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On the cover: *Students collaborate on NASA's Human Exploration Rover Challenge in the Bechtel Innovation Design Center, an advanced makerspace that provides students with training and access to high-end equipment used to build design prototypes.*

Our innovation continues.

This fall, Purdue University's 150th anniversary celebration came to a close after a full year of celebrating the people, places, experiences and advancements that make this amazing University a true force in our world. Looking back over this time of celebration, I recall that just one year ago – in the last edition of this very magazine, in fact – I asked you to join me in celebrating the dramatic transformation of the Purdue Polytechnic Institute. From curricula to teaching methodologies to real-world work experience, we continue to improve how the Polytechnic delivers education… and we have achieved dramatic growth along the way.

The Polytechnic by the numbers

Our enrollment figures illustrate the success of dedicated faculty and staff who work hard to bring real change to higher education in general, and to the Polytechnic specifically. As of the fall 2019 semester, our total enrollment reached a record high for the third year in a row. The programs we offer, and the methods with which we deliver them, have never been more popular.

Equally impressive is the academic strength and growing diversity of our student body. Our incoming class holds the highest entrance exam scores of any first-year class in the 55-year history of our college. The Polytechnic also continues to become more diverse, with a 67 percent increase in undergraduate female students and a 33 percent increase in underrepresented minority students in the last six years.

Expanding the Polytechnic footprint on campus

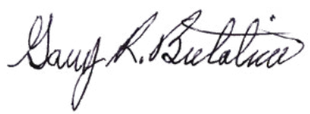
Also a year ago, I shared with you that the University would soon submit a request to the State for a new building to be shared between the Polytechnic and the College of Engineering. I am pleased to tell you that the State approved our request and, with the addition of generous gifts from the Lilly Endowment, our alumni, and industry partners, construction of the new Gateway Complex has already begun. The new facilities will encompass 255,000 square feet and will include laboratories that promote project-based instruction; design studios that support senior capstones and other team efforts; collaborative spaces for interdisciplinary student work; and research and other instructional spaces dedicated specifically to advanced manufacturing and Industry 4.0. (You can learn more about the exciting Gateway Complex on page 06.) I look forward to bringing you regular updates on the progress of this exciting next step in the continuing growth of Purdue Polytechnic.

More work to be done

Our own University president, Mitch Daniels, recently acknowledged the Polytechnic as a model for transformation in higher education. And, our high school in Indianapolis recently opened a second location as we also work to transform K-12 education and better prepare these young students for success. And yet, as thrilling as it is to experience these and other successes at the Polytechnic, I know that there is more that we can accomplish.

Thank you for your continued support of our efforts to continue the important work of transforming not only our college, but the world around us.

Boiler Up!



Gary R. Bertoline, *Dean and Distinguished Professor*

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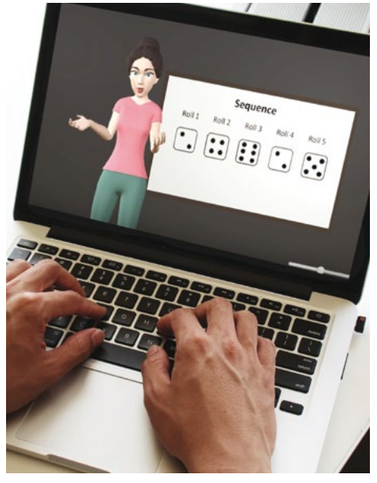

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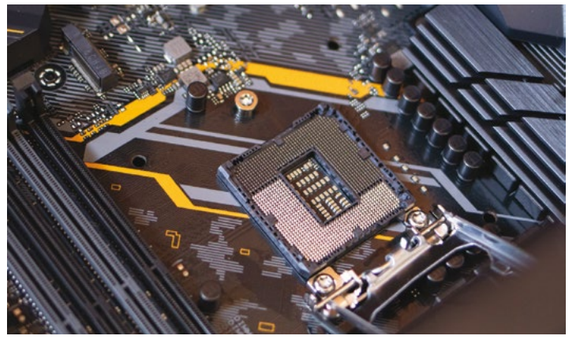

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Gary Bertoline, dean and distinguished professor

"These are going to be flagship facilities. The innovative project represents a **leading design for teaching, learning, research and engagement for universities in the future."**

by: John O'Malley

Gateway to Innovation

"Gateway" project to provide major expansion of Polytechnic, Engineering instructional space

In mid-2019, the Purdue University Board of Trustees approved a major construction project for Purdue's Polytechnic Institute and College of Engineering.

The "Engineering and Polytechnic Gateway" project will provide a total of 255,000 gross square feet, primarily for instructional laboratories, faculty offices, design studios and collaborative spaces. Consisting of two connected buildings, the complex will increase both the quality and quantity of instructional lab space, provide more dedicated space for active learning and lab-centric instructional methods, and bring together labs that are currently geographically separated.

"These are going to be flagship facilities," said Gary Bertoline, dean of Purdue Polytechnic. "We believe the innovative project represents a leading design for teaching, learning, research and engagement for universities in the future."

The modern, five-story project will have a total cost of $140 million, funded by $60 million from the state of Indiana, a $40 million grant from Lilly Endowment Inc., and another $40 million from the two colleges and their donors. Replacing the current single-story Nuclear Engineering Building and Michael Golden Labs facilities and wrapping around the west and south sides of Knoy Hall of Technology, the complex will serve as a new gateway to the academic campus. It will also provide an eastern terminus to Purdue's Student Success Corridor, which spans Third Street from Horticulture Park to Grant Street.

New laboratories for Purdue Polytechnic's School of Construction Management Technology, School of Engineering Technology, Department of Computer and Information Technology and Department of Computer Graphics Technology, plus faculty offices, will be located in the complex.

Transformation served as catalyst to new facilities, renewed collaboration

Mitch Daniels, president of Purdue University, praised Purdue Polytechnic's college-wide adoption of a transformed approach to education.

"The modernization of the Polytechnic Institute was, to me, superb," Daniels said. "No one should overlook or underestimate what an incredibly difficult thing that was."

The college's transformation that began in 2013 also served as a catalyst to the formation of the Gateway Complex project, Daniels said.

Clay Robbins, chairman, president and CEO of Lilly Endowment, noted that the organization's $40 million grant to help realize the new complex represents the next phase of ongoing support.

"Purdue has achieved significant impact through earlier grants to launch Discovery Park and enhance the College of Engineering and the Polytechnic Institute," said Robbins. "The intellectual and entrepreneurial energy on campus is magnetic. We are pleased to help build on this momentum."

Bertoline said that the College of Engineering and the Polytechnic have been working together more closely than ever before.

"I can't overstate how important the collaboration between our two great colleges is," he said. "That actually is a unique attribute of Purdue University. By having these two colleges at a major research institution, it brings all kinds of advantages for both programs. Engineering students get exposure working with technologists and vice versa, and the same thing goes for faculty and research."

The complex will feature the Hoosier Hot Corner, a physical "front door" to connect Indiana companies as they collaborate with faculty, hire students and interns and identify future graduates for full-time positions.

"We are going to prepare graduates, especially in the manufacturing area, better than anyone in the nation, if not the world," said Bertoline.

Site preparation began in fall 2019 with construction of a new service drive north of Knoy Hall. Demolition of existing buildings and construction of the new project will follow. The complex is expected to open for instructional use in January 2023.

Record-high Enrollment

by: John O'Malley

For three years in a row, the Purdue Polytechnic Institute achieved record enrollment at its West Lafayette location. In fall 2019, 4,910 students called Purdue Polytechnic home, including 4,144 undergraduates and 766 graduate students. During the period of 2006-2013, total enrollment had decreased from 4,346 to 3,640.

Since fall 2013, Purdue Polytechnic's number of new beginner undergraduate students has grown at a faster rate (+57%) than the University's growth (+27%).

First-year students this fall had the highest ACT and SAT scores of any incoming class in the college's history. The average ACT score was 27.2 (including one perfect score of 36), a sharp improvement from 2013 when the average was below 25. The average SAT score was 1269, a 34-point jump from two years earlier.

"In high school, our newest students proved that they are ready for the challenges that they will face in the Polytechnic Institute," said Gary Bertoline, dean of Purdue Polytechnic. "Their academic achievements are impressive. Their scores also demonstrate both for future students and future employers the value of the degrees they will earn by studying in our college."

In fall 2019, 20.5% of Polytechnic undergraduates were female, a six-year change of +67%. Over the same period, there was a 24% growth in the quantity of male undergraduates.

Underrepresented minority student enrollment has grown at a 33% rate in the last six years, improving to 12% of the Polytechnic's undergraduates. Overall, 10% of the University's undergraduate students are minorities.

Since 2013, graduate enrollment in Purdue Polytechnic has changed by +58%; the University's graduate enrollment grew by 19% during the same period.

The college's growth has received recognition from Mitch Daniels, president of Purdue University.

"Back in 2013, President Daniels challenged us to transform the undergraduate learning experience in our college," Bertoline said. "Today, he speaks often of our success and enthusiastically supports our growth."

Leaders in government and industry around the state have also recognized the Polytechnic's transformation and years of record enrollment.

"The state of Indiana and Lilly Endowment generously funded the new Engineering and Polytechnic Gateway Complex so that we may continue on this path of growth," said Bertoline. "They have given us an incredible vote of confidence."

Enrollment growth: Purdue Polytechnic flourishes

Dean Gary Bertoline attributes the Polytechnic's growth to the dedication of faculty and staff in creating a modern educational experience, focusing on:

» Hands-on, active learning

» The development of global perspectives and cultural understanding

» Real-world experiences

» A range of high-performing Polytechnic majors

High-performing Polytechnic majors

Each school and department in the Polytechnic offers a range of undergraduate degree programs designed to help students become successful members of an evolving workforce. Out of more than 30 undergraduate options, the following majors currently lead the college in enrollment numbers:

» Mechanical Engineering Technology

» Construction Management

» Cybersecurity

» Computer and Information Technology

» Professional Flight

» Aeronautical Engineering Technology

» Electrical Engineering Technology

» Game Development and Design

» Aviation Management

» Organizational Leadership

» Animation

» UX Design

» Robotics Engineering Technology

» Industrial Engineering Technology

First-year students – more accomplished than ever

New beginners at the Polytechnic continue to raise the bar in terms of academic excellence and college readiness. New fall 2019 students have achieved the highest average ACT and SAT scores in the history of the college.

Average ACT and SAT*

ACT	24.7 (2013)	26.2 (2016)	27.2 (2019)
SAT	1235 (2017)	1257 (2018)	1269 (2019)

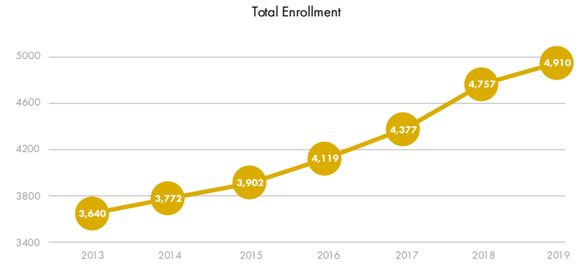
**Beginning in fall 2017, SAT results reflect new scoring and are not comparable to previous years.*

Average high school GPA

3.52 (2013)	3.63 (2019)

College enrollment gains outpace the University

Over the last six years, the Polytechnic has achieved a 31% increase in undergraduate students and a 58% increase in graduate students, handily outpacing the University's undergraduate and graduate gains in the same time period. The total enrollment of 4,910 students for fall 2019 is the highest in the college's history.*



**All data and information is for Purdue University – Main Campus, West Lafayette, Ind.*

Flying First Class

by: Brigid O'Brien and Melissa Templeton

School of Aviation and Transportation Technology

As a matter of course, the faculty and staff of the Purdue Polytechnic Institute's School of Aviation and Transportation Technology (SATT) consistently pursue grand challenges and industry needs. One of these challenges especially has the full attention of SATT's head of school, Manoj Patankar.

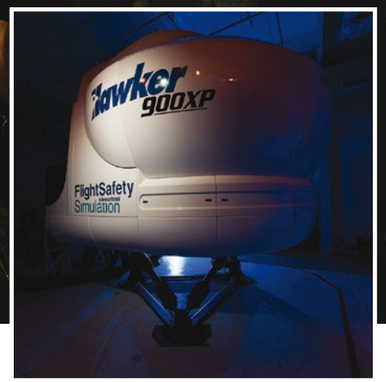
"There is a global shortage of pilots, and Purdue is part of the solution," said Patankar.

To remedy that pilot shortfall, Patankar has instituted a suite of advanced flight simulators, industry partnerships and an accelerated path to a professional flight degree.

Full-motion flight simulator

Purdue is the only university to offer Hawker simulator training.

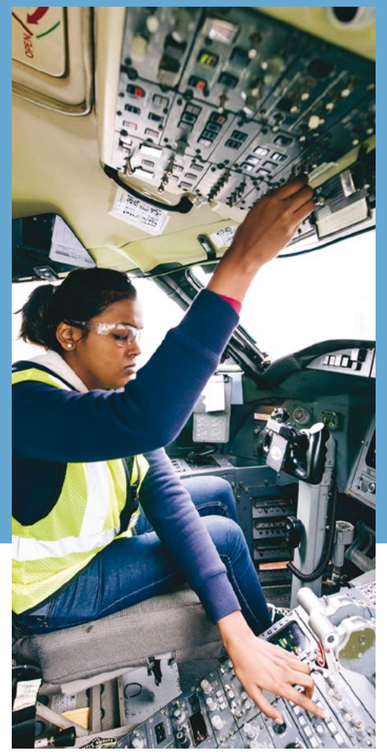
Students can now experience a Hawker 900XP full-motion, Level D simulator, designed and manufactured by FlightSafety International, a world leader in aviation training and simulation. The Hawker is housed in Holleman-Niswonger Simulator Center, with the school's new aircraft training devices and a number of part-task trainers.



Partnerships with Frontier and Airbus

Students graduate from Purdue "airline ready" to directly enter Airbus flight decks.

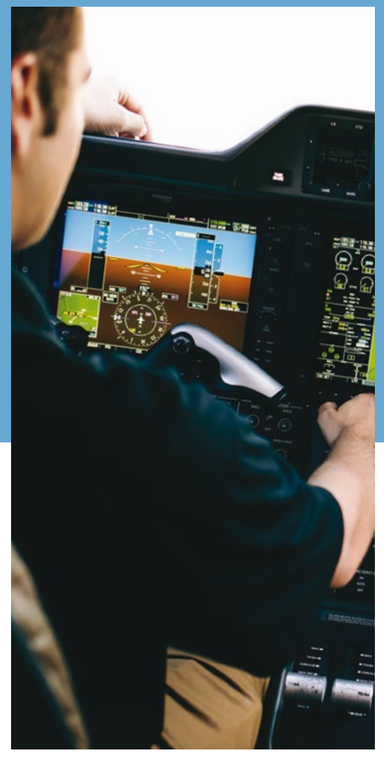
Thanks to an agreement between Purdue University, Frontier Airlines and Airbus, Purdue is the only university to offer A320 Type rating and utilize the latest Airbus tools, methodology, industry knowledge and technology.



Affiliate flight training

SATT partners with Purdue Global to expand professional flight program offerings

In a partnership with Purdue Global, SATT is creating an affiliate flight training program that will expand the reach of Purdue's aviation program to more students in other locations around the country. General education and open elective courses will come from Purdue Global's inventory, while students will earn academic credit for flight credentials obtained through affiliate flight schools. SATT will lend its expertise in curriculum development, faculty hiring, affiliate flight school selection, and accreditation by the Aviation Accreditation Board International.



