing their wisdom: "College is not a time to find yourself but, rather, to create yourself." With a smile and a selfie, ira reassures students he looks forward to seeing them at graduation; he has not missed a ceremony since 2003.

"The biggest thing our family enjoys is our engineering students," ira says. "To come on campus and tell them how much we appreciate them — we enjoy doing it. We want them to know that we were there."

ira and son Doug are ASU Trustees, and ira provides additional support by serving on the ASU Foundation Board of Directors, the ira A. Fulton Schools of Engineering Campaign Board, the ASU president's Club and the ASU Sun Devil Club. The family brings its support to campus, providing lasting evidence that investments change lives through connection and the direct inspiration of individuals.

As leading national philanthropists, the Fultons have found an equally dedicated partner in ASU. Visitors need only walk through campus to realize the transformative family's impact.

TIM TRUMBLE/ASU

Professor Gerald Heydt

Faculty Service Achievement Award

ASU r egents' professor g erald Heydt

A world-recognized academic whose seminal work in power engineering has impacted the industry, higher education teaching and students for more than four decades, professor g erald Heydt of the ira A. Fulton Schools of Engineering is the 2018 recipient of the ASU Founders' Day Faculty Service Achievement Award.

Says Fulton Schools Dean and professor Kyle Squires of Heydt: "He is not your average faculty member. He is a world-class researcher with global impact who cares about the future through each and every student he interacts with. He is the embodiment of the n ew American University."

Focused on student success and meaningful, impactful research, Heydt and his colleagues have grown the School of Electrical, Computer and Energy Engineering and the power engineering program into the largest and most prominent in the country.

As an ASU r egents' professor — the university's highest professional rank — his leadership role at ASU dates back to 1994, when he took the position of site director of the n ational Science Foundation's Center for power Systems r esearch.

"Throughout his time at ASU, Dr. Heydt has worked tirelessly with students and their passions for power engineering, truly caring for each student as an individual," says Squires.

Founders' Day: Tradition of excellence

Since 1964, Founders' Day has showcased ASU's evolution as a top innovative university. This signature event honors alumni, faculty and university advocates whose efforts have advanced groundbreaking research, distinguished service and visionary philanthropy.

For more information on Founders' Day 2018, visit alumni.asu.edu/events/founders-day

Class notes

Engineering a difference

Here and on subsequent pages is a sampling of ASU Fulton Schools of Engineering graduates who are excelling in their professional careers — in Arizona, across the country and around the world. These noted, and the thousands who join them as successful, thriving alumni of the Fulton Schools, represent a renowned and respected community of problem solvers who are deeply passionate about designing and launching innovative and entrepreneurial solutions to society's greatest challenges. Students and alumni from more than 135 countries are dedicated to the "Fulton Difference," committed to ongoing discovery, design, innovation, entrepreneurship and societal impact.

2010s

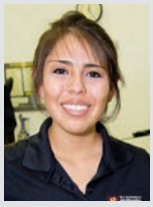
Kassidy Arias '17 MS graphic information technology is a UX designer at g oDaddy in Tempe. She served as an office in the student Aig A chapter at ASU polytechnic, where she helped launch the g iT Creative Agency, a course providing top graphic information technology students with opportunities to work hands-on with clients. in her role, she helped develop course workflo , chose a project management system for student use and helped organize clients and projects and plan activities.

Emma Card '17 BSE chemical engineering, a Barrett, The Honors College and Fulton Schools dean's list graduate, is a process development engineer in the carbon technologies division at ingevity in Charleston, South Carolina. At ASU, Emma minored in engineering management and served as an undergraduate teaching and research assistant.

Meera Doshi '17 BSE biomedical engineering, '17 BS sociology, a co-founder of partners in Empowerment while a student in the Fulton Schools, is an ASU research assistant and a Fulbright Scholarship recipient who is currently in Malaysia. Meera has been a business analyst intern at McKinsey and Co. in the greater Atlanta area and also works as a customer business analyst at intel.

John Heffernan '17 PhD biomedical engineering is a research and development engineer at Sonoran Biosciences, a medical startup operated at ASU that is developing a novel drug delivery device for effectively treating prosthetic joint infections. Long term, he hopes to lead teams engineering innovative medical products that improve quality of life. He says the knowledge and experience he gained at ASU in biomaterials development and tissue engineering have primed him to enter these fields where innovation can push the limits of what is possible in health care.

