



SCHOOL OF ENGINEERING

2017 Annual

IMPACT

Report



DAYTON ENGINEERING

BY THE NUMBERS



NO. 1

Catholic university for
sponsored engineering R&D

NO. 2

nationally for federally
sponsored materials R&D

75

Faculty

63

Staff

NO. 9

nationally for sponsored research
among private, comprehensive
research universities without
medical schools

243

Publications

745

Degrees awarded

→ 394 Undergraduate

→ 351 Graduate

2212

Undergraduate students

609

Graduate students

90%

First-year
retention rate

\$135 MILLION

IN SPONSORED
ENGINEERING R&D
INCLUDING UNIVERSITY OF
DAYTON RESEARCH INSTITUTE

79%

Six-year
graduation rate



From the Dean

At the University of Dayton School of Engineering, we are transforming engineering education. After developing a strategic plan in 2015, we have been making dramatic changes in the way we are structured and staffed in order to accomplish the ambitious goals set forth in that plan.

As we began the implementation phase, it became important to develop a methodology to evaluate our progress and the impact our changes were having on the educational experience we offer our students. We are concentrating on four key areas of focus:

1. Cultural Impact

How are we doing in terms of diversity, equity and inclusion and preparing students for a global working environment?

2. Societal Impact

Do our efforts encourage Research for the Common Good in accordance with our Catholic, Marianist values? Are our students prepared to become leaders who consider the common good in their decision making?

3. Organizational Impact

Are we changing internally to embrace best practices in education, communication and student support services?

4. Experiential Impact

Are we giving our students learning opportunities inside and outside the classroom that allow them to put theory into practical action?

In this report, we share stories that are reflective of the work we are doing in each area. As a top-tier, Catholic research university we remain committed to the growth of our students and the importance of our research endeavors for the common good.

My best,

Eddy Rojas, Dean
School of Engineering



Cultural Impact

Building a Culture of Diversity

It's no secret that diversity brings strength. It provides new perspectives, enriches the learning environment and allows students to see themselves represented in the student body and at the front of the classroom. In turn, more students explore — and succeed in — engineering.

“That’s why we are acting boldly to diversify — one new hire at a time. Since 2014, two-thirds of our new faculty (shown to the right) have been women or persons of color,” said **Dean Eddy Rojas**. “Here, we don’t just talk about diversity and inclusion. We do something about it.”

Hiring decisions are important, but developing a culture of diversity requires much more.

DIVERSITY IN ENGINEERING CENTER

In 2016, the School designated the Diversity in Engineering Center (DEC) as the lead office to develop a focused, consistent culture of diversity within the School. Their staff energetically facilitates outreach programs for female and underrepresented minority prospective students. The team also focuses on enrolled diverse student retention, matriculation, and graduation as well as School climate.

DEC relies heavily on metrics to improve the School’s outreach programs and recruitment efforts, keeping a close eye on what their target audiences respond to.

With that information in mind, the Diversity Center helped create new literature for the School with inclusive language and images. Recruitment events were also modified to offer experiences that research and prospective student feedback revealed would appeal to a more diverse audience.

Several years ago, the School developed an Engineering Ambassadors program comprised of undergraduate engineering students. This past year, the program expanded to not only assist the DEC with recruitment events, but also to schedule and host prospective students and families visiting the School.





During the Spring 2017 semester alone, Ambassadors engaged with more than 300 families to tell the University of Dayton engineering story.

In 2016, DEC received additional resources to grow the team, including an assistant director for the Minority Engineering Program and an assistant director for the Women Engineering Program. The School also realigned the outreach and recruitment coordinator from the Dean's Office to the DEC. In 2017, a new assistant director for international engineering student engagement came onboard.

"The DEC has grown and emerged as a driving force behind the School's success embodying an inclusive culture," said Dean Rojas.

CLASS OF 2021 TO BE LARGER, MORE DIVERSE

"Thanks to the leadership of the DEC and a high percentage of participation by faculty, staff and students, the School has achieved its recruiting goals for our 2021 incoming class," says Dean Rojas. "We expect more than 500 students to be enrolled this fall."

This fall's engineering class proves that an enrollment plan based on inclusive excellence works. The School of Engineering will welcome five percent more females (28 vs. 23 percent) and five percent more underrepresented minorities (18 vs. 13 percent) than ever before. The entering class is also one of the most academically talented to date.