Professional flight "Degree in 3" program

Students save time and money when they earn degrees in professional flight technology in three years

Students are taking advantage of Indiana's summer weather to fly year-round, just like their professional pilot counterparts in the airline industry. Participating "Degree in 3" students save approximately $20,000 to $30,000 in tuition and living expenses, and enter the job market sooner, which brings the total value of SATT's Degree in 3 program to more than $60,000.

Air Force cadet pilot training

Cadets earn private pilot certificates in summer training program

In 2018, SATT launched a partnership with the United States Air Force to teach high school students in the Junior Reserve Officers' Training Corps (AFJROTC) how to fly. In the first summer of the partnership, 20 cadets used an AFJROTC scholarship to earn their private pilot certificates at Purdue and take a giant first step toward a career in military or civilian aviation. In 2019, the number of cadets in the summer program increased to 52, and SATT intends to continue expansion of the program.

Electronic Purdue Bag

Each SATT student – including aeronautical engineering technology, aviation management, unmanned aerial systems and professional flight – receives a new cellular iPad, Apple Pencil and Logitech keyboard.

Dubbed an Electronic Purdue Bag (EPB) – a nod to the Electronic Flight Bag (EFB) that replaced pilots' paper-based flight information in the cockpit in the 1990s – the iPad systems provide Polytechnic aviation students with another competitive advantage by preparing them for the technologically advanced aviation industry, where most major airlines use iPad in the cockpit.

With their EPBs, students:

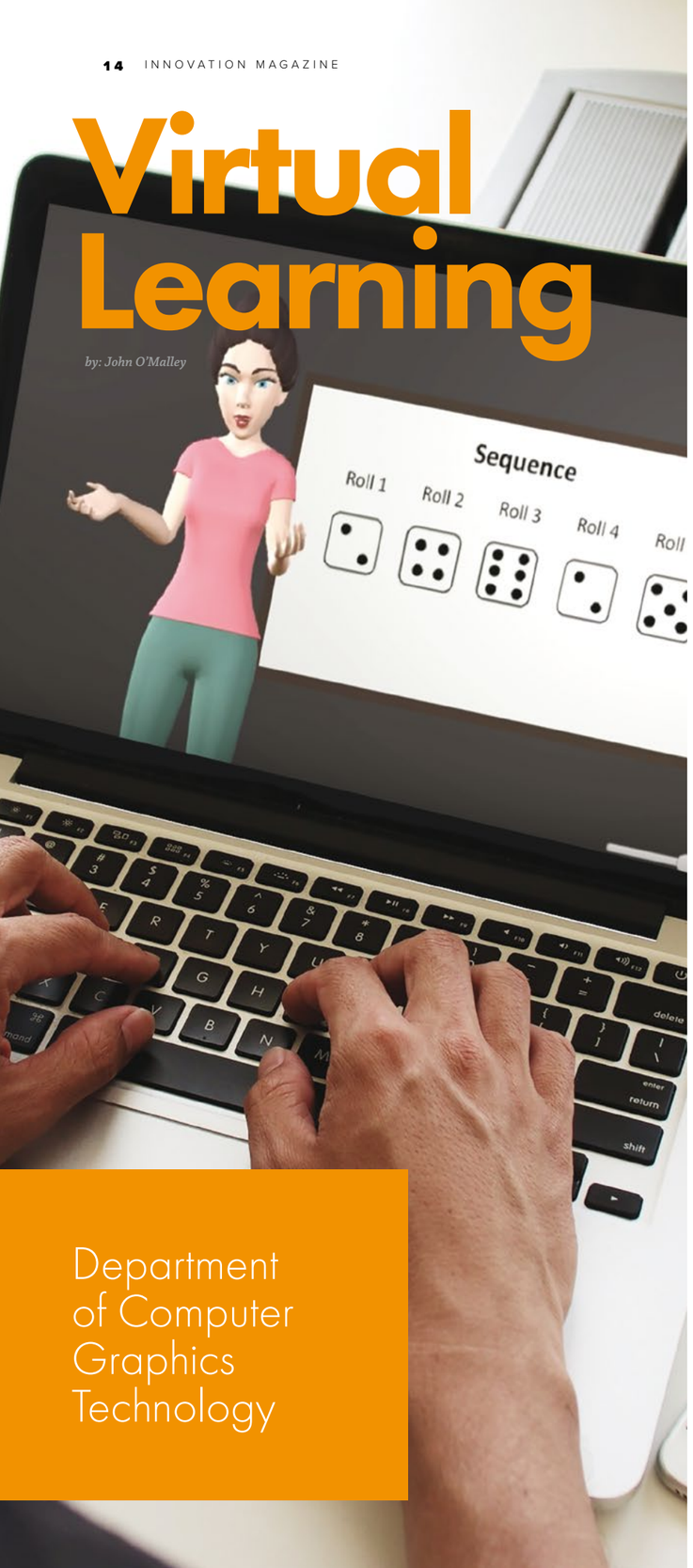
- Access the latest technical documents, including operating manuals and navigational charts.
- Generate multimedia safety reports on the spot.
- Leverage immersive virtual and augmented reality tools.
- Develop their own apps and customize their learning experience.
- Connect with instructors via video.
- Receive documentation required for classroom grading and professional certification.

New Piper Archer fleet

A new fleet of Piper Archers will continue student access to modern, reputable aircraft

A brand new fleet of Piper Archer aircraft, arriving in the spring of 2020, will further enhance SATT's learning environment. The four-place, piston, single-engine Piper flight trainers will enable students to hone their instrument and cross-country flying skills. The exceptional and diversified SATT fleet already includes Piper Arrows, Piper Seminoles and an Embraer Phenom 100 Corporate Light Jet.

The forward-thinking actions taken by faculty and staff of SATT continue to prove why their partnerships and resources place Purdue's aviation program – and its graduates – in a league of its own.



Virtual Learning

by: John O'Malley

Department of Computer Graphics Technology

CGT professors aim to create lifelike online teachers capable of emotion and emotional intelligence

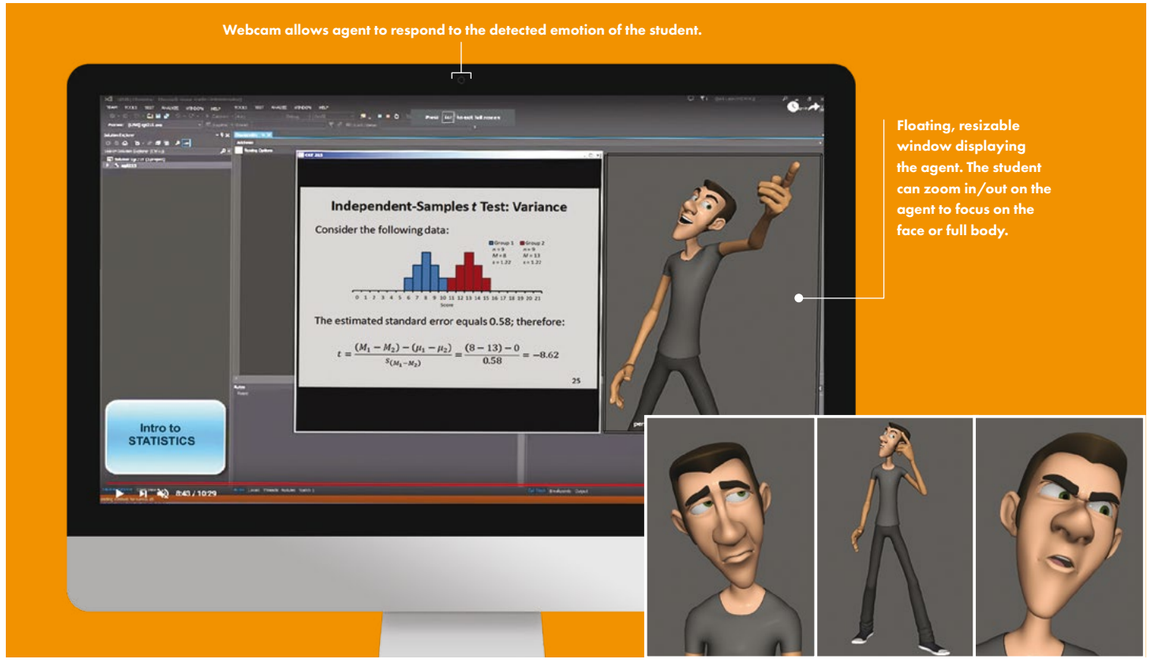
How can students learn when there aren't enough teachers, especially in remote locations? Textbooks provide a good start – but it's easier to learn with the help of a human instructor. When none are available, can computers step in?

Lifelike computer-generated instructors that speak fluently, employ human-like gestures, understand and correctly interpret human speech, and recognize and believably emulate human emotion have been commonplace in science fiction for decades. Two Purdue Polytechnic professors, together with collaborators at the University of California, Santa Barbara, are taking steps toward making lifelike affective educational avatars a reality.

Nicoletta Adamo, professor of computer graphics technology, and Bedrich Benes, George McNelly professor of technology and professor of computer science, are researching the ways in which emotional computer-animated instructors, or agents, affect student learning. Their research also aims to guide the design of affective (that is, emotion-generating) on-screen agents that work well for different types of learners.

Decades of animated research

Adamo has been working on character animation for more than 20 years. She has conducted extensive research on teaching avatars, including the use of gesturing avatars to teach math and science via sign language to children who are deaf. Her research also led to the creation of software that enables educators who don't have programming or animation expertise to generate computer-animated instructors from a script. Adamo's research showed



that young learners, especially those not proficient in reading or fluent in English, found learning easier when the material is presented through speech with context-appropriate gestures.

"Speech analysis research provides some of the rules for how to make a teaching avatar talk and produce certain language-specific gestures," she said. "My research focused on charisma and personality gestures and how to generate them automatically based on the script."

For their current research, "Multimodal Affective Pedagogical Agents for Different Types of Learners," Adamo and Benes are collaborating with Richard E. Mayer, distinguished professor of psychology at the University of California, Santa Barbara. The National Science Foundation-sponsored project represents an integration of several areas of research:

» Computer graphics research on lifelike and believable representation of emotion in embodied agents

» Advanced methods and techniques from artificial intelligence and computer vision for real-time recognition of human emotions

» Cognitive psychology research on how people learn from affective on-screen agents

» Efficacy of affective agents for improving student learning of STEM (science, technology, engineering and math) concepts

Effective affective agents

The team's new research goes beyond Adamo's 2017 project, which focused on automating the creation of effective animated gestures for an avatar programmed to teach math concepts.

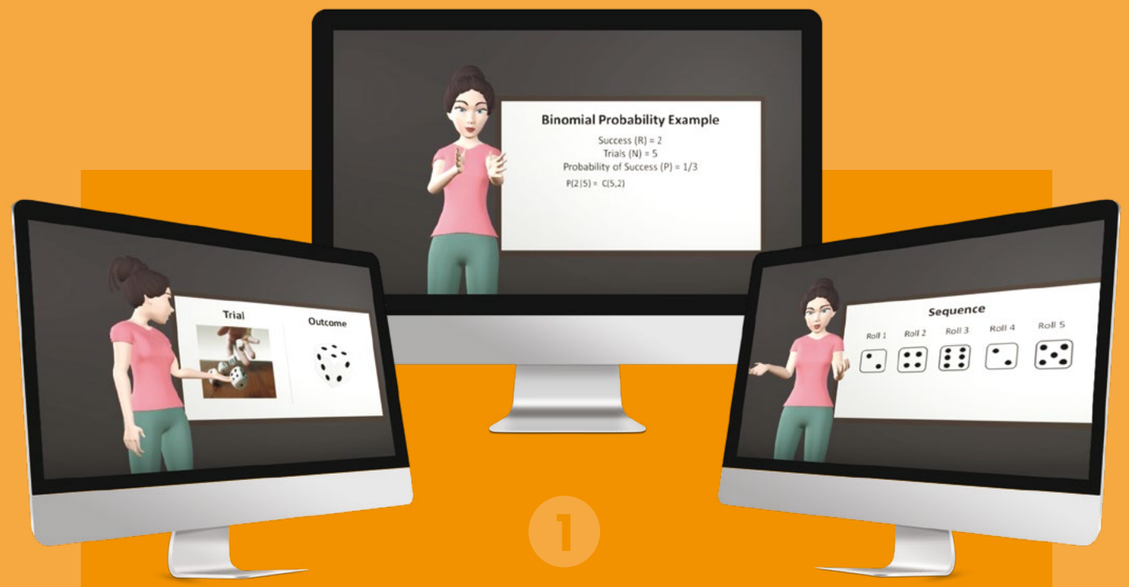
"We're taking this a step forward," said Adamo. "We are developing animated avatars that not only teach using speech and gestures but also show emotions and emotional intelligence. They're called 'affective agents.'"

They're studying whether the emotional style of the agent affects student learning. If the agent presents a lesson with excitement, for example, do students remain engaged? If the avatar is dull, do learners get bored?

To gather research data during experiments, the team is working to automate the animation of avatars, making it easier to display different emotional styles.

"We've done a little bit so far," Adamo said. "There's a script for what the avatar should say in the lecture. We want to develop automation to add emotion to the avatar and give it the ability to display the emotional state through facial expressions and body language."

The style of those gestures is also important, said Benes. "For example, hand gestures should be faster when showing excitement, and facial expressions should change. We want to encode all this to automatically generate the animation."



Frames extracted from the animation featuring pedagogical agent "Luna" giving a lecture on binomial probability and displaying a positive-active emotional design (open/forward body poses)

Frames extracted from the animation featuring pedagogical agent "Luna" giving a lecture on binomial probability and displaying a negative-passive emotional design (closed/backward body poses)

Adapting to real emotion

Another goal, added Benes, is to determine whether the system can recognize the students' emotions and react to them. To gauge the reaction of test subjects during experiments, Mayer produced two videos of affective agents. In one, the agent is excited. In the other, the agent is dull.

"If you are excited as a learner, what is the best response of the agent to keep you engaged?" asked Benes. "Does the agent need to remain as excited, or temper its emotions?"

On the other hand, if students become inattentive, the agent needs to choose a course of action. The agent might need to shout, attempt to be entertaining, or perhaps even leave the room for a time. It's challenging to determine which action would be most effective toward learning.

"This has been studied with real teachers," Adamo said. "It's an interesting question: How do we transfer that to avatars?"

"It needs to be a bidirectional way of communication," Benes said. "We're trying to break the paradigm of one-way interaction. The agent needs to adapt to the learner."

Benes said they've developed their own system that is capable of detecting emotions in real-time for the research, with custom software and a webcam.

"It's based on a large dataset with a deep neural network that has been trained on existing humans' emotions, and it can feed data back into the system," he said. "It's still under development, but we can recognize seven expressions so far, with differing qualities. The systems are dependent on the training data. It's not easy to get accurate data on different human emotions. Neutral is actually the hardest to detect."

The researchers make the assumption that their subjects won't have a neutral face for long, Adamo said. The system is being designed to recognize emotions in two dimensions, she said: valence, which is negative to positive, and arousal, which is inactive to active.

"The webcam sees the students' facial expressions and the software tries to recognize their emotions," said Benes. "Our new system reads facial expressions like confusion, boredom, happiness or excitement" and then reacts accordingly. If the system detects confusion, for example, the agent could slow its pace or offer a more detailed explanation to the learner.

Better animation = better teachers

When considering the emotional representation abilities of affective pedagogical agents, Adamo, Benes and Mayer note that the animation quality of existing agents is low. Highly engaging animated characters that display convincing personality and emotions are seen frequently in entertainment and games, but they haven't yet had a substantial impact in education.