Allison Llave '17 BSE biomedical engineering is a supplier-quality engineer at Stryker instruments in Kalamazoo, Michigan. A summa cum laude graduate of the Fulton Schools, she was a lead quality and product development engineer at n eoLight Medical in phoenix.



Brittany Nez '17 BSE aerospace engineering is a materials engineer for QuesTek innovations, an Evanston, illinois, company specializing in integrated computational materials engineering. As an undergraduate student she led ASU's n ext Level Devils microgravity team in creating a project accepted by n ASA for the 2017 Micro-g n ExT program held at the Johnson Space Center in Houston. She served as the ASU chapter co-president for the American indian Science and Engineering Society, a group that promotes STEM disciplines to n ative American students.

Brian Zucker '17 BSE materials science and engineering, a Barrett, The Honors College student at ASU, is an additive manufacturing engineer at Titan industries in Tempe. Focused on the application of additive manufacturing — the industrial version of 3-D printing — to expand design opportunities and encourage technological innovation, his consulting work at Titan matches the company's focal point: leveraging advanced manufacturing technologies to build higher-performing components.

Engineers in action: leading, growing, succeeding

They are CEOs, presidents and co-founders. They are leading entrepreneurs, engineers and visionaries. Their businesses range from small startups with bright futures to growing enterprises employing hundreds of thinkers and doers.

Like those before them, and like those who will come in future years, the Fulton Schools of Engineering alumni who are members of this year's Sun Devil 100 are making a difference and introducing new ideas and new ways of solving longstanding challenges.

Our congratulations to these engineering alumni who are celebrated as the newest members of the Sun Devil 100.

Michael E. Johnson Jr.
'95 MS, civil engineering; Wilson Engineers, principal

Michael P.W. Kyle
'93 BS, industrial technology; n ova 42, co-founder/CEO

Clarence McAllister
'91 BSE, electrical engineering, '97 MS electrical engineering; Fortis, CEO

Rick Ahlf '16 BSE aerospace engineering, '16 BS sustainability, '17 MS aerospace engineering is working as an aerodynamics engineer in the low-speed aerodynamics product development group at Boeing in Mukilteo, Washington, and serving as chief tech office for the company he co-founded, 6-4-3 Charts. At 6-4-3, r ick leads all software development efforts, sabermetric data analytics and data management framework. The startup company provides advanced charts and analytics, short game statistics, batting averages by count data and more to n CAA Division i baseball programs. r ick was a Barrett, The Honors College scholar at ASU.

Nick Kemme '16 BE mechanical engineering, '17 MS mechanical engineering, a Barrett, The Honors College student and two-degree Sun Devil, is an optomechanical engineer ii at g eneral Atomics, a defense contractor headquartered in San Diego. Optomechanical design is a subdiscipline of optical engineering in which optics are integrated into mechanical structures. n ick is an original member of a team of ASU engineering students that worked on "Engineering Smiles," the creation of a mobile dental clinic delivered to Universidad Catolica de n icaragua, where it will be used as a training aid for dentistry students when not serving the underdeveloped region's residents.

“Treat people the way you expect to be treated, including customers and employees. Do the right thing, always. Never compromise your values.”

— CLARENCE MCALLISTER, CEO, FORTIS

Ibrahim Mesbah
’00 BS, computer systems engineering; ’04 MS, computer science; r evolutionparts, CEO

Phillip J. Noonan IV
’96 BS, civil engineering; Wilson Engineers, principal

Cynthia A. Pulte-Barutha
’95 BS, chemical engineering; CFM Mechanical, owner and vice president

Andreas Ronneseth
’04 BSE, computer system engineering, ’06 MS, computer science; r evolutionparts, co-founder/CTO

Stephen Todd
’90 BS, chemical engineering; Wilson Engineers, principal

David Yauchzee
’94 BS, mechanical engineering; Exhibit Marketing g roup, owner

“People make all the difference. If you put together the right set of people and give them the freedom to succeed, fail and grow, you will get the best results possible.”

— ANDREAS RONNESETH, CO-FOUNDER/CTO, REVOLUTIONPARTS

Celebrating the entrepreneurial spirit

Sun Devil 100 annually celebrates the outstanding achievements of ASU alumni around the world who own or lead businesses that best exemplify the innovation and entrepreneurship of the university.