The team expects to lean on Adamo's long experience in character animation to improve the design and quality of existing affective agents. They aim to create algorithms that guide the animation of emotion, generating lifelike gestures, speech, body movements and facial expressions from both data-driven and synthesis approaches. An existing database of specific gestures developed during earlier research will be expanded.

They also hope that the project will lead to improvements in the basic visual design of the avatars. What designs maximize learning? Certain visual features could have effects on learning. Agents could be designed to look realistic or like cartoons, for example. Adamo noted that they will also be watching for potential correlation between the agents' features and student characteristics such as age, ethnicity and level of expertise. In earlier research, she noticed that young learners preferred an avatar that appeared as a casually dressed teenager over another that appeared as a professionally dressed young adult.

The emotional state of the learner and the emotional state displayed by the instructor can also have substantial effects on student learning, according to research. Adamo, Benes and Mayer are examining the instructional effectiveness of affective agents that respond appropriately to learners' emotions, seeking to build lifelike, multimodal expressive agents with adaptive emotional behaviors.

The research team includes graduate students Justin Cheng and Xingyu Lei, who are working on animation and motion capture. Wenbin Zhou developed the emotion recognition system. Undergraduates Kiana Bowen and Hanna Sherwood worked on character design.

"The ultimate goal is to enable anybody who is not an animator to generate these affective agents and embed them in an online lecture," said Adamo. "That's the goal. We're not there yet."

But the team does not intend their research to lead to human teachers being replaced.

"We want to help people who might not have access to high quality education," said Adamo, "but face-to-face interaction with real people remains very important."

Idea Challenge

by: Brigid O'Brien

Department of Computer and Information Technology

Lafayette Mayor Tony Roswarski mentors a team of students with the goal of fighting human trafficking.

Student teams devise high-tech methods to fight human trafficking

This past February – in conjunction with Purdue's 150 Years of Giant Leaps in Health, Longevity and Quality of Life – the Purdue Polytechnic Institute hosted a design innovation event to fight the modern-day kidnapping and slavery epidemic known as "human trafficking."

The practice of human trafficking is "the acquisition of people by improper means, such as force, fraud or deception, with the aim of exploiting them." While human trafficking is a global phenomenon, it has a local impact because of our community's proximity to Interstate 65. The National Human Trafficking Hotline consistently reports year-over-year increases in calls related to human trafficking in Indiana, with Interstate 65 – the primary route for traveling Purdue students – reportedly considered a "trafficking superhighway."

The event

"Fight Human Trafficking in the Americas" was the brainchild of Kathryn Seigfried-Spellar and Chad Laux, associate professors of computer and information technology. The event brought together approximately 200 Purdue students and an additional 200 members of the public. The day's events included a presentation from a trafficking survivor and a panel discussion that featured local community leaders.

The challenge

After being briefed of the prevalence of human trafficking, students broke into teams and, with assistance from local professionals serving as mentors, spent the ensuing 17 hours in all-night brainstorming sessions. The multidisciplinary teams combined their own backgrounds and unique perspectives to devise workable solutions. As an added incentive, $6,500 in prize money would be awarded to the two teams with the most promising ideas.

The community rallied around the event

Seigfried-Spellar and Laux were thrilled with the student participation and community response.

"Human trafficking is not just someone else's problem," said Seigfried-Spellar. "It's happening right here in the Greater Lafayette community because I-65 runs directly through our community. If we are going to mitigate human trafficking, we must come together as a community."

Laux appreciated the event's strategy of incorporating students of different majors and community members from various professions.

"The issue of human trafficking is one that requires a wide community of people, from a variety of backgrounds, to take a stake in the problem," said Laux. "The event was very interactive, thanks to that broad range of students and participants."

"A number of community leaders participated as student team members," added Seigfried-Spellar, "including the mayors of West Lafayette and Lafayette, and the three chiefs of police (of the West Lafayette Police Department, Lafayette Police Department and Purdue University). A number of businesses and advocacy groups, including Cook Medical, Unity Healthcare, the Heartford House, and the YWCA also were in attendance. The community rallied around this event."

Each team's "all-nighter" problem-solving session included the production of a video presentation of their ideas. The videos were viewed by Seigfried-Spellar, Laux, local community representatives and subject matter experts in order for them to decide the winners of the idea competition.

Winning solutions

The two teams that presented the ideas with the most potential to fight human trafficking were honored at an awards ceremony in March. Due to the proprietary nature of their solutions and the desire to keep traffickers unaware of tactics to disrupt their illicit activities, details of the teams' ideas will not be made public. However, it can be mentioned that both solutions incorporate leading-edge video technologies that identify conditions and circumstances that the human eye misses.

The first-place team consisted of Forrest Brown, junior in applied statistics; Calvin Robinson, senior in general management; Jason Marron, junior in finance; Jackson Atassi, junior in computer and information technology; Logan Bedford, junior in chemistry; Cooper Fetters, junior in chemical engineering; and Gavin Burn, junior in chemical engineering. The team members split $4,000 in prize money. Their team mentor was Dawn Laux, associate department head and clinical associate professor in the Department of Computer and Information Technology.

Jon Gaide, graduate student in biomedical engineering; Mickey Smith, senior in biomedical engineering; Derek Paz, sophomore in exploratory studies; and Adam Killeen, senior in biomedical engineering, comprised the second-place team and split $1,500 for their idea. Their team mentor was John Cox, chief, Purdue University Police Department.

> "The event was very interactive, thanks to that broad range of students and participants."
>
> **Chad Laux,** associate professor of computer and information technology

first-place team

second-place team

Cybersecurity Scorecard

by: John O'Malley

CIT graduate researchers develop cybersecurity scorecard for Indiana government, businesses

Computer viruses, online phishing scams, spyware, ransomware and other technological miscreants continue to plague society and appear to be increasing. For many government and private organizations, especially those small in size, it is challenging to assess their readiness to deal with these threats to their critical cyberinfrastructure. Most organizations have interdependent computers, networks, devices, and/or industrial control systems – and daily tasks to accomplish through the use of those systems. But many organizations lack the on-staff cybersecurity experts needed to confidently self-assess the state of their information technology infrastructure.

Thanks to Purdue Polytechnic's Jim Lerums and Katherine Reichart, a solution is available for business managers, salespersons, physicians, lawyers, directors and other non-cybersecurity experts who run agencies, offices and businesses. Lerums and Reichart developed the Indiana Cybersecurity Scorecard, and you don't need a degree in computer and information technology to use it.

Lerums, who graduated with a PhD in information security, and Reichart, who graduated with a master's degree in computer and information technology, studied under Eric Dietz, director of Purdue Homeland Security Institute and professor of computer and information technology.

The need for cybersecurity awareness

In recent years, the United States was affected by more targeted cyberattacks than any other country, according to Symantec's 2018 Internet Security Threat Report. In 2018, the Ponemon Institute reported that the average cost of each data breach was $7.91 million.

Attacks affect both public and private sectors. Industry has some of the best tools for cybersecurity, but Lerums noted it's a government function to pursue and punish cybercriminals. That's why state governors nationwide have seen the need for public-private partnerships.

"Critical infrastructure sectors are everywhere," said Lerums. "Think about healthcare, companies that handle money, and power and water utilities. If any became unavailable due to an attack, it would cause major problems – possibly cascading problems."

Businesses with industrial control systems can be affected physically as well as digitally. A cyber disruption of an industrial control could result in loss of resources, damage to equipment, and/or harm to human health.

"Factories often have machinery with controls designed by my parents' generation," Lerums said. "Automated systems with isolated relays and circuits were designed when the Internet didn't exist and were made to last for twenty years. As companies started connecting those control systems to the Internet, they became subject to the same attacks as modern computers."

> "Factories often have machinery with controls designed by my parents' generation. As companies connect those systems to the Internet, **they become subject to the same attacks as modern computers."**
>
> **Jim Lerums,** PhD information security '19

Project origins

In April 2016, after a government agency in another state was hit by a ransomware attack, Indiana formed the Executive Council on Cybersecurity (IECC). Governor Eric Holcomb has guided the IECC to be a cross-sector body of subject-matter experts, including government officials and private-sector, military, research and academic stakeholders, who protect Indiana government and businesses. Security and information technology professionals and officers from Purdue University, Indiana University, the Federal Bureau of Investigation and the Department of Homeland Security were among those who participated.

The Council's goal: Form an understanding of Indiana's cyber risk profile, identify priorities, establish a strategic framework of the state's cybersecurity initiatives, and leverage the body of talent to stay on the forefront of the cyber risk environment.

Chetrice Mosley, cybersecurity program director at the Indiana Office of Technology and Indiana Department of Homeland Security, brought one of the Council's initiatives, the development of a cybersecurity scorecard, to Purdue's Eric Dietz, who asked Lerums to work on the project.

They started by looking around to see if assessment tools existed that could meet their needs.

"It was like 'Alice in Wonderland' at the beginning of our research," said Lerums. "If you don't know where you are going, any scorecard will do, and any cybersecurity risk measurement techniques will do."

They discovered several existing scorecards, based on different standards and different assessment tools. For example, the National Institute of Standards and Technology has a comprehensive framework for assessing cybersecurity. But it's difficult for small companies with limited expertise or funding to complete the assessment.

They also didn't find any comparisons of existing tools that measured their effectiveness. Information that might accelerate improvements was difficult to locate.

"We wondered, what can Purdue bring to the state of Indiana?" said Lerums. "We realized we had a lot to offer."

Purdue's applicable strengths, Lerums said, were the following:

» The ability to automate the collection and analysis of data about cybersecurity threats and breaches

» Anonymity for those who want to keep details private about their organizations' breaches

» The ability to update the scorecard over time to address new objectives and changes in threats

» Academic vigor and cybersecurity expertise needed to develop a scorecard

Dietz and Lerums partnered with state officials to create a workable cybersecurity scorecard for Indiana, and Reichart joined the project. They teleconferenced with Mosley every few weeks to set and refine their goals.

Objectives

The team targeted several objectives for the Indiana Cybersecurity Scorecard. First, the tool should be usable by people who are not cybersecurity experts, enabling them to confidently learn, self-assess, and initiate cybersecurity improvement.

"Using the scorecard is voluntary, so it has to be non-threatening, understandable and educational to managers of organizations of all sizes, especially if they don't have in-house expertise," Lerums said. "The scorecard has to be accessible to everyone, including town government officials, non-profits, mechanics, dry-cleaners, and medical and construction workers." When users identify a potential cybersecurity issue, Lerums said the scorecard was designed to enable self-help and to encourage them to contact professionals or government agencies for assistance when required.

The tool should provide a means of comparing preparedness across public and private sectors of any size within the state who are responsible for critical infrastructure and key resources.

Finally, the scorecard should utilize standards and measurements that support "apples to apples" comparisons between public and private entities. It should also support the state's participation in external cybersecurity assessments such as the Nationwide Cybersecurity Review, which is reported every other year to the U.S. Congress.

"Through quantifiable measures, the scorecard can be used to compare results before and after cybersecurity initiatives are completed," said Lerums. "The scorecard can be used to quantify the success of an organization's initiatives."

Development

Lerums, Reichart and the team reviewed a variety of existing evaluation methods to identify best practices, including the Baldridge Cybersecurity Excellence Builder, the State of Michigan's CySAFE IT Security Assessment Tool, the National Cybersecurity and Communication Integration Center and others. Each was reviewed to determine if standards used were already required of Indiana organizations.

"Voluntary completion of questions on the Indiana Cybersecurity Scorecard is easier if an organization has already answered similar questions during other compliance checks," said Lerums.

They selected the National Institute of Standards and Technology's Cybersecurity Framework Core as a baseline for developing questions for the Indiana Cybersecurity Scorecard. The Core provides a set of cybersecurity activities, desired outcomes and applicable references that are common across critical infrastructure and key resource sectors, Lerums said. The Core organizes industry standards, guidelines and practices, and it helps facilitate communication about cybersecurity within organizations.

Lerums and Reichart refined the Framework Core's subcategories, selecting a level of detail to use in the Indiana scorecard that makes it accessible to organizations of every size.

"If each subcategory was addressed in our scorecard, it would have 98 questions," said Reichart. "Several questions would be challenging to answer, if not impossible, for the operator of a small garage, nursery, law office or other non-information-technology organization."

Areas of focus from the U.S. Department of Defense's Cybersecurity Implementation Plan were used to refine the scorecard. The four focus areas are:

» Ensuring strong authentication: How do users log in?

» Hardening devices: Are devices and systems properly configured and updated?

» Reducing the attack surface: How many devices need to be connected to the Internet, and are those devices properly configured?

» Detecting and responding to potential intrusions: Can cyber-defenders do their jobs?

Lerums noted the difficulty organizations sometimes have is in hardening their devices. Some systems are old and obsolete, unable to be upgraded to a secure operating system, but remain in use simply because modernizing them is cost-prohibitive.

Scoring the scorecard

After refining the various categories and focus areas, Lerums and Reichart produced a pilot version of the Indiana Cybersecurity Scorecard. It contained 22 questions that were written with minimal jargon to be understandable by a non-technical office manager and short enough to be completable by small Indiana organizations.

Members of the Indiana Executive Council on Cybersecurity each invited one large, two medium, and three small organizations from across eleven critical infrastructure and key resource sectors, for a total of sixty-six organizations, to test the new assessment tool.

"We designed anonymity into the data collection and analysis process," said Lerums. "We thought that would increase candor in the results and address concerns participants might have had about revealing their cybersecurity weaknesses."

Useable data from 56 scorecards (an 85% participation rate) during the pilot phase were received from large, medium and small organizations, both public and private, from all the state's business, critical infrastructure and key resource sectors. The data immediately identified trends that could help identify where organizations could focus resources for cybersecurity improvements. For example, many organizations noted a low level of confidence in the security of "smart" devices like security cameras, thermostats and alarm systems.

Testing, correcting and updating

The Indiana Cybersecurity Scorecard is available for public use via the state of Indiana's website: *https://www.in.gov/cybersecurity/3837.htm*

Lerums and Reichart said that the scorecard's first version will help increase cybersecurity awareness, identify cybersecurity differences between sectors and sizes of organizations, and identify where to focus investments in cybersecurity.

"We hope that the scorecard will help nudge a shift from reactive to proactive cybersecurity," Reichart said. "We have the opportunity to infer how large and small business will respond to cyber threats. The results will influence where policy will head and how we will spend money."

The tool is also designed for flexibility. As organizations throughout the state increase their cybersecurity competence, the scorecard's questions, data collection and analysis can be updated to remain relevant as new cyber threats emerge.

Lerums enjoyed the challenge of developing the tool. "It was a real-time, real-world adventure," he said. "I'm glad it went into use right away."

School of Construction Management Technology

Indiana Building Academy

by: Brigid O'Brien

The Purdue Polytechnic Institute's School of Construction Management Technology (CMT) held their inaugural Indiana Building Academy, a one-day conference for building industry professionals in the public, private and nonprofit sectors, in November of 2018. Indiana State Building Commissioner Craig E. Burgess and Indiana State Fire Marshal James Greeson were keynote speakers. Topics ran the gamut of industry needs and included an introduction to the state's building plan review process, an exploration of community-based design for nonprofits and information regarding the Americans with Disabilities Act, including ensuring buildings are ADA-compliant. The event was so successful, a follow-up conference was organized for November 12, 2019.

"Our goal is not to repeat this event but to continue to grow it, with subject matter experts," said Burgess.

Bradley Benhart, associate professor of practice in CMT, explained how the inspiration for the conference came from the desire to increase communication and share best practices with professionals throughout Indiana's construction industry.

"The building commissioner approached us as partners to help support his office on a variety of fronts. The Building Academy was born from that partnership," said Benhart. "It was great, from an education standpoint."

The conference provided opportunities for CMT students to meet construction industry professionals and engage in real-world business discussions.

Conner Batchelder (BS construction management technology '19) attended the 2018 Building Academy. He graduated in May and began working for JE Dunn Construction in July. Batchelder is a field engineer, working on JE Dunn's parking addition and consolidated rental car facility project at the Portland International Airport, a $300 million project scheduled for completion in the spring of 2021. In his new, employed role, Batchelder sees the Building Academy as a continuing networking opportunity for industry professionals from throughout Indiana.

"The Building Academy allows professionals to connect with the younger generation entering the workforce, get a taste of Purdue's CMT program and make valuable industry connections themselves," Batchelder said.

Batchelder also acknowledges the Building Academy event for helping him transition from a student to a working professional.

"The Building Academy certainly helped me as I was stepping out of my role as a student and into my new role as a member of a diverse project team," said Batchelder. "The event gives students the chance to relate with, learn from and collaborate with different industry professionals of all ages. My takeaways from attending the academy have certainly been applied in my new position, and I'm thankful to have had the opportunity to attend."

Željko Torbica, department head and professor of construction management technology

"Over the years, I have followed **Purdue's accomplishments and innovation with great interest.**"

Welcome Željko Torbica

by: Brigid O'Brien

In July, the Purdue Polytechnic Institute welcomed Željko Torbica to the position of professor and head of the School of Construction Management Technology. Torbica, whose name is pronounced ZHAYL-ko TOR-bitza, goes by his initial, "Z," from students and colleagues alike.

Torbica received his bachelor's degree from the University of Belgrade in Serbia. His postgraduate study in quantity surveying and project management was completed at B. Jupp & Partners in London, England. He received his doctorate from the Rinker School of Construction Management at the University of Florida.

Torbica came to Purdue with more than 30 years of professional experience in engineering, construction, real estate development, leadership and strategic planning. His background also includes academic positions at West Virginia University Institute of Technology, Drexel University, Roger Williams University, Florida International University, Minnesota State University and the University of Florida.

He is a fellow of the American Society for Quality and a certified general contractor in the state of Florida. He has completed leadership programs at Columbia University and Harvard University and holds certifications as a project management professional and quality engineer.

Torbica was excited to add Purdue University to his global resume.

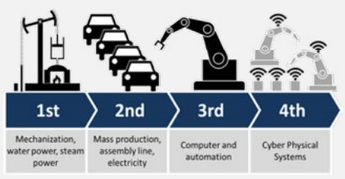
"Over the years, I have followed Purdue's accomplishments and innovation with great interest," said Torbica. "The unique approach to education in Purdue Polytechnic's School of Construction Management Technology is spectacular, and we have phenomenal opportunities on the horizon when we move into our new lab facilities as part of the Gateway building project. I couldn't ask for more!"

Intelligent Learning Factory

by: Melissa Templeton

School of Engineering Technology

The Polytechnic's Intelligent Learning Factory, slated to debut as part of the Gateway Complex, will focus on these nine core capabilities of Industry 4.0.



Industry 4.0, a key component of the Fourth Industrial Revolution, unites artificial intelligence, the Industrial Internet of Things, big data and more in a new, smart manufacturing environment. Graduates will need to solve problems and make decisions based on data from integrated, cyber-physical systems.

Intelligent Learning Factory prepares Polytechnic graduates for Industry 4.0

Artificial intelligence (AI), robotics, cyber-physical systems, the Internet of Things (IoT), cloud computing and other advanced technologies in automation and data exchange are improving manufacturing at a rapid pace. When referring to these next-generation technologies in this, our present-day Fourth Industrial Revolution, they are collectively known as "Industry 4.0," and industries of all sorts need qualified experts who are equipped to make decisions and solve problems based on the data from these integrated systems.

Ragu Athinarayanan, professor of engineering technology, predicts that AI and machine learning will be predominant factors in manufacturing facilities within the next five to 10 years.

"Employers in the manufacturing world need a new type of graduate to help them incorporate and benefit from these technologies," said Athinarayanan.

Under construction: the nation's first Learning Factory

Athinarayanan and Grant Richards, assistant professor of practice in the School of Engineering Technology, have the vision to prepare Purdue Polytechnic graduates to excel in this new cyber-physical manufacturing environment: an "Intelligent Learning Factory." The creation of a formal learning factory on Purdue University's West Lafayette campus provides another historic first – the first institution in the United States invited to join the International Association of Learning Factories (IALF).

The IALF is a collection of academic institutions across the globe that operate learning factories for achieving excellence in the teaching of manufacturing engineering. The Polytechnic's membership in IALF offers the opportunity to create unique partnerships with other member institutions in the network, providing a natural pathway to develop new international educational, research and experiential opportunities for Polytechnic students.

Because Purdue is the only member of the IALF to focus its facilities on undergraduate education, Richards believes the Intelligent Learning Factory provides a globally unique opportunity for undergraduate Polytechnic students to experience a fully functioning learning factory environment.

"The manufacturing world knows that these new capabilities exist and that Industry 4.0 will give them a significant competitive advantage, but they need people to help facilitate the adoption of these new technologies," said Richards. "Our approach will allow the Polytechnic to develop a pipeline of well-trained graduates with the knowledge and skills needed to understand and apply data and intelligence to manufacturing processes."

Creating Purdue Polytechnic's Intelligent Learning Factory

The Intelligent Learning Factory will be an at-scale, fully functional, cyber-physical production system designed to foster collaboration between multiple disciplines and prepare students to excel in a next-generation manufacturing environment. Students will benefit from real, industry-scale experiences centered around the production of devices and services with a high appeal to a collegiate audience, starting with the design and manufacture of smart scooters and smart skateboards.

"Polytechnic students working toward a Bachelor of Science degree in the School of Engineering Technology will experience technologies in context and gain a holistic perspective of the interdependent structures of cyber-physical systems – all while developing skills and aptitude relevant for functioning in an Industry 4.0 manufacturing environment," said Athinarayanan. "In conjunction with production technologies, students also will experience hands-on critical management scenarios relating to raw materials and supply chain, component creation, inventory flow, assembly, packaging and more."

Athinarayanan and Grant assert that graduates of the Intelligent Manufacturing program will understand the links between physical manufacturing systems with the virtual world of data and information processing, with strong skills in the application of data-centric tools and technologies to harness the power of data for solving manufacturing problems. To that end, featured core technologies in the Learning Factory include IoT, the Industrial Internet Architecture, cloud computing, AI/machine learning, augmented reality, simulation, digital twin, cybersecurity, additive manufacturing, and collaborative and autonomous robots.

"All of this will be delivered in a new curriculm that addresses the integration of physical operational technologies with information technologies and inspires innovation in manufacturing processing and production through the use of data," Athinarayanan said.

An industry advisory board is already in place to guide the development of a new Intelligent Manufacturing-focused bachelor's degree curriculum and the design of the new Intelligent Learning Factory, which is slated for 4,700 square feet of space in the new Gateway Complex.

"Employers in the manufacturing world need a new type of graduate to help them incorporate and benefit from these new technologies," said Athinarayanan. "We'll make systems and processes much more efficient as we reduce scrap, increase quality, and reduce production time. All of these things ultimately will make U.S. manufacturing more competitive and more successful on an ongoing basis – and we will make sure that our graduates are ready to lead the way."

Learn more about the Polytechnic's Intelligent Manufacturing Education Initiative at *polytechnic.purdue.edu/intelligent-manufacturing*

Ken Burbank

McGraw Award

by: Brigid O'Brien

Burbank honored with McGraw Award by the American Society for Engineering Education

Ken Burbank, head of the School of Engineering Technology, was named the recipient of the James H. McGraw Award by the American Society for Engineering Education (ASEE) in 2019. The award recognizes outstanding service in engineering technology education.

Before arriving to Purdue in 2011, Burbank earned his bachelor's, master's and doctoral degrees in electrical engineering from Brown University, where his research centered on the optical and electrical properties of compound semiconductors. He is the past chair of the Engineering Technology Council of ASEE and a senior member of the Institute of Electrical and Electronics Engineers.

Burbank shares the praise effortlessly. Upon the announcement of his McGraw Award, Burbank acknowledged the University by saying, "Purdue is nationally recognized for its strong engineering technology programs, and the applied nature of these academic programs is a great asset to Indiana and the nation." And in a 2013 interview, Burbank lauded students pursuing engineering technology degrees and professionals already in the field by saying, "Those in technology tend to be self-directed learners who can solve open-ended problems by using off-the-shelf technology."

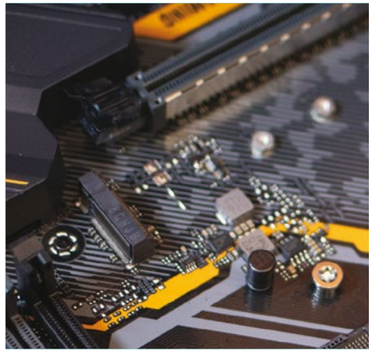
The James H. McGraw Award was established in 1950 by the McGraw-Hill Book Company, and is co-sponsored by McGraw-Hill Higher Education, the Engineering Technology Council and the Engineering Technology Division of ASEE.

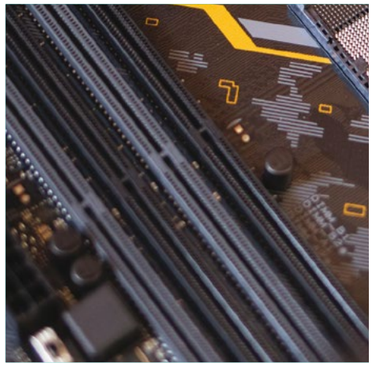
Exciting New Majors

In fall 2019, the School of Engineering Technology introduced two new majors that are now available as part of the electrical engineering technology program.

Energy Engineering Technology

Polytechnic students in the major learn about energy use and the engineering principles necessary to make systems – from renewable energy to industry-scale HVAC systems, and from creation to end-user – work smoothly and efficiently. The Applied Energy Lab provides these students with hands-on experience with solar energy and the energy use of high-performance buildings.





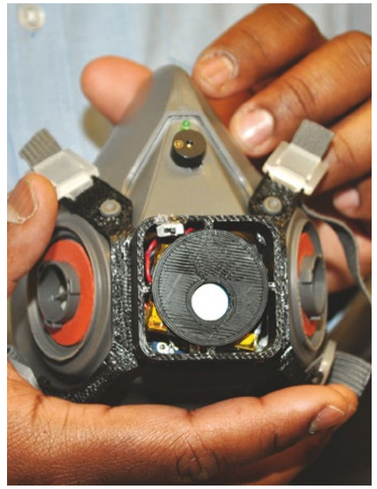
Computer Engineering Technology

Polytechnic students in the computer engineering technology major gain a broad understanding of how microcomputer systems can be designed to sense the environment and control the systems that contain them. These students work daily with the tools familiar to all engineering professionals and will complete an industry-sponsored project that puts their knowledge to work on a real-world problem. In short, graduates of this program are professionals who understand the computer and its surrounding electronic systems.

Department of Technology Leadership & Innovation

Design & Innovation Challenge

by: Brigid O'Brien



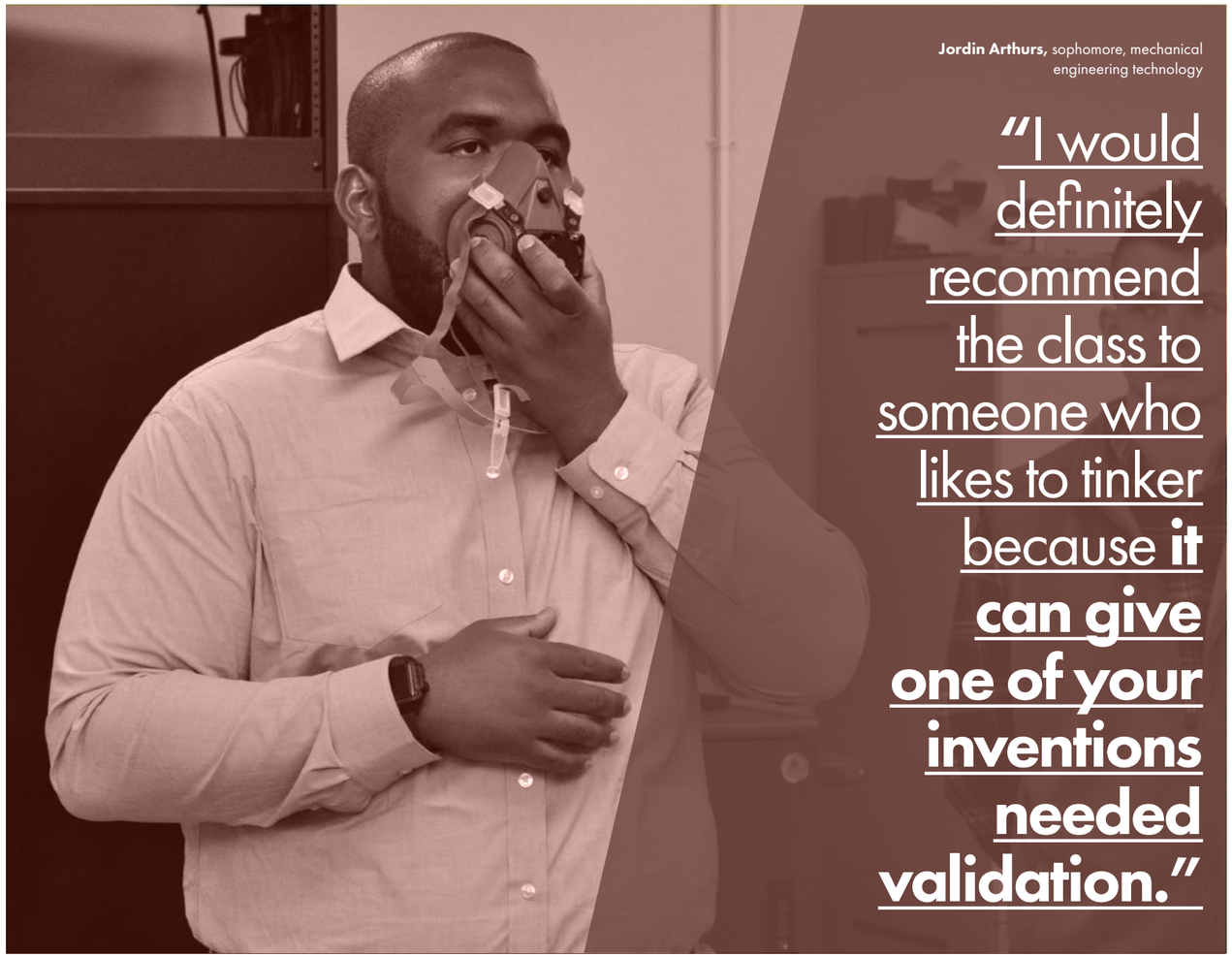
Student teams share $10,000 in prize money and scholarship funds

The Design and Innovation Challenge returned to the lobby of Knoy Hall during the spring semester. The competition is the brainchild of the Department of Technology Leadership & Innovation (TLI) and was sponsored by Autodesk, manufacturers of 3D design and engineering software.