For more information on Sun Devil 100, visit alumni.asu.edu/sun-devil-100

Emily (Sutton) Preston ’16 BSE biomedical engineering, ’17 MSE biomedical engineering is an engineer at W.L. g ore and Associates, a global materials science company focused on fluoropolyme technology and manufacturing. president of the Fulton Schools’ national award-winning social entrepreneurship program Engineering projects in Community Service (EpiCS) during her time as an ASU student, Emily joined g ore in 2017 after three years at the phoenix Children’s Hospital as a biomedical image processing applications researcher.

Mackenzie Hagan ’15 BSE civil engineering, ’16 MSE civil, environmental and sustainable engineering is in the water resource consulting division at g HD, an international provider of engineering, architectural, energy, environmental and construction services. At g HD, Mackenzie prepares project estimates, analyzes water distribution capacities and works with product representatives and specialists.

Kody Klimes ’15 BSE mechanical engineering, ’17 MSE materials engineering is a two-degree Sun Devil who anticipates earning his phD from ASU in the spring of 2018. He founded and is CEO of K2 OLED in phoenix, working on high-efficienc monochromatic OLED panels for application in the automotive industry.

Dillon Card ’14 BSE mechanical engineering, ’15 MS mechanical engineering, a summa cum laude graduate of the Fulton Schools, is a build reliability engineer ii at SpaceX in Hawthorne, California. in his role at the aerospace manufacturer and space transport services company, Dillon is responsible for monitoring the build quality and non-conformance resolution for Falcon propulsion, avionics and fina integration work centers. He was a project lead and aeronautical engineer at Lockheed Martin prior to joining SpaceX in 2016.

Priya Challa ’14 BS aerospace engineering, ’14 BSE earth and space exploration is a propulsion development engineer at Blue Origin in Kent, Washington. A Barrett, The Honors College and two-time summa cum laude ASU graduate, priya interned in solid rocket motor component research and development at ATK in promontory, Utah, and was a n ASA Space g rant intern while at ASU. She has been at Blue Origin — a privately funded aerospace manufacturer and spacefligh services company launched by Amazon.com founder Jeff Bezos — since 2016.

Paul Juneau ’14 BSE biomedical engineering, a magna cum laude graduate who, as a student in the ASU biomaterials lab in 2013, led a team of four in the development of a novel wound dressing, is a Salesforce software engineer at g /O Digital in phoenix. At g /O, He is part of a team that designs, develops, tests and deploys custom modification and updates to the company’s Salesforce organization.

Jennifer Megan Mincieli ’14 BSE mechanical engineering, ’15 MS mechanical engineering is a composites reliability engineer ii at SpaceX in Hawthorne, California. Following her 2014 undergraduate degree work at ASU, Megan turned an internship at Medtronic into a full-time position as a product engineer before joining SpaceX in 2016. At ASU, she was a Barrett, The Honors College student.

Abby Soulek ’14 BSE biomedical engineering is a new product development engineer at Cincinnati-based powerex, a leader in vacuum and clean air systems. prior to joining powerex in August 2017, Abby was a biomedical engineer at Tata Consultancy services, where she represented Johnson & Johnson in a life cyle engineering/design role, working with international teams to align product lines, FDA regulations and product performance requirements.

Celia Barker ’13 BSE biomedical engineering, ’14 MS management is a project manager for health care initiatives at Meals on Wheels America in Arlington, Virginia, working with third parties and member programs to implement projects of interest to the industry. Celia was program lead for isagenics international before being recruited by Meals, responsible for the coordination of consumer product commercial-ization projects — from inception through completion with teams across the organization — for all international markets.

Spencer Prost ’13 BS computer science is a software engineer developing instrument control operating systems at the Environmental Molecular Sciences Lab at pacifi n orthwest n ational Laboratory, a DOE research center. in his work, he has designed and implemented a modular data station for ion mobility spectrometry/mass spectrometry while involved with the lab’s Structures for Lossless ion Manipulation project.

Mariela Robledo ’13 BSE chemical engineering, a Barrett, The Honors College graduate, is a senior manufacturing supervisor at Medtronic in Albuquerque, n ew Mexico, and has been the Society of Hispanic professional Engineers national conference special events committee lead since 2014, organizing events in Detroit, Baltimore, Seattle and Kansas City.

Jared Schoepf ’13 BSE chemical engineering, ’16 MSE chemical engineering, ’17 PhD chemical engineering, a three-degree Sun Devil, has returned to his alma mater to serve as director of epics@asu, the award-winning Engineering projects in Community Service social entrepreneurship program in the Fulton Schools. He is also president and founder of Sustainable Storm Solutions, a phoenix-based company that designs storm-grate systems to efficientl remove trash and toxins from storm-water outlets — a solution to the challenge of floodin and pollution.

Gordon Freirich ’12 BSE mechanical engineering, a Barrett, The Honors College scholar and vice president of the Society of Automotive Engineers at ASU during his days on the Tempe campus, is a product development engineer at Hunter Douglas. in just more than two years with HD, g ordon has optimized injection mold tooling for cost savings and parts enhancement and has taken a new powerView system for horizontal blinds from concept to completion. prior to going to work at HD, he was lead design engineer at Vantage r ealized in Tempe.

Katherine (Rue) Huffer ’12 BSE biomedical engineering, ’13 MSE biomedical engineering is a research and development engineer ii for BD (previously Bard peripheral Vascular). in her role, she develops test methods to prove out the feasibility of prototype designs to the fina end product, collaborates on new product ideas and generates and submits invention disclosures. BD markets its products and services worldwide to hospitals, individual health care professionals, extended care facilities and alternate site facilities.

Amy Kacz-marowski ’12 BSE earth and space exploration, ’12 BS aerospace engineering is a senior member of the technical staff for research and development at Sandia n ational Laboratories in Albuquerque, n ew Mexico. Her work involves initial concepts, modeling, materials science, chemistry and testing to design for the future and to support national security.

John Kondziolka ’12 BSE civil engineering, a summa cum laude graduate and Barrett, The Honors College graduate, is a senior environmental engineer at g radient — an international environmental and risk science consulting company — in Cambridge, Massachusetts.

Kevin LaRosa ’12 BSE, electrical engineering is an applications engineer at Texas instruments in Dallas. A Barrett, The Honors College graduate, Kevin is on the analog circuit design team at the global semiconductor design and manufacturing company, where he has worked for nearly six years in a research position at the Flexible Electronics g roup at the University of Texas, Dallas.

Elizabeth (Walker) Nofen ’12 BSE chemical engineering, ’16 MS chemical engineering, ’16 PhD chemical engineering, a three-degree Sun Devil, is a senior materials engineer in the materials technology development group at intel in Chandler, Arizona. With a focus on packaging research and development, Elizabeth provides materials support for intel’s microelectronics packaging. She is a cum laude graduate and an ASU Moeur Award winner.

Regina Arreola ’11 BE chemical engineering, a summa cum laude Fulton Schools graduate and winner of the schools’ Chemical Engineering Outstanding Senior award, is helping grow the user base and adoption rate for Workplace by Facebook as a strategic partner manager in London. Celebrating a year with Facebook in April 2018, r egina previously was a fiel engineer with Dupont in Mexico, leading a cross-functional, multicultural team in the realization of $1 million in water and energy savings in one year.

Laila El-Ashmawy ’11 BE civil and environmental engineering is — in her own words — “an oilfiel engineer-turned-energy economist.” She is an energy data office at international Energy Agency, a paris-based autonomous intergovernmental organization. Her responsibilities at iEA are focused on energy statistics and balances in Middle East and African countries, including the publication of the 2017 edition of “World Energy Balances.”

Andrew Larson ’11 BSE chemical engineering has served engineering roles in production, process and process control, working in the ammonia nitrate, polymer and refinin industries. An advanced process control engineer at Citgo petroleum, he works with the operations team to ensure the efficienc and safety of multivariable controllers.

Omar Habib ’10 BSE electrical engineering, ’17 MSE electrical engineering is a senior silicon validation/design engineer at Apple in San Diego, pursuing his phD in engineering at ASU. An ASU president’s Award of Excellence recipient as an undergraduate, Omar joined Apple in 2016.

Ben Jimenez ’10 BSE, aerospace engineering is a computational flui dynamics engineer at the Whirlpool Corporation in Benton Harbor, Michigan. At Whirlpool, he has developed test and simulation best practices for thermal and airflo measurement of in-door icemakers while mentoring a number of global CFD engineers across the Fortune 150 company.

CHARLIE LEIGHT/ASU NOW; JESSICA HOCHREITER/ASU

Tom Prescott

Pegging the needle in entrepreneurship

ASU electrical engineering graduates r yan Brown (left) and Ahmed Ahmed, with Trestle Automation, unload their automated skateboard security rack to display at the Venture Devils Demo Day.