Student teams competed for a share of $10,000 in prize money and an additional $10,000 in scholarships to enroll in the Polytechnic Design and Innovation minor. Votes from audience members decided the winner of the Crowd Favorite award, worth an additional $500 cash to the winning team.

Design thinking in technology

"Students in TECH 12000 addressed open-ended, local problems that have global significance," said Nathan Mentzer, associate professor of engineering/technology teacher education. "They then devised solutions for those challenges by applying the principles of human-centered design, which incorporates the users' perspectives in the problem-solving process."



Jordin Arthurs, sophomore, mechanical engineering technology

"I would definitely recommend the class to someone who likes to tinker because **it can give one of your inventions needed validation."**

Teams were made up of 4-5 students from various majors and backgrounds. While the challenges hone the students' problem-solving skills, the team dynamics allow students to polish their interpersonal communications skills. And their final presentations to the judges can reveal which teams practiced their presentation skills.

The TECH 12000 students presented their technological ideas and design rationales to a panel of judges made up of Polytechnic faculty Shawn Farrington, continuing term lecturer; Dawn Laux, clinical associate professor and associate department head in the Department of Computer and Information Technology; Greg Strimel, assistant professor of engineering/technology teacher education; Jared Vanscoder, Autodesk program manager; and Tim Peoples, managing director of Purdue Foundry. The judges deliberated over the five presentations for nearly an hour.

"The competition was very intense," said Strimel.

The judges reviewed each team's design process to ensure the students had incorporated all the required steps. They took special note of each product's ensuing design iterations that resulted from consumer testing and feedback. One group had taken a prototype of their product to Wilmeth Active Learning Center (WALC) and interviewed passers-by who interacted with the product.

"I loved seeing the video showing people at WALC testing their product out," said Laux.

First place winner: 3M RED (respiratory emergency defense) series

Jordin Arthurs, sophomore in mechanical engineering technology, and his team members – Jacob Mellady, sophomore in the College of Health and Human Sciences; Joel Quasebarth, first-year student in construction management technology; and Mason Wilcox, junior in aeronautic engineering technology – chose to improve a design of respiratory safety mask.

During their presentation, they noted that existing respiratory masks offer a false sense of security because "current respiratory masks do not have an internal warning system, which leaves users vulnerable to

diseases, cancers and death." And by the time a body's "internal warning system" reacts to dangerous fumes with symptoms, such as dizziness or shortness of breath, the ensuing loss of consciousness can have deadly consequences.

"People working with harmful chemicals need a way of being warned of toxic gases," said Arthurs.

The team devised a working prototype of a respiratory mask, which they modified with a personalized monitoring system that calculates the concentration of gases in the mask. Once the mask is calibrated to its user's unique natural carbon dioxide levels, sensors in the mask provide an early warning of any toxic gases that might be entering the respirator.

Arthurs spoke highly of the competition.

"I learned how to sell and market a product so it can appeal to the intended user," Arthurs said. "I would definitely recommend the class to someone who likes to tinker because it can give one of your inventions needed validation."

Designing technology for people

Like their counterparts in TECH 12000, students in TECH 22000 (Designing Technology For People) defined an open-ended problem, but their process utilized ethnographic techniques, such as observing people interacting with the technology, and then used those observations to create design solutions.

"By spending time observing, asking questions and listening to end users, TECH 220 students learn how to represent those constituents' views and recommend innovative design solutions," said Todd Kelley, associate professor of industrial technology.

First place winner: Musical Shares

The winning team from TECH 22000 had been assigned to identify a problem that people were having and design a product to help alleviate that problem. The team's open-ended assigned topic was simply "music."

Through surveys that they administered to the public, the team learned that people aren't necessarily looking for new music technology, such as headphones.

"We learned they're looking for experiences to find out about new music," said Isaiah Thomas, senior in human resource development.

"And, through our ethnographic research, we found that people want to share new music," said Brandon Shimkus, junior in industrial engineering technology. "But with the way everything's been digitalized, it's really hard for people to bring back those social interactions. So we came up with an idea that revolved around bringing people together to share their favorite music."

> "We created a product that we are not only passionate about, but **one we know can help solve problems."**
>
> **Derek Whitis,** senior, industrial technology

The team developed Musical Shares, a play on words of "musical chairs." The face-to-face game was designed to help people connect and build relationships over their mutual love of and interest in music.

"Musical Shares is set up like 'speed networking', but instead of having a two-person, one-on-one interaction, we devised a method for a three-person, one-on-one-on-one interaction," said Shimkus. "The three-person aspect helps ease any anxiety of meeting and interacting with someone new. Everyone gets time to share their song and explain why they like it. Then, there are notifications that show when it's time to rotate to a new group. That way, everyone gets a new song, and everyone gets a chance to share their experience."

"Meeting new people might seem awkward at first," said Thomas, "but as people began to share about things they already like, it became easier to talk about something else, and talk to someone else about it.

"From beginning to end, this project was a truly gratifying experience," said Derek Whitis, senior in industrial engineering. "We started from nothing and were sent out in the world to find some issues that people were having, specifically with music. Throughout the semester, after following a rigorous ideation process, we created a product that we are not only passionate about, but one we know can help solve problems."

Colette Rosenbarger, junior in human resource development, and Shawn Makulec, senior in industrial engineering, rounded out the winning Tech 220 team.

Design and Innovation Minor

The Design & Innovation Challenge is an element of the Design & Innovation Minor degree program, which was launched in the fall of 2018 by the Department of Technology Leadership & Innovation (TLI) and is co-taught by interdisciplinary faculty.

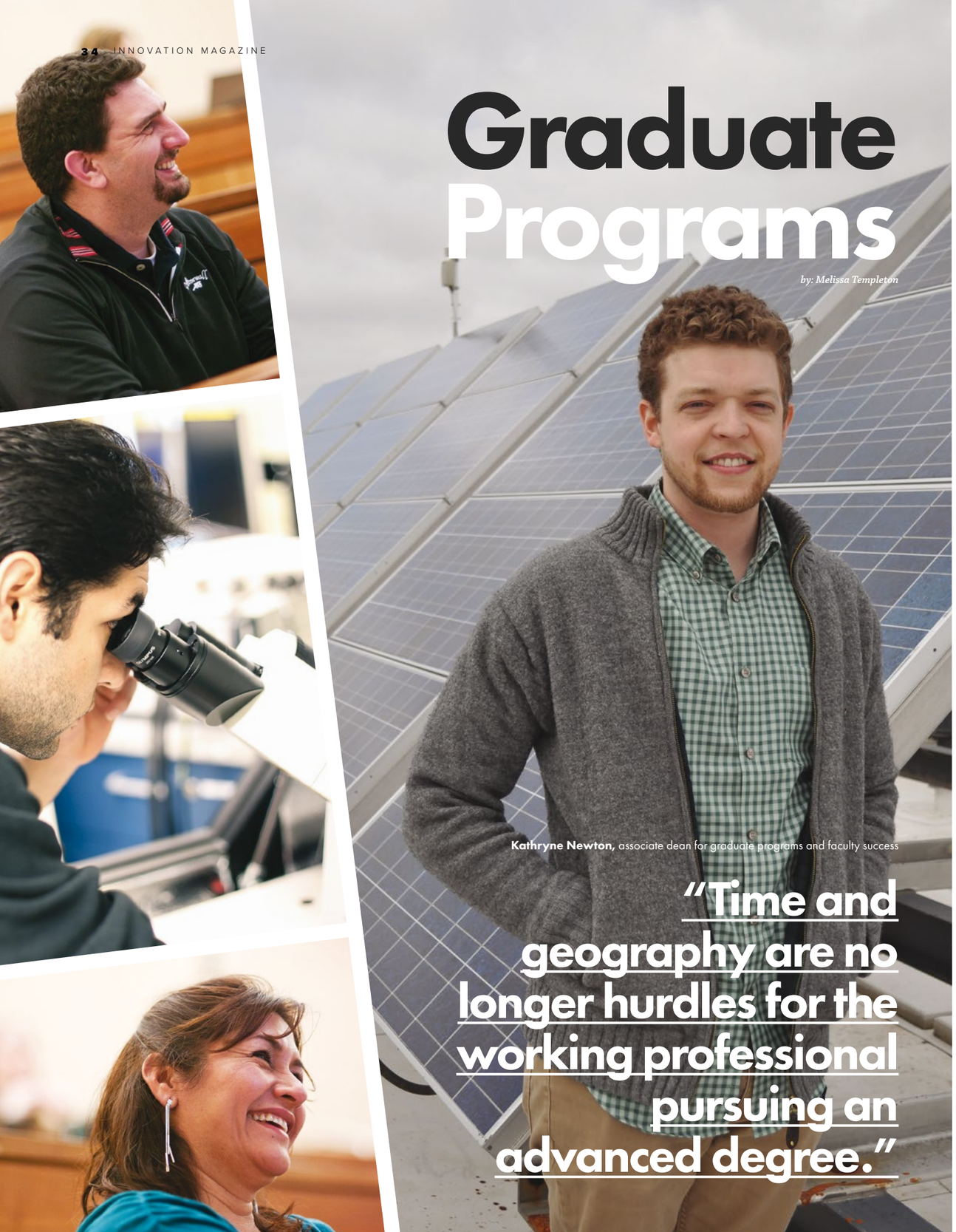
The Design & Innovation Minor degree program provides Purdue students, regardless of major, with a multi-year learning experience that develops their innovation mindset. This is achieved by using the practice and language of innovation to build authentic and recognizable connections horizontally and vertically across coursework. In this manner, the program provides a continuous pathway for students to identify opportunities for innovation in alignment with their major and develop technological solutions over multiple years of study.

The Design & Innovation Minor has three core design and innovation courses:

- TECH 12000 – Design Thinking in Technology, which provides students with the opportunity to apply design-thinking methodologies to authentic problems.
- TECH 22000 – Designing Technology for People, which is integrated with anthropology to engage students in ethnographic studies of people to formulate valid design problems and design concepts.
- TECH 34000 – Prototyping Technology for People, which is integrated with entrepreneurial thinking to enable students to prototype a business model related to their design concept and create a high-fidelity physical prototype of their idea that meets the needs/wants of their potential customers/end-users.

At the conclusion of each course, students compete in the Design & Innovation Challenge for monetary prizes to invest in their products, and scholarships to continue their studies.

For more information, contact Greg Strimel, assistant professor of engineering/technology teacher education, at gstrimel@purdue.edu.



Graduate Programs

by: Melissa Templeton

Kathryne Newton, associate dean for graduate programs and faculty success

"Time and geography are no longer hurdles for the working professional pursuing an advanced degree."

New "distance doctorate" program the first of its kind

In fall 2019, Purdue Polytechnic Institute officially launched a new Doctorate of Technology distance-learning program tailored to actively employed, working professionals. The new graduate degree program, which took six years to create, is the first Doctorate of Technology degree offered completely online by a Tier 1 research university.

Kathryne Newton, the Polytechnic Institute's associate dean for graduate programs and faculty success, explained that demand from working professionals for a distance doctorate was the driving force behind this new program. She said the time was right.

"Online learning has become more mainstream in recent years, and the Polytechnic already boasts proven success with its master's degree distance programs," said Newton. "Time and geography are no longer hurdles for the working professional pursuing an advanced degree. We can serve individuals who, due to work and home responsibilities, would choose not to pursue a doctorate in a traditional campus setting."

Newton worked closely with Mitchell Springer, executive director of Purdue Online – Polytechnic Institute, to create a program that focuses on developing the competence in technology and research needed by business, industry and government. The doctorate program includes use-inspired basic research and purely applied research and development – all with no on-campus residency requirement. And, while the coursework is completed online, students have the opportunity to network with fellow professionals and faculty in a world-class program designed to support a work-life balance.

Springer describes the Doctorate of Technology program as one with "every bit of the rigor of a traditional doctorate program," complete with a research-based dissertation. Students apply their innovation, management capabilities and research skills to evolving challenges across organizations, industries and society. At present, Technology Leadership and Innovation is the first track offered in the Doctorate of Technology program, and is open to professionals with a master's degree from a wide range of fields. As the program grows, additional tracks aligned to other Polytechnic academic department specialties will be added.

After a soft launch with a limited number of students in spring 2019, the goal for fall 2019 was to enroll 10 students in the new distance doctorate program. Instead, Newton and Springer welcomed 35 new Doctorate of Technology students.

"Working professionals want and need this next level of education," said Springer. "Industry has a growing need for this Doctorate of Technology degree, and a need for employees who can conduct their own research."

Online graduate certificates

Purdue Polytechnic Institute also offers an online graduate certificate program that allows working professionals to advance their careers in specialized areas:

- aviation safety management
- executive construction management
- information technology business analysis
- managing information technology projects

Learn more: *polytechnic.purdue.edu/purdue-online*

Doctorate of Technology student studies bio-warfare defense

Christopher L. King – Laker fan, inspirational speaker, and student in Purdue Polytechnic's Doctorate of Technology program – has titled his research, "Bio-security defensive strategies against bio-warfare." He studies ways to prepare for and defend against weaponized diseases. King already holds a master's degree in biotechnology, innovation and regulatory science from Purdue, and a doctorate in synthetic organic chemistry from Howard University. He is adding a prestigious Doctorate of Technology degree to his educational triumphs.

"Industry requires you to multitask and wear more than one hat, and this program helps to broaden my capabilities," said King. "And, when you hear 'Purdue,' you automatically think 'excellence.'"

After just a few months in the Polytechnic Institute's distance doctorate program, King appreciates the accessible faculty and the ability to customize his program to focus on what he needs.

"If I'm not grasping a concept, I can schedule the time to talk with faculty and make sure I understand the topic and can apply it to my work," he said.

King's ultimate goal is to serve in a department of the federal government, with an eye toward agriculture or energy.

Research Impact Areas

by: John O'Malley

Interdisciplinary research in the Purdue Polytechnic Institute uses a socio-technical approach to pursue one goal from many angles and create significant impact on global grand challenges. A unique, collaborative research style within Purdue Polytechnic is on the rise, with Research Impact Areas leading the way. From automation and process control, innovative training and learning, and safety and security in the cyber and physical worlds, integrated Polytechnic research teams focus on **three key areas:**

» **Realizing the Digital Enterprise**

» **Future Work and Learning**

» **Holistic Safety and Security**

Continue reading to learn about innovative research projects under way within each Research Impact Area.

Realizing the Digital Enterprise

Richard Voyles, professor of electrical and computer engineering technology and head of the Collaborative Robotics Lab, and Bedrich Benes, professor of computer graphics technology, are collaborating with Karthik Ramani, the Donald W. Feddersen Professor of Mechanical Engineering, and six other faculty members on a project to create 3D-printed objects infused with sensing, computation and actuation abilities. The research could lead to the creation of a "smart product printer" that combines the printing of a structure with the printing of electronics, sensing and other functions.

Yingjie "Victor" Chen, associate professor of computer graphics technology, and his research team are developing a new technique that could make visualization of big spatial data sets easier and more concise. Conventional techniques like heat maps, which represent data graphically as a matrix of colors, can make it nearly impossible to categorize and compare data when many different types of objects are involved, such as planning resources for a city or tracking enemy locations for military strategy. The Purdue visualization technique uses a specially designed algorithm that incorporates information about thickness, density and boundaries tied to data points. Objects can be grouped by type or time, allowing users to see changes in distributions over time. The technique could be used to study nature phenomena, track political affiliations within a geographic region and many other areas where data can help in comparison and future planning.