This alum’s support helps students launch business ventures

Tom prescott ’83 believes that all ASU students are capable of becoming impactful innovators. And he’s backed up that belief with a gift to fund the eSeed Challenge, a program that identifies and supports early-stage student ventures that may be well-suited to compete for and win other entrepreneurship competitions.

The eSeed Challenge features three highly competitive phases. First, challenge teams have to validate or reject their key business model hypotheses. Then they present the status of their ventures and compete for admission into the eSeed Accelerator, where they increase traction within their target markets.

Finally, they pitch their ventures to a panel of industry judges. Top teams earn prescott Fellow status and travel with prescott to Silicon Valley to meet with top-level professionals, tour startup companies and enjoy the opportunity to pitch to successful entrepreneurs.

“You ought to prize your failures. Those are the seeds for the great lessons you learn that can wire you for the rest of your life.”

–Tom Prescott ’83, former CEO and president, Align Technology Inc.

Stephanie (Naufel) Thacker '10 BSE biomedical engineering, '11 MS biomedical engineering is a systems engineering and technical adviser at ECS Federal in Arlington, Virginia, a top-100 government contractor and top-50 government technology contractor. Stephanie advises DAr pA (Defense Advanced r esearch projects Agency) program managers involved in research and development of breakthrough technologies for national security on behalf of ECS.

2000s

Daniel Bishop '09 BSE biomedical engineering is co-founder and CEO of Qualaris Healthcare Solutions. An innovator who advocates for defect-free health care, he has guided proven hospital programs to prevent and reduce falls, transferable software platforms delivered by QualarisAudit that improve hospital safety compliance, patient communication improvements and pan-hospital process automation to drive and launch new health care solutions.

David Latshaw II '09 BSE chemical engineering is a senior scientist at the Janssen pharmaceutical Companies of Johnson & Johnson in the greater philadelphia area, creating data- and science-based research and pharmaceutical manufacturing efficienc solutions. He is the global program lead for real multivariate process analytics and the technical operations lead for large-molecule modeling strategies.

Philbert Huskon '08 BSE biomedical engineering is a biomedical engineer at indian Health Service, an agency within the U.S. Department of Health and Human Services. Working out of the iHS Whiteriver indian Hospital in Whiteriver, Arizona, philbert is part of a team serving American indian and Alaska n ative people in their health care needs.

Soroush Mirtalaei '07 BSE biomedical engineering, '09 MSE mechanical engineering is an associate manager supporting global manufacturing of medical devices for Baxter international, where he has also served as a principal quality assurance engineer. in his role, Soroush is part of the company's global footprint and the expansion of access to health care in emerging and developed countries.

1990s

Daniel X. Houston '91 MSE industrial engineering, '00 PhD industrial engineering has co-authored "What Every Engineer Should Know About Modeling and Simulation." The book presents "fundamental concepts and issues in computer modeling and simulation in a simple and practical way for engineers, scientists and managers," according to publisher Cr C press.

Recommended reading among engineers

The Lean Startup

by Eric Ries

RECOMMENDED BY Brent Sebold, Fulton Schools, Entrepreneurship + Innovation

If you consider yourself to be an innovator, a scientist or an engineer who aims to create something new under conditions of extreme uncertainty, this book will change your life and shape your future. With "The Lean Startup," Ries sets himself apart from his predecessors by clearly defining startup founding teams as temporary organizations searching around in the dark for repeatable, scalable business models. It offers a pragmatic tool chest to support the belief that entrepreneurs aren't born, they're made.

Salt: A World History

by Mark Kurlansky

RECOMMENDED BY Oswald Chong, School of Sustainable Engineering and the Built Environment

If you look back in human history, you will find salt is one of the rare materials that changed our world in many ways. Like oil and sand, salt is one of Earth's abundant materials and substances that in some times and places was seen as largely undesirable (because it caused rust) and at other times and places became extremely valuable (as food). It makes you wonder: Are there other materials we think of today as "undesirable" that will someday make some people rich and powerful?

Set Phasers on Stun

by Steven Casey

RECOMMENDED BY Nancy Cooke, The Polytechnic School

This book recounts 20 true stories of disasters (in some cases very gruesome) that result from the failure of technology to effectively connect to humans. Most of the disasters are not the result of a single-point failure in the system or human interface, but multiple issues that often interact to result in unanticipated consequences. These true stories inspire me to help make systems that are useable, resilient and safe for humans.