Gozdem Kilaz, assistant professor of engineering technology and director of Purdue's Fuel Laboratory of Renewable Energy (FLORE), is leading efforts to optimize a new chemical conversion process for the production of aviation biofuel from plastic waste. The FLORE team is cataloging specific properties of polyolefin waste products and working to ensure the correlations between the products' chemistry and properties are more thoroughly understood. Improved understanding of the waste products' chemical properties could help ready them for conversion in into jet fuel.

Future Work and Learning

Adaptive comparative judgment (ACJ), a relatively new assessment approach designed for assessing solutions to open-ended problems, has demonstrated potential for improving reliability in the evaluation of student design work in engineering and technology design settings. Scott Bartholomew, assistant professor of technology leadership and innovation, and Esteban Garcia-Bravo, assistant professor of computer graphics technology, are researching how to incorporate ACJ in graphic design education, determining the best time to incorporate it in the learning progression.

Alejandra Magana, professor of computer and information technology, is researching the creation of virtual spaces in which learners can be immersed together and nurtured into learning via wearable technology such as glasses, haptics and sensors. These virtual spaces would become authentic environments in which to observe, feel, simulate and experiment under the guidance of a personal skilled tutor. Magana hopes the research will lead to inclusive and personalized adaptive learning environments at scale.

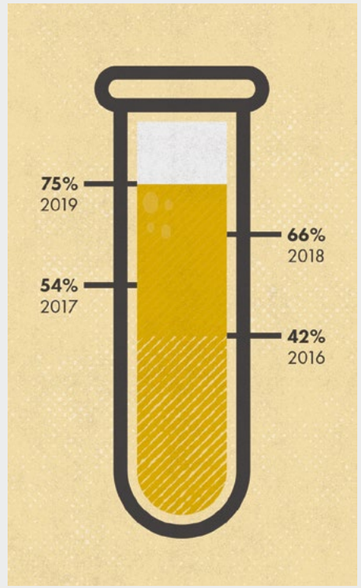
Holistic Safety and Security

An all-in-one cybersecurity toolkit developed by Kathryn Seigfried-Spellar, assistant professor of computer and information technology, John Springer and Baijian Yang, associate professors of computer and information technology, Marcus Rogers, professor of computer and information technology, and others is helping detectives dust for digital fingerprints. The Toolkit for Selective Analysis & Reconstruction of Files (FileTSAR) combines the top open source investigative tools used by digital forensic law enforcement teams at the local, state, national and global levels. It captures data flows and provides a mechanism to selectively reconstruct multiple data types, including documents, images, email and VoIP sessions for large-scale computer networks. FileTSAR is available free to law enforcement.

A Purdue invention is improving the efficiency and maneuverability of a firefighting robot, and the field-tested design could make firefighters' jobs less dangerous, according to Eric Dietz, professor of computer and information technology and director of the Purdue Homeland Security Institute. Dietz and his research team developed a new automatic T-valve system for firefighting robots that can remove water from the fire hose whenever the robots move to a new location, as they can maneuver more quickly when pulling empty fire hoses. The invention improves firefighters' overall safety and efficiency in and around burning structures.

Collaborative research on the rise thanks to Research Impact Areas

Purdue Polytechnic's commitment to interdisciplinary research in specific Research Impact Areas has resulted in significant year-over-year growth in funded collaborative research for the college.



From 2016 to today, an increasing percentage of funded research at Purdue Polytechnic is collaborative in nature.

Learn more about the Polytechnic Institute's Research Impact Areas at *polytechnic.purdue.edu/office-of-research/impact-areas*

Recruitment, Retention and Diversity

The Polytechnic's Office of Recruitment, Retention and Diversity (RRD) is made up of five individuals who assist and encourage high school students on their paths *to* college, and Polytechnic students on their paths *through* college.

They recognize the innovative potential within all students, and connect them with the opportunities for success that the Polytechnic offers. Their doors are always open.

"I'd like to thank Toni Munguia for convincing me and my family that Purdue Polytechnic was a place where I would have a seat at the table and be celebrated for being a woman in technology."

Colleen Denunzio, BS computer and information technology '19

From left: Toni Munguia, Guillermo Morgado-Rodriquez, Ryne Kerchner, Cathy Pullings and Cyndi Lynch

Of what achievement are you especially proud?

"The retention rate for my Tech 101 class (TECH 10100 - Women In Technology: Exploring The Possibilities) is outstanding! Students who take Tech 101 have higher first-year retention rates than students who do not take the class."

Antonia (Toni) Munguia
Director of Recruitment, Retention and Diversity

What is your favorite part of your job?

"I enjoy helping families and students make Purdue Polytechnic their college of choice. I also enjoy helping my RRD team be successful! Every day is different and I like having new challenges to solve."

Guillermo Morgado-Rodriguez
Administration

What is your favorite part of your job?

"Seeing a prospective student's eyes light up when they learn about a degree that matches their goals – and how they will be prepared for their careers – makes my job amazing!"

Ryne M. Kerchner
Associate Director of Recruitment

What advice do you have for incoming students?

"Don't let distractions get in the way of achieving your goals. Purdue has plenty of resources available on campus and in the Polytechnic to help you succeed."

Cathy Pullings
Recruitment and Diversity Coordinator

What is your advice to students, both incoming and graduating?

"Don't be afraid to try new things. This is how you grow, how you learn about yourself and others. Trying new things is how you change the world."

Cyndi Lynch
Associate Director of Retention and Diversity

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by: Brigid O'Brien

Thanks to the Polytechnic's multiple campuses located throughout Indiana, students can reach their collegiate goals regardless of where they reside.

Andy Schaffer, associate dean, oversees the statewide locations, which include Anderson, Columbus, Indianapolis, Kokomo, Lafayette, New Albany, Richmond, South Bend and Vincennes. His goal is to provide a seamless scope of technology instruction, no matter where a Polytechnic student is located.

"The Purdue degrees earned at our statewide locations are a direct extension of the Polytechnic in West Lafayette," said Schaffer.

Following are examples of activities and achievements taking place at some of the Polytechnic statewide locations.

Purdue Polytechnic Statewide students at a glance

68%
are 25 years or younger

59%
are full-time college students

93%
are Indiana residents

"Like elsewhere across the Purdue Polytechnic Institute, we are proud of our students and their senior capstone projects."

Andrew B. Takami, director, Purdue Polytechnic New Albany

01

New Albany

Capstone students at Purdue Polytechnic New Albany, including Brandon Wood (BS mechanical engineering technology '19), spent 2,000 hours designing and building a tornado simulation machine. The device is approximately the size of a refrigerator.

The machine can produce, on demand, examples of all three types of tornadic formations. Tornadoes range from the smallest rope tornado to the larger and more destructive cone tornado. Wedge-shaped tornadoes are typically the largest and most catastrophic tornado type. Besides demonstrating formation, the tornado machine can vary the miniature storm's wind speed.

"In New Albany, like elsewhere across the Purdue Polytechnic Institute, we are proud of our students and their senior capstone projects," said Andrew B. Takami, director of Purdue Polytechnic New Albany.

The capstone client was Kevin Harned *(left)*, chief meteorologist for WAVE 3 News in Louisville, Kentucky. The tornado machine will be used by the WAVE 3 News Storm Tracking Team as an educational tool.

Shelbey Summers, third from right, represented Aptiv at Purdue's Industrial Roundtable.

02

Kokomo

Shelbey Summers (BS computer information technology '18) graduated from Purdue Polytechnic Kokomo and became a computer systems engineer at Aptiv. We caught up with Summers to hear how her Polytechnic degree contributed to her success in the fast-changing, tech-oriented automotive industry.

When Shelbey Summers wasn't studying, the hometown student was building and piloting her defensive end robot, "Eve," for the champion Boilerbots robotic football team.

In 2018, Summers graduated with a Bachelor of Science degree and was hired at the Kokomo location of Aptiv, an electrical and electronic manufacturer previously known as "Delphi." There, she worked on radios and rear entertainment systems in the "Infotainment" department.

Question: What did you like best about college at Purdue Polytechnic Kokomo?

Shelbey Summers: I was interested in Purdue Polytechnic Kokomo largely because I was able to stay close to home and still get the same degree that I could from Purdue's main campus in West Lafayette.

Also, I enjoyed the smaller class sizes that made the learning experience more intimate and valuable. I could get to know my professors and, therefore, I felt more open to ask questions and answer in class.

Question: Can you give an example of an achievement at work that you're quite proud of?

Summers: I've had several unique and interesting experiences at Aptiv as a systems engineer. I traveled to Alabama to visit a customer manufacturing plant to help solve some issues in the plant. It was rewarding to meet the customer in person and see vehicles being put together on the line.

I also participated in recruiting for Aptiv during the Purdue Industrial Roundtable events for the past two years. It is very gratifying to see fellow Purdue students getting started in their careers.

Question: What advice do you have for incoming first-year students?

Summers: We only grow if we allow ourselves the opportunity to figure out where we need more direction and clarification, so it's important to study and ask questions! Sometimes, it can be challenging to ask questions, but never be afraid to reach out to professors or fellow students to try and understand a concept more thoroughly.

Also, be prepared to *study*! The more you study and learn, the more advantages you will have in the future.

03

Anderson

On April 12, 2019, the meeting of the Purdue Board of Trustees took place at Purdue Polytechnic Anderson. This was the first Purdue Board of Trustees meeting to convene at a statewide location.

"The Board's visit to Purdue Polytechnic Anderson validated the benefit that this statewide network of education centers delivers to our students and faculty as well as industry," said Michael Berghoff, chairman, Purdue Board of Trustees. "Spending two days at the Anderson site allowed us to meet with all the dedicated folks who make it happen. I'm certain we will visit again for updates on additional success stories being created."

04

Vincennes

Students at Purdue Polytechnic Vincennes can take a global approach to lessons in supply chain management.

See the Study Abroad story on the next page (44).

Study Abroad

by: Brigid O'Brien

Jim Tanoos is a clinical associate professor at the Purdue Polytechnic Institute in Vincennes. He teaches supply chain management with emphasis on globalization and leadership.

"Supply chain management is the movement of components in commerce, such as raw materials, from manufacturing all the way to the end user," explained Tanoos. "Supply chain management has become increasingly important in today's world because we don't produce everything in America that we did several generations ago, so as consumers, we need to import. Furthermore, our own manufacturers need an export market for their products."

A class field trip (to Europe)

While some instructors do a fine job of teaching supply chain management in the classroom, Tanoos has literally taken a global approach to his lessons. Since 2017, in conjunction with Purdue's Office of Globalization, Tanoos has shepherded his students – some of whom had never been outside of Indiana – onto planes and into four cities that play roles in the European supply chain: Munich, Germany; Prague, Czech Republic; Hamburg, Germany; and Rotterdam, the Netherlands.

"Besides the disciplines that my students learn in class – micro-economics and macro-economics, organizational leadership, industrial management, global marketing, quality production, organization change and supply chain management – there are two themes to the trips: cultural immersion and the history of capitalism and trade. Those two themes are inherent to understanding how the supply chain works."

Tanoos' technology-themed destinations include a tour of the BMW plant in Munich; a factory tour of the Volkswagen subsidiary, Škoda, in Prague; and a visit to 18th-century water-management windmills that are still in use in the Netherlands. Tanoos' students also visit major port locations to witness the transportation of merchandise, ranging from cheese to automobiles.

"I included two European automotive industries in the tour because the automotive industry is so relevant to the economy of Indiana," said Tanoos. "And because Purdue is at the crossroads of America, putting us right at the forefront of the American supply chain, I picked two of the largest ports in Europe as the last two stops on the trip. The Port of Rotterdam is the largest port in Europe and it handles more cargo than any American port. With one out of every three products going through the Port of Rotterdam, it is an integral cog in the European supply chain."

While in each city, Tanoos' students become proficient with maneuvering local public transportation systems, be they on rails, water or bicycle.

"Because the supply chain is constantly moving and mobile, we take that movement to heart," said Tanoos. "Our trip involves moving ourselves from city to city. Otherwise, a trip that is static, just in one city, wouldn't truly represent how the supply chain works."

To promote the four-city, three-credit-hour excursion, Tanoos visits each of the nine Polytechnic statewide locations during the fall semester and provides students with logistics information.

"I think going around the state to the various locations, meeting the students and offering them a bit of face time allows them the confidence to sign up for the trip."

It all started at Purdue

Tanoos traces his interest in travel back to his own college days.

"I first went to the Netherlands with a roommate, when we were 20-year-old Purdue students," said Tanoos. "I enjoyed that culture so much that I went back every few years and just kept exploring. I think I've been to Munich 12 times, Prague six times, Hamburg seven times, and Rotterdam more than 25 times."

During his stays, Tanoos discovered points of interest in each city, including highlights that were off of a typical tourists' beaten path. When faculty adopted a college-wide requirement for globalization/cultural immersion, Tanoos knew he already had the basis of a trip that his supply chain students would appreciate.

Students return with more than just souvenirs

Upon returning to the U.S., Tanoos often notices an increase in his students' self-confidence.

"We usually have a bit of free time in the evenings, so I advocate for students to go explore on their own as much as possible. At first, they don't realize that they have it in them (to explore by themselves). They return feeling comfortable in their own skin and, in some instances, feeling like they can conquer the world!"

by: John O'Malley

Purdue Polytechnic High School

Second Indianapolis location opens

Purdue Polytechnic High School, a tuition-free public charter school aligned with Purdue University, opened its second Indianapolis location on Broad Ripple Avenue in fall 2019. The new school has the same goal as the original downtown location: preparing students for success beyond high school through rigorous coursework that places extra attention on science, technology, engineering and math (STEM).

"With our second campus, more Marion County students now have access to our hands-on STEM-based curriculum that teaches students the skills and knowledge to succeed in a 21st-Century economy," said Scott Bess, head of schools.

Keeanna Warren, principal at the new location, said that Purdue Polytechnic High School is passionate about making sure underrepresented minorities have access to high-quality education.

"We'll know that we're successful once we increase that pipeline of students who are academically and socially prepared for the workforce or for any post-secondary education they pursue," said Warren.

Scott Bess, head of schools

"More Marion County students now have access to our hands-on STEM-based curriculum."

The Broad Ripple location, known as Purdue Polytechnic High School North, has an initial enrollment of about 70 first- and second-year students. Additional classes will be added in 2020 and 2021.

The downtown location, which currently has about 400 students, will enroll all four high school grades for the first time beginning in fall 2020. The first senior class will graduate in spring 2021.

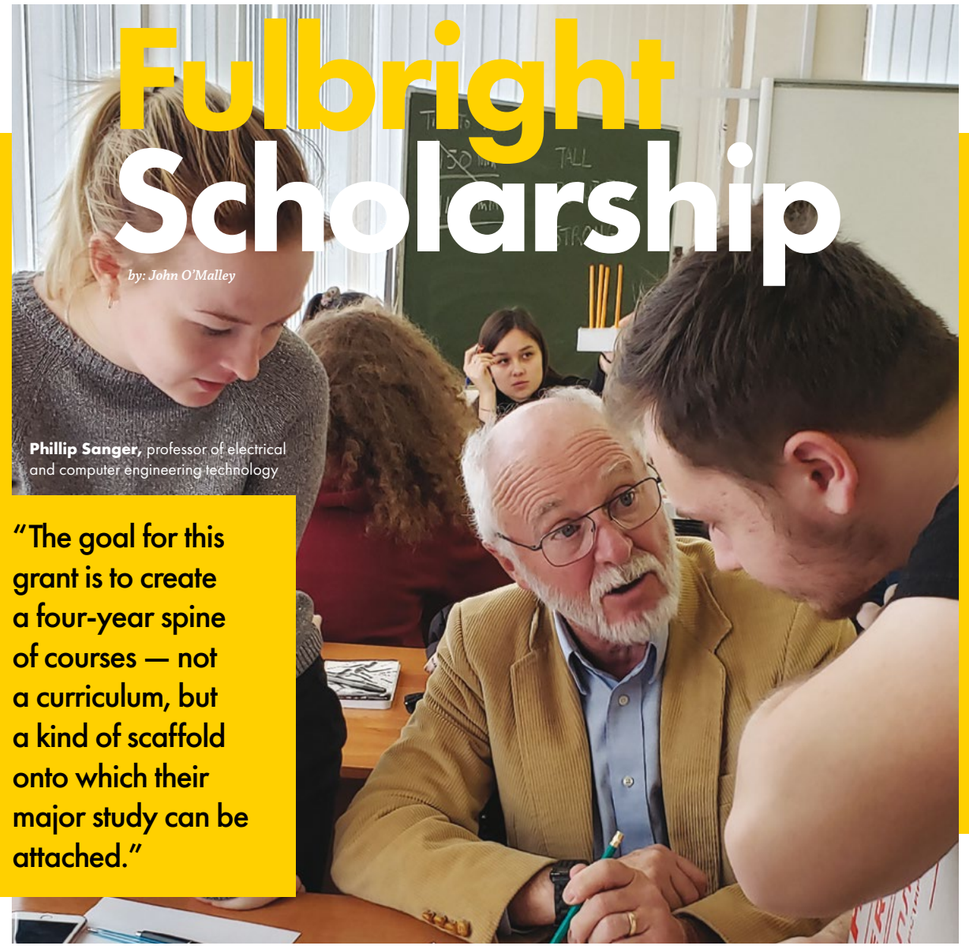
Both schools are operating at temporary locations. The downtown school, currently located at Circle Centre Mall, will move to the P.R. Mallory site on East Washington Street after renovations are complete. The north campus, currently operating in a converted office building, is searching for a permanent site in the area.

Purdue Polytechnic is considering options to open additional high schools around Indiana in the coming years.

pphs.purdue.edu

Fulbright Scholarship

by: John O'Malley



Phillip Sanger, professor of electrical and computer engineering technology

"The goal for this grant is to create a four-year spine of courses — not a curriculum, but a kind of scaffold onto which their major study can be attached."

Sanger's Fulbright Scholarship enables research in Russia on active learning and multicultural team dynamics

In a world that is increasingly multicultural and infused with technology, good team dynamics are essential for success. A Purdue Polytechnic professor is using a Fulbright Scholarship to study intercultural and gender influences at play in team dynamics at a Russian university. He's also helping to infuse Polytechnic-style active learning into their curriculum.

Phillip Sanger, professor of electrical and computer engineering technology, is among eight Purdue faculty who won Fulbright U.S. Scholar Awards for 2019-20. His research, "Project Management Innovation Curriculum and Multicultural Team Dynamics," is underway at Kazan National Research Technological University, located in Kazan, the capital city of the Republic of Tatarstan, Russia.

The demographics of science and engineering

When it comes to achievement, Sanger believes a group's successful performance is linked to diversity in the composite of a team's individual traits. His belief comes from decades of experience in industry and academia.

Sanger began working in industry as an engineer and scientist in 1974. He joined Western Carolina University as an associate professor in 2004 and Purdue as a full professor in 2012. Sanger also spent the last 14 years developing team-based multidisciplinary capstone project courses with industry sponsors.

Since Purdue has one of the largest international student populations in the country, there are often students of many nationalities working together in the capstone program in the Polytechnic's School of Engineering Technology – and this provides a unique opportunity for research. While they work together for an entire school year on real-world problems for industry clients, Sanger observes the dynamics of their teamwork.

"Capstone projects serve as a bridge between academic studies, which are often neat and tidy, and the global engineering workplace, which is often messy and complicated," said Sanger.

The goal of the research, Sanger said, is to achieve a better understanding of how to form effective, high-performance teams.

To date, over 600 students have completed more than 200 capstone projects, including a dozen projects in which students from Purdue and international universities formed transcontinental teams. Those projects provide Sanger the opportunity to observe even deeper levels of multiculturalism as students work to overcome extra challenges of distance and language.

But although there are many opportunities on campus to study the dynamics of multicultural teams, Purdue hasn't yet succeeded in attracting a sufficient quantity of female students to achieve gender balance in the Polytechnic's capstone teams. For that, Sanger looks to Kazan National Research Technological University (KNRTU) in Russia, where over 50% of students in science and engineering programs are female.

Purdue Polytechnic would benefit by achieving a gender balance that isn't so "dramatically different," he said.

In the United States, it's easier said than done. KNRTU achieved it through a combination of historical, cultural and sociological factors. To understand how the Russian university achieved gender balance in these STEM fields, Sanger suggests we look at basic demographics. Worldwide, the gender ratio is 101.8 men per 100 women, according to 2015 United Nations data. In the U.S., there are 98.3 men for every 100 women.

In Russia, though, there are currently only 86.8 men per 100 women. The region has been predominantly female since at least World War II, when many Soviet men died in military service. Women have been playing major roles in engineering since then.

"The Soviet system allowed women to succeed in science and engineering," said Sanger. "Sixty percent of engineers were female, and they held many leadership positions. There were two Russian women in space long before the United States even allowed women to be astronauts."

On the other hand, even though there are more women enrolled in engineering, many do not continue in the discipline as a career. Russian society in general is male-dominated and often chauvinistic, Sanger said. "It's an interesting contrast."

The high percentage of women in science and engineering is not the only notable feature of the Kazan demographic, said Sanger.

"Kazan is where the European/Russian Orthodox culture meets with the Tatar/Muslim culture," he said. "Overlaying the gender issue is the cultural issue. Not only are there more women enrolled, but about half are European and half are Tatar (Turkic-speaking). The role of women in Muslim culture is quite different than it is in the Orthodox culture."

What can American educators learn from this? Sanger is exploring how to better capitalize on the diversity of social skills that women bring to team dynamics. He's also seeking a deeper understanding of the influence that culture has on team dynamics.

"This is most important when we in the U.S. have so few women in our engineering community," Sanger said. "How do we benefit from that diversity? I don't think that the Russians have figured out how to capitalize on this special situation either, so we will be learning together."

Fulbright Scholarship enables sharing Purdue Polytechnic's strengths

The engineering technology programs in Purdue Polytechnic and at KNRTU employ different educational approaches. Although there are some exceptions, Russian professors rely on traditional oral lectures. In addition, project management, which Sanger notes is essential to efficient team operation, is not a regular component of the technical education of Russian undergraduate students.

"In general, they are not comfortable with a project-based learning approach," said Sanger. "At Purdue Polytechnic, we use problem-based learning with lots of interaction and hands-on activities. In my experience with Russian students, they love active learning even though they feel it's more work for them. But their professors are reluctant to transform their pedagogical style to the hands-on approach. After all, in their minds, the lecture style has worked for ages, so why change?"

Through a Fulbright specialist grant in 2013, Sanger completed a six-week project at Northern Arctic Federal University (NArFU) in Arkhangelsk, Russia, on a university-wide project management initiative. He also delivered several workshops and short courses at KNRTU from 2011 to 2016. When he was named a Fulbright Scholar for 2019-20, Sanger wanted to transform his earlier projects in Russia into something that would be sustainable.

"My project-based learning (PBL) style matches well with an educational transformation that KNRTU desires, and it was received by students with excitement and enthusiasm," Sanger said. "The goal for this grant is to create a four-year spine of courses – not a curriculum, but a kind of scaffold onto which their major study can be attached. Students will learn to manage real-world projects in challenging multicultural teams."

The spine will be primarily extracurricular, serving as an interdisciplinary enhancement to a student's disciplinary curriculum. One of KNRTU's goals is to stimulate innovation, and Sanger hopes his work will further enable that goal. This fall, he's teaching at every level of the university, from first-year students through seniors, to progressively develop the collaborative working skills and attitudes needed to be successful.

"The project management/innovation (PMI) curriculum spine needs to be sustainable when my Fulbright grant period is complete," said Sanger. To accomplish that, he is enlisting, recruiting and training KNRTU faculty to continue the series of courses after his visit concludes by co-teaching the courses with them during his second semester in Kazan.

Sanger's collaboration with Russian faculty represents a continuation and broadening of the efforts he made during earlier visits to the country.

"During my shorter experiences in Russia, I connected with colleagues who are interested in and willing to implement PBL techniques and apply project management skills in their courses," he said. Professors come from departments of engineering, language, innovation, business, economics, history, psychology and education.

"This cross-disciplinary dimension is exciting to me and offers the potential of a true cross-disciplinary aspect to the PMI spine," said Sanger. "The professors I'm working with are a narrow slice of the general faculty, but they also represent a critical mass of transformative talent. We're working together to make the PMI spine sustainable, and it will be a lasting benefit to KNRTU."

Connecting teaching to research

While developing and co-teaching courses in the PMI spine at KNRTU, Sanger is using a suite of five survey tools to enhance students' team experiences and provide a window into understanding their team dynamics.

Three survey tools help educate students about the individual traits each possesses and how they affect team dynamics. The surveys help them learn about the following:

- Individual personality traits, through measurements of extraversion, emotionality, conscientiousness and agreeableness.
- Conflict management style preferences, through measurements of dominating, avoiding, integrating, accommodating and compromising.
- Leadership style preferences through 14 elements, including five that are self-reported and nine from a 360-degree external survey.

One survey explores the functioning of their teams through peer-to-peer feedback. The remaining survey measures overall team health by focusing on many vantage points: cooperative conflict management; role clarity; strategy planning, monitoring and assistance; goal progression; coordination; workflow; contribution equity; healthy, fact-driven conflict; lack of personal conflict; trust; constructive controversy; exploitive learning; and exploratory learning.

"We examine these same elements at Purdue," Sanger said, "and we will use them at KNRTU to facilitate conversations on how to improve team performance."

Data from these surveys can be useful for exploring other factors that lead to successful teams, and Sanger believes the information will help refine ongoing studies at Purdue of senior capstone teams in the Polytechnic's School of Engineering Technology.

"With the mixed cultural traits and a minority of men at KNRTU, the resulting team dynamics could lead to useful lessons learned and a model for more successful team dynamics at both Purdue and KNRTU," Sanger said.

Third time's a charm

In addition to his present two-semester stay at KNRTU and his 2013 project at NArFU, Sanger was awarded a Fulbright research grant in 1970, right after earning his bachelor's degree, for studies in France.

"I have always enjoyed engaging internationally with colleagues and students abroad. I find experiencing different cultures exciting and challenging," said Sanger. "I feel very honored to have been selected for a third time. At this stage in my career, I look at this Fulbright grant as an opportunity to give back to the academic community, and I hope to leave behind a transformative legacy at KNRTU."

Sanger also notes that this is an interesting time for Americans to visit Russia.

"For most Russians that I have met in the past, particularly young students, I am the first American person that they have met," Sanger said. "Peace comes from person-to-person interactions. Despite political tensions between our countries, I have always found the Russian people to be very friendly to Americans. My goal is to leave behind positive feelings with all the people with whom we interact."

Faculty and Staff Recognition

Purdue Polytechnic faculty and staff are recognized frequently for their achievements. This summary is presented in chronological order.

Mark French, James L. Jenkins and Linda L. Naimi

Mark French, professor of mechanical engineering technology, James L. Jenkins, associate professor of building construction management technology, and Linda L. Naimi, associate professor of organizational leadership and supervision, were inducted into Purdue University's "Book of Great Teachers." The award honors outstanding teaching faculty who have demonstrated sustained excellence in the classroom and is given only every five years.

Toni Munguia

Antonia "Toni" Munguia, director of recruiting, retention and diversity, was named a Purdue University Martin Luther King Jr. Dreamer Award recipient for 2019. The award is presented annually to individuals or organizations within the Purdue community whose contributions embody Dr. King's vision of service to others and furthers the University's commitment to diversity and inclusion.

Marcus Rogers

Marcus Rogers, professor of computer and information technology, was elected to the board of directors of the American Academy of Forensic Sciences, a multidisciplinary professional organization that provides leadership to advance science and its application to the legal system.

B.C. Min

Byung-Cheol "B.C." Min, assistant professor of computer and information technology and director of the Smart Machine and Assistive Robotics Technology Lab, was honored with the National Science Foundation's Faculty Early Career Development Program Award for his work related to human-robot interaction and multi-robot systems.

Dawn Laux

Dawn Laux, associate department head and clinical associate professor in the Department of Computer and Information Technology, was named a recipient of the 2019 Outstanding Undergraduate Teaching Award in Memory of Charles B. Murphy. The award is Purdue University's highest honor for undergraduate teaching.

Bedrich Benes

Bedrich Benes, the George McNelly Professor of Technology and professor of computer science, has been promoted to senior member status by the Association for Computing Machinery (ACM). As the world's largest computing society, ACM connects computing educators, researchers and professionals to inspire dialogue, share resources and address the field's challenges.

Scott Bartholomew

Scott Bartholomew, assistant professor of engineering/technology teacher education, was presented with the Public Understanding of Technology and Engineering Education Award at the 81st Annual International Technology & Engineering Educators Association (ITEEA) Conference.

Ken Burbank

Ken Burbank, head of the School of Engineering Technology, was named the recipient of the James H. McGraw Award by the American Society for Engineering Education (ASEE). The McGraw Award recognizes outstanding service in engineering technology education.

Mitchell Springer

The University Professional and Continuing Education Association (UPCEA) recognized Mitchell Springer, executive director of Purdue Online – Polytechnic Institute, with its 2019 UPCEA Leadership and Diversity Award. The annual honor singles out one individual for his or her outstanding accomplishments in one or more of the areas of research, educational programs and services, administrative practice or organizational commitment.

Misty Clugh & Robert Cox

Two sister units within International Programs honored members of Purdue Polytechnic's Office of Globalization with awards. Misty Clugh, administrative assistant, was given the Outstanding ISS Liaison Award by the International Students and Scholars office, and Robert Cox, senior associate dean, was presented with the Vision Award by the Center for Intercultural Learning, Mentorship, Assessment and Research (CILMAR).

Phillip Sanger

Phillip Sanger, professor of electrical and computer engineering technology, won a Fulbright U.S. Scholar Award for 2019-20.

Anthony Sparkling

Anthony Sparkling, assistant professor of construction management technology, was honored with the Early Career Award from ELECTRI International, the Foundation for Electrical Construction. The foundation conducts research for the electrical construction industry, in order to deliver exemplary management education and supervisory training programs.

Mesut Akdere & Renu Dalal

Mesut Akdere, associate professor of human resource development and director of Purdue HRD Virtual Lab, and Renu Dalal, a doctoral candidate in the Department of Technology Leadership & Innovation, won Emerald Publishing's 2019 "Highly Commended" award for their co-authored article "Talent Development: Status Quo and Future Directions" published in Industrial and Commercial Training journal. The Emerald Literati Awards honor outstanding contributions of authors of scholarly research.