Getting to Yes: Negotiating Agreement Without Giving In

by Roger Fisher, William L. Ury and Bruce Patton

RECOMMENDED BY Lina Karam, School of Electrical, Computer and Energy Engineering

Throughout life, we have to deal with people who have different personalities, beliefs and interests. "Getting to Yes" offers an effective method for productively communicating with different kinds of people, and to negotiate agreements and resolve disputes to everybody's benefit. The method is designed to help strengthen relationships and avoid creating more conflicts and misunderstandings in the future.

The Chip: How Two Americans Invented the Microchip and Launched a Revolution

by T.R. Reid

RECOMMENDED BY Daniel E. Rivera, School for Engineering of Matter, Transport and Energy

"The Chip" is a fascinating account of the invention of the integrated circuit, which was independently developed by Jack Kilby (at Texas Instruments) and Robert Noyce (at Fairchild Semiconductor; he would later be one of the co-founders of Intel Corporation). The book is an engaging account of the history of the semiconductor industry.

The Fourth Industrial Revolution

by Klaus Schwab

RECOMMENDED BY Gail-Joon Ahn, School of Computing, Informatics, and Decision Systems Engineering

"The Fourth Industrial Revolution" elaborates on an overview of the world's previous industrial revolutions and highlights the advances in technology that have sparked major societal change and created opportunities. It's necessary for engineers and scientists to understand where we are heading and what kinds of critical challenges we are facing in our fields.

NICOLE NERI/ASU

Teresa Clement

Lead, live, pay it forward

Engineering alumni chapter

Teresa Clement (right) volunteers for the Fir ST Lego League state meet with middle school students.

"ASU taught me all about communication. Every group has its own style of communication and requires a unique way of delivering information."

— Teresa Clement, Outgoing president, ASU Alumni Association engineering chapter

in 10 years at r aytheon Missile Systems, ASU double-degree alumna Teresa Clement knows a thing or two, because she's seen a thing or two.

Strategic technology manager for tech development at the Tucson-based company, she joined the company in 2007 upon receiving her phD in materials science engineering, which fit hand in glove with her 2002 BSE. She has prospered at r aytheon, and she pays it forward outside the office: She is a member of a handful of professional associations and chairs the America Makes r oadmap Advisory g roup, earning its 2015 Distinguished Collaborator Award.

She is also outgoing president of the Fulton Schools of Engineering alumni chapter and is an ASU Alumni Association board member.

On her missile-like trajectory: "Motivation is different for everybody," she says. "i have three prizes in my life: work success, family joy, community impact. The sum of these makes me feel like a whole person."

Her motivation to give back, to pay it forward to her communities is reflected in her role with the engineering alumni chapter. She owns a unique perspective on the connection between alum and university. "Staying connected to your alma mater doesn't mean you're living in the past," she says. "You continue to look forward while valuing the education, friendships, connections and advancements made possible by your time at ASU.

"By maintaining the connection and paying it forward, continuing to invest in your education as an alumni member, you will see the returns many times over."

She counts among those returns a direct link to her professional success: "Connections to the engineering school have benefited r aytheon and also me as a technical contributor within the company. The huge breadth of technical knowledge and expertise among graduates of the Fulton Schools provides a very strong business case to working with ASU and the engineering schools."

And, ASU's impact?

"ASU taught me all about communication in large groups," she relates. "Every group has its own style of communication and requires a unique way of delivering information.

"i learned skills that would enhance my interaction with my network, how i communicate and make connections with those people today."

Those communication skills have been instrumental at r aytheon, where her role in tech development requires her to interact across the massive missile maker. "They set my foundation; how to communicate, how to interact with executive-level folks, how to affect advancements for the entire company."

Clement looks forward to continuing her work with the chapter; giving back, paying it forward, making a difference for others is a focus. "it's only through my experience at ASU that i've been able to thrive when given such amazing opportunities," she says.

–Stephen Des g eorges

JESSICA HOCHREITER/ASU

Brad Bensen

Stay in touch with alumni chapters

Meet the incoming chapter lead for engineering

Brad Bensen could never have guessed his bachelor of science degree in computer science in 2001 would one day be his ticket to two Olympic g ames. His Olympian effort required more brains than brawn as a Ticketmaster software engineer who made sure all systems were a go in Beijing and Athens. Flash forward, and today he's set his sights on new goals as the ASU Alumni Association engineering alumni chapter president-elect.

How did your ASU computer science degree prepare you for your role today at Ticketmaster?
it really gave me the ability to understand operating systems, networking, hardware concerns and the building blocks of programming languages. it not only taught me how to code, it also taught me computer fundamentals that allowed me to tackle diverse challenges and quickly learn new technologies on the job.

Brad Bensen

What are some of your most interesting projects?
Working at Ticketmaster for 15 years, i've had the opportunity to work on many interesting projects — from building applications for multiple Olympic g ames to adding fan-pleasing features like interactive seat maps to our website and apps. For both Olympic g ames, we had to deal directly with not only the Olympic organizations, but the local country's organizations. For the Athens Olympics, everything was last minute, and we had to deal with very slow internet speed access on the g reek islands. The Beijing Olympics had stricter requirements to follow when i coded a ticket pickup and receipt application for their banking system so local fans could pick up tickets at a very large bank's outlets.

What inspired you to become the engineering alumni chapter president?
Seeing the passion that our outgoing president Teresa Clement and other leaders showed for chapter activities made me want to step up to a larger role.

How did alumni chapter involvement enhance your career?
My software engineering career was well-established before joining the chapter, so i see my role as serving students, fellow alumni, the Fulton Schools and the university at large. But the chapter does provide networking and mentoring opportunities that i think are very valuable. You can use this chapter for pure job opportunities, knowing what's going on in the business community and asking questions about a field you are interested in exploring.

What are your goals as incoming alumni chapter president?
To establish an online presence that makes it easy to know who we are and how to participate in our activities. To continue to clarify the role of an academic alumni chapter in the era of the n ew American University and social media. The two goals converge in engaging alumni in student-focused events and using our industry connections to evangelize for the ira A. Fulton Schools of Engineering. Alumni are effective at spreading the message that the college not only produces talent — graduates who are very well prepared — but the college has a lot of opportunities for public-private partnerships and undergraduate- to graduate-level research opportunities.

–Lori K. Baker

Connect with your chapter, find social media links and more at alumni.asu.edu/chapters

Facebook instagram Linkedin Email

3 ways: Get involved in chapters in the U.S. and worldwide

1. Join a local chapter in your area or one based on your interest and attend meetups to stay current on what fellow alumni are doing. See alumni.asu.edu/chapters for links to regional and special-interest chapters.

2. Connect your company with ASU by reaching out about internship or capstone projects that would be a good fit for your work or research.

3. Attend Innovation Showcase, Career Exploration Night or another on-campus event to meet students and share expertise.

The future is fast!

No, this jet pack won't help you fly — but it will help you run faster. In fact, in tests, a waist-mounted version helped a bicyclist increase top speed from 39 to 53 mph, and a skateboarder got up to 32 mph. The jet pack was created at Professor Thomas Sugar's lab on ASU's Polytechnic campus, where Sugar and his team build devices to help people overcome a physical disability or enhance performance.

The devices run the gamut, from a refrigerated suit that can help soldiers stay cool in a desert environment to an exoskeleton that can help a warehouse worker beat fatigue. One of Sugar's latest projects is an all-terrain prosthetic ankle for amputees. Though many of the projects are funded through the military, he says the future of wearable robotics may be commercial. "My belief is that the younger baby-boom generation will want to stay active, and they like technology," Sugar says. "So instead of a walker or a cane that assists, they might want to wear one of these devices."

JESSICA HOCHREITER/ASU

The future is brighter here.

Mirabella at ASU combines urban sophistication with a rousing university environment for an incredible retirement lifestyle. Elevate your continued learning experience in the magnificent auditorium, a haven of knowledge and discovery, or take advantage of your all-access pass to the more than 5 million books in the ASU library system—among many other university campus amenities. Living right on campus puts a world of possibilities at your fingertips.

Our new model home is open! Schedule your personal tour today: 602-777-7701

MIRABELLA | ASU

1155 W. Rio Salado Parkway, Suite 110 | Tempe, AZ 85281 | 602-777-7701 | mirabellaliving.com/ASU

Mirabella at ASU is a nonprofit, resident-centered community developed in partnership with Pacific Retirement Services and Arizona State University.
Equal housing opportunity.

Arizona State University
PO Box 875011, Tempe, AZ 85287-5011