College Awards:

Academic Advisor Award

Danielle Gilbert, senior academic advisor

Business Office Service Award

Emily Stevenson, business assistant

Customer Service Awards

Elizabeth Barajas, global programs coordinator

Brenda Sheets, School of Construction Management Technology

Leadership Awards

Sarah Prater, Division of Military Science and Technology

Corey Sharp, director, Purdue Polytechnic Anderson

Statewide Excellence Award

Whitney Ramer, student affairs coordinator, Purdue Polytechnic Columbus

Staff Equity, Inclusion and Advocacy Award

Misty Clugh, administrative assistant, Office of Globalization

Faculty Equity, Inclusion and Advocacy Award

Nathalie Duval-Couetil, professor of technology leadership and innovation

Outstanding Faculty in Learning Award

José Garcia Bravo, assistant professor of engineering technology

Exceptional Early Career for Outstanding Undergraduate Teaching Award

Nicole Hands, clinical assistant professor of computer and information technology

Outstanding Faculty in Discovery Award

Byung-Cheol "B.C." Min, assistant professor of computer and information technology

John P. Lisack Early-Career Engagement Award

Mark Zimpfer, assistant clinical professor, School of Construction Management Technology

Outstanding Faculty in Engagement Award

Mark Zimpfer, assistant clinical professor, School of Construction Management Technology

Outstanding Graduate Faculty Mentor Award

Gozdem Kilaz, assistant professor of engineering technology

Alumni Spotlight

Amy Noah: Boilermaker & connection-maker

Keeping the lights on at a major land-grant research university, says Amy Noah, is just as much about building and fostering connections as fundraising.

As vice president for development, Noah serves as Purdue's chief connection-maker, focusing on building relationships between the University and alumni, friends, corporations and foundations. She believes that nurturing healthy, long-lasting relationships is the best way to find the support that Purdue needs to advance its mission.

Noah (BS organizational leadership and supervision '94) was named to her position in November 2013 by Purdue President Mitch Daniels after she served as interim vice president for six months.

"Amy's performance in the interim role validated her readiness for this job," said Daniels. "She is highly regarded and well-respected among our many University stakeholders. Her commitment and dedication to this University made her the ideal choice."

Noah inherited a huge task in the form of a $2.019 billion goal, set in 2012, for Ever True: The Campaign for Purdue University. Noah and the University Development Office team reached that goal in 2018 — but donors were even more ambitious, giving a total of $2.529 billion before the campaign's 2019 completion.

We spoke with Noah about the challenges and rewards of her job, how alumni can support Purdue even without opening their checkbooks, and why her organizational leadership degree has been important in her career.

by: John O'Malley

Question: The role of the University Development Office is to help with fundraising efforts for the University. But our guess is that your role is a lot more nuanced than "please give us money." What is your approach? How do you inspire donors to support a large institution like Purdue?

Amy Noah: It's actually about connecting alumni to the institution. Very few discussions that I start ever are about money. It's trying to understand what made their experience at Purdue unique. What do they remember fondly – a class? a professor? Many people meet their spouse at Purdue.

When I meet with alumni, I typically ask: Do you come to visit? How often do you come back? It's important for people to want to be on campus, to know what's happening and have a presence. We often talk with people who aren't close to Purdue, whether emotionally or geographically. So our role is to give them an update. Sometimes they've heard things and want to know more. "How is Purdue continuing to do this tuition freeze? What's new in the Polytechnic?" They want to know what Purdue is focusing on. They ask about what looks different and what has been built since the last time they visited.

People have incredible pride in Purdue, and they're proud of being graduates. They talk about how difficult it was and their sense of accomplishment in having earned Purdue degrees.

Question: How do alumni and other friends of the University decide to support Purdue financially?

Noah: People feel compelled to give back, to support things that are important to them. They might want to celebrate a faculty member. Or they might remember that certain labs aren't as good as they wanted them to be, so they want to provide support for upgrades.

When I go to visit alumni, I want to give them a glimpse of what it's like to be here every day. In those conversations, it's usually very natural for them to talk about wanting to make an investment in the University. "I owe all my success to Purdue" is something I hear frequently, and it makes me smile every single time! Giving to Purdue, regardless of the amount of the gift, really does help the students and faculty who are here today with their daily learning and research.

Question: You've been working in a development role for more than 18 years. We're guessing you have some fun stories to share.

Noah: I often find myself having conversations about interesting ways that people want to provide support. It's not surprising that Purdue alumni are very creative.

I once talked with a former professor who also served as an administrator. He chose to donate a very rare stamp collection. From a process standpoint, we are not able to accept gifts like that — but he arranged to sell the collection, and the proceeds were his gift to Purdue.

When I worked in Armstrong Hall, a gentleman called and asked me to come downstairs. He was parked out front by the statue of Neil Armstrong. He had driven from Illinois with horses in a trailer, and he wanted to give them to Purdue!

Question: How can your role be challenging?

Noah: Sometimes we find ourselves doing work that is difficult but rewarding. I've had to work with parents who lost a child as a student or as a young alumnus, and they wanted to find a way to honor them. Of course, it's heartbreaking, and we'd rather no one be in that situation. But it's wonderful when families are moved to provide support because their kids loved Purdue.

One family created a scholarship to honor a student who committed suicide. I had a six- or seven-year relationship with them. Grief is a process, and they were in different places at different times. It eventually became painful for them to hear how the scholarship's recipients were doing. But it was important to them – and it was also important that we get it right.

In 2003, I reached out to a gentleman who lived in Cleveland to have coffee. He met to tell me that he would never make a gift because he was angry about a parking ticket! He was very emotional about it. There wasn't much I could do except listen and talk with him. We stayed in touch for a while.

Eight years later, he contacted me and said he wanted to come to campus because he had experienced a personal loss that got him evaluating his life, and he realized he had carried his anger too far. A year later, he ended up making a $2 million gift. Ultimately, he recognized Purdue had positioned him for success and he felt compelled to give back. He wanted to give to a parking ticket fund! We could not channel his gift in that specific manner, but some of his money did go into an emergency fund for students.

Question: What is a day on the job like, typical or otherwise?

Noah: Because I'm trying to provide oversight to the entire organization, today I don't have as many opportunities to travel or to visit face-to-face with alumni as I did before accepting this assignment. However, I still hear from people that I first met in the early 2000s.

There isn't a typical day. We spend a lot of time coordinating efforts in our office. My role is to make sure we are always representing Purdue in the absolute best way possible. Some alumni tell us they hear from us too much; we try to align with what they want. We spend a lot of time managing that.

At the close of a campaign, I imagine how we can focus our efforts over the next 18 months, expressing adequate and full gratitude for those who supported the campaign and who support Purdue on an ongoing basis.

I spend a fair amount of time identifying talented people who want to work in this field and helping them develop. How do we best enable their success? I want to help people stay in one place for a good amount of time and to build and maintain relationships.

We spend a lot of time supporting the president and his interactions with alumni and friends of the University. We want to provide good support for those efforts.

Question: You've been working with President Daniels since he started the Purdue Moves initiatives, one of which was the transformation of our college into the Polytechnic. What role did you play in shaping and executing those initiatives?

Noah: That was very much a Mitch move. It was a brilliant opportunity for the University to step forward. The ideas that came from that were incredible. The thought, creativity and uniqueness were fantastic. Fortunately our office was able to compliment those efforts, and the community responded very positively. Everyone was encouraged to hear about the vision and about the ambitious plans for the colleges and programs.

Some of the initial Purdue Moves initiatives are ongoing, including efforts to grow the Polytechnic. It has been helpful to work with colleges and departments as they create frameworks for the future, and it's rewarding to see the fruits of our work. The Engineering and Polytechnic Gateway Complex that will be built during the next two years is a great example.

Question: Let's say you're talking to current college seniors. How would you describe what's next for them, as they prepare to go out into the world as Purdue alumni? How can new graduates help Purdue?

Noah: I think about the differences between when I graduated and now. We do a better job today talking with graduates about the need to stay connected. President Daniels talks about it frequently in commencement remarks. You're always representing the University, he says. You can showcase Purdue in all that you do, personally and professionally.

I encourage new graduates to prioritize staying in touch and visiting. You're going to find yourself in good on-the-job relationships, so you can encourage colleagues to look at our alumni. It's a great way to be an advocate for Purdue.

Younger people often say, "I'm not yet in a position to give, and I don't know what to do." I tell them that they are always able to help Purdue just by building a network of fellow alumni around them. By helping their companies get an impression of the quality of our graduates, it provides valuable support to Purdue. And we are grateful for all the support we receive, in every form it comes.

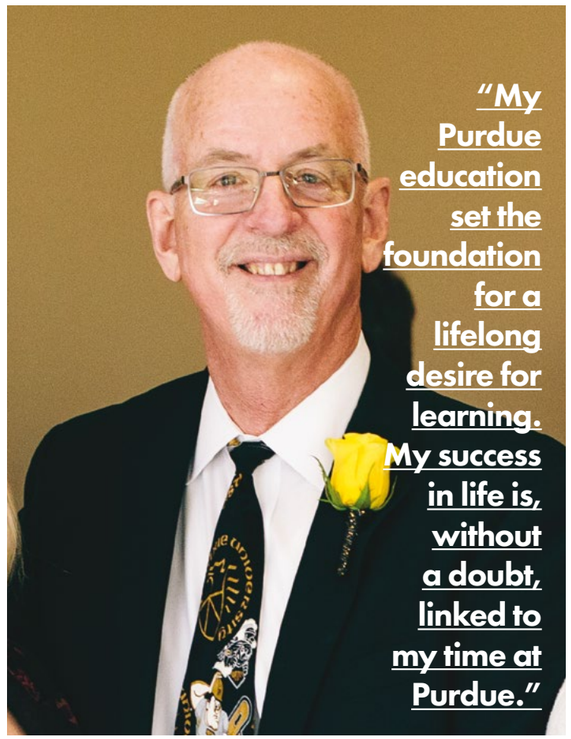
Question: You earned a bachelor's degree in organizational leadership back in 1994 — a major that's still offered in Purdue Polytechnic today. How does your degree still influence the way that you do your job?

Noah: I worked with a diverse group of people in my degree. There was a heavy emphasis on developing strong communication skills, both verbal and written. The college, now known as Purdue Polytechnic, opened my eyes to things I didn't previously know or understand. I liked the program and the structure it offered. Organizational leadership opened a lot of doors for me.

When you're doing something, it's sometimes hard to measure its impact. I have come to realize that the work our team does is special. We meet really incredible people. Helping coordinate opportunities to name a facility or endow a scholarship is very rewarding. Those will always exist, and we get to be a part of it!

We feel like we really make a difference. I continue to be amazed by the kindness, the generosity and the authentic nature of the people with whom we interact. They – and we – love Purdue deeply.

Distinguished Technology Alumni



Mark S. Loepker

Senior Advisor and Education Lead
National Cryptologic Museum Foundation

AS '74, Aviation Electronics Technology, Purdue University
BS '77, Electrical Engineering Technology, Purdue University
MBA '82, Statistical Methods, University of Missouri

Mark Loepker chose the College of Technology for his electrical engineering technology studies because he enjoyed the applied aspects.

"Making things work – and fixing those that do not – always interested me," he says.

Loepker leveraged his innate multi-tasking skills and the technological knowledge he acquired at Purdue to make the world a safer place.

"The work accomplished over my 43-year career in the Air Force and National Security Agency helped to protect and defend our nation's most highly classified networks and information systems. Serving as a Missile Combat Crew officer demanded discipline and attention to detail. Assignments in nuclear research and development utilized my cross-disciplinary education in nuclear engineering. I was well-prepared to oversee technically complex programs supporting national defense."

Melody Birmingham-Byrd

Senior Vice President and Chief Procurement Officer, Duke Energy

BS '94, Organizational Leadership, Purdue University
MBA '10, Strayer University
Advanced Management Program '17, Harvard University

Melody Birmingham-Byrd is responsible for more than $12 billion in annual supply chain managed spending for the Duke Energy enterprise. She credits her degree and experience at Purdue with enabling her to enter her career with a balanced perspective of people, process and technology. However, when it comes to providing opportunities to everyone who has the drive, desire and ability to change the world, she believes there is still work to be done.

"The work I've accomplished over my career demonstrates that progress is in the making, and that boundaries can be removed when it comes to what women, African Americans or people who come from non-traditional backgrounds in their industry can do when they have the desire, tenacity, ability and are provided the opportunity."

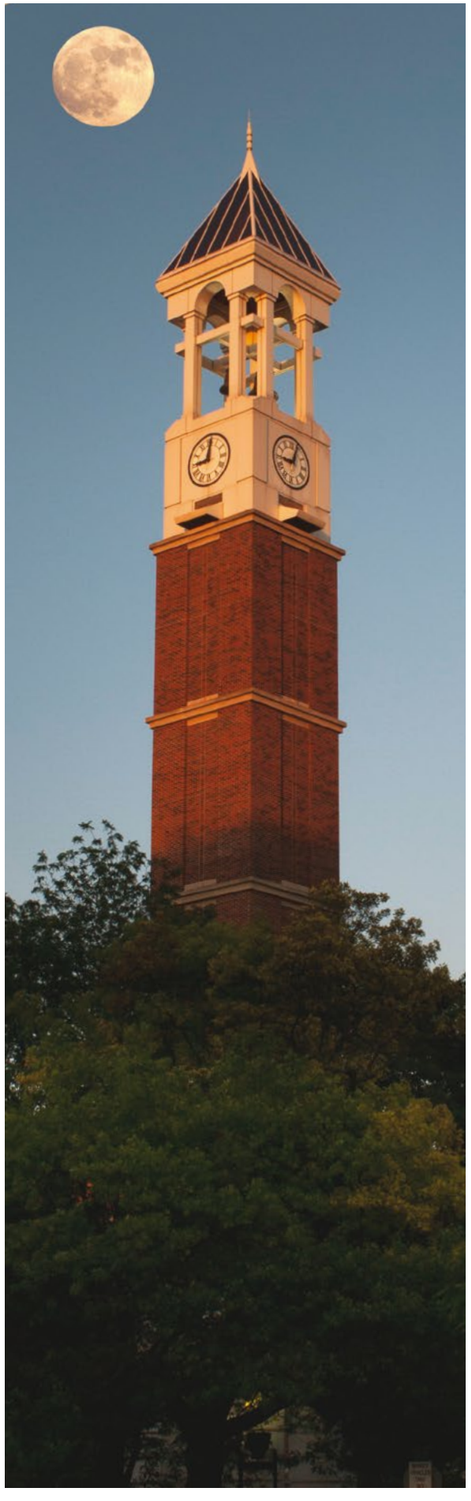
Bradford Sims

President, Capitol Technological University

BS '90, Building Construction Technology, Purdue University
MS '96, Building Construction Management, University of Florida
PhD '99, Curriculum & Instruction, (Co-chairs from Technology & Education), Purdue University

After graduating from Purdue, Bradford Sims built a career in the industrial construction industry, first as a project controls engineer with the Westinghouse Savannah River Corporation and then as a project controls supervisor for Cherne Contracting. He also was a cost engineer for a subsidiary of Raytheon.

Sims returned to Purdue to pursue a doctorate degree, transitioning his career onto an academic trajectory. Since 1999, he has been an assistant professor at the University of Florida, a professor and department head at Western Carolina University and dean of the College of Technology at Indiana State University. Sims also was the interim chancellor and chief academic officer at Embry-Riddle Aeronautical University's Worldwide campus from 2013 until 2017.



Make a Difference

Opportunities to invest in the future

As the Purdue Polytechnic Institute continues to grow, we have several opportunities for our alumni to invest in the future of our college, our faculty and our future students.

» Named spaces in the new Gateway Complex

» Diversity scholarships

» Need-based scholarships

» Graduate student fellowships

» New laboratory equipment

» Learning communities

» K-12 outreach programs

» Retention and recruitment programs

» Student organization travel

» Endowed professorships

» Faculty awards

» Endowed deanship

» Early career faculty funds

To learn more about how you can make a difference, please contact our Office of Advancement:

techdev@purdue.edu

(765) 494-7967

We thank you for your support.

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