According to **Laura Bistrek**, DEC director, "The School's Strategic Plan is our guide as we advance our inclusive culture and strive for representation parity with the general population. Increases in the diversity of our students and faculty enriches our initiatives to affect intercultural competence in the School. Everything we're doing from recruitment to initiatives including current students, faculty and staff enhances our cultural impact on the School and the University."

The School of Engineering has made diversity, equity and inclusion issues a priority in its recruitment of faculty, staff and students. As a result, two-thirds of new faculty members hired since 2014 are women and/or minorities. The incoming class of 2021 will have record numbers of women and underrepresented minorities.





Societal Impact



A cross departmental team led by fall prevention researcher Kimberly Bigelow, director of the Engineering Wellness through Biomechanics Lab, is studying how modifications made to standard walkers can provide feedback to improve user posture and prevent falls. Researcher Courtney Golembiewski (right) developed an early prototype of the smart walker as part of her master's thesis.



Research for the Common Good Takes Center Stage

In his April 4, 2017, inaugural address, President **Eric Spina** called upon the University community to become the “University for the Common Good.”

“In becoming the ‘University for the Common Good,’ we cannot neglect the essential role that research plays in addressing societal problems, driving economic development and expanding opportunity,” Spina said. “We must leverage our greatest strengths and pursue a well-defined research agenda that fulfills societal needs and represents great opportunity.”

It was a message that resonated with the School of Engineering because the alignment between Spina’s vision and the School of Engineering’s 2015 Strategic Plan is remarkable. It may not be surprising that the same culture that holds Catholic and Marianist values such as community, servant leadership and social justice so dear would seek to translate those values into research priorities, but the President’s affirmation is significant.



The School of Engineering has developed ten principles for identifying “Research for the Common Good.” They are research projects with the following objectives:



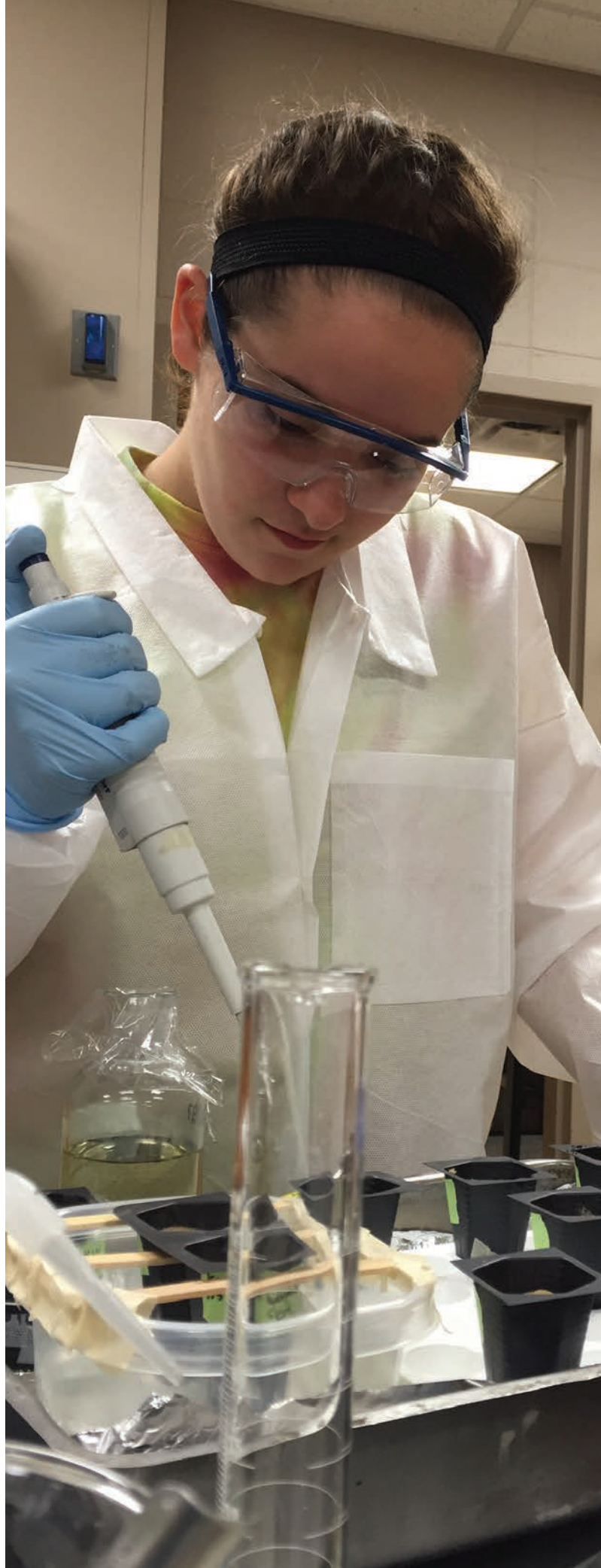
SUPPORT FOR RESEARCH

One of the ways these types of projects are supported is through the newly-created STEM Catalyst Grant Program, which is sponsored by the School of Engineering, College of Arts and Sciences and University of Dayton Hanley Sustainability Institute. The grant program encourages research proposals that benefit humanity by addressing significant, unmet needs or that utilize collaborative teams to address challenges across multiple academic disciplines.

“It is clear from the overwhelming response of our faculty to the STEM Catalyst Grant Program that there is both a desire to advance research for the common good and an abundance of promising ideas that deserve to be funded,” Dean Rojas said. “It is our hope that these projects will advance to the point of attracting outside funding.”

One of the funded proposals was from a cross-disciplinary team working on a “smart walker” to reduce falls and improve health outcomes for older adults. Mechanical engineering professors **Kimberly Bigelow** and **Tim Reissman** partnered with **Kurt Jackson**, associate professor of physical therapy, and **Julie Walsh-Messinger**, assistant professor of psychology, to develop a prototype that can provide feedback to the user on their posture and position with the hope of preventing falls. The data collected will serve as a proof of concept to apply for larger federal grants so the walker can be refined.

Another funded project is the STAR (solar thermal adsorptive refrigeration) project led by **Jun-Ki Choi**, assistant professor, Mechanical and Aerospace Engineering, and **Amy Ciric**, senior lecturer, Department of Chemical and Materials Engineering.





A rotating team of students, under the direction of chemical engineering lecturer Amy Ciric (second from left) and mechanical engineering assistant professor Jun-Ki Choi (second from right), continue work on the STAR (solar thermal adsorptive refrigeration) project that has won numerous awards and both federal and University grant funding.

Choi and Ciric, working with a team of students, will build a second-generation prototype and explore less expensive forms of the ethanol that provide refrigeration through heat extraction. The pair seeks to develop an affordable, non-electric powered refrigerator to store vaccines and other essential supplies in remote communities.

The long-running project began with an international immersion in Bihar, India through the School's ETHOS Center and has received Phase 1 and Phase 2 grant funding from the U.S. Environmental Protection Agency's People, Prosperity and Plant (P3) program. The initial prototype received three awards at the 2016 USA Science and Engineering Festival in Washington, D.C.

More than 36 percent of electricity consumed by American homes is used for space cooling and refrigeration. As developing countries seek the same cooling amenities, there is a huge potential impact on the earth's carbon footprint if those needs are served by current technology.

"I would like to see a broader effort at UD to explore alternative forms of refrigeration," Ciric said. "Although it sounds cliché to call it disruptive technology, adsorptive refrigeration or some other alternative could grow to challenge existing technologies."

A portrait of Kristen Comfort, an engineering researcher, smiling in a laboratory. She has shoulder-length brown hair and is wearing a black blazer over a white shirt and a necklace with a green pendant. In the background, there are laboratory equipment like pipettes and a centrifuge.

Engineering Researcher Wins NSF CAREER Award

BODY BUILDING

Researcher **Kristen Comfort**, assistant professor, Department of Chemical and Materials Engineering, won a five-year National Science Foundation (NSF) CAREER award to support her quest to build a cellular model that acts more like a human body, allowing for a better understanding and visualization of human-drug interactions.

According to the National Science Foundation, CAREER awards are among the foundation's most prestigious and support the early career-development activities of teacher-scholars who most effectively integrate research and education. About 150 engineering faculty across the country receive NSF CAREER awards annually, Comfort said.

Her research could lead to better ways to deliver medicine straight to the source of an illness — a malignant tumor or an infection — without the cost and ethical concerns of animal testing.

Comfort has tested 3-D cultures, multicellular systems and fluid flow models individually, but she wants to use her award to tie it all together into more realistic systems. Comfort will set up the systems in her first year and use the rest of the term to examine how nanomaterials, tiny particles like silver used to deliver medications in the body, interact with the systems.

“Traditional tissue cultures are typically static. You sit them in an incubator and they stay there. These cultures are two-dimensional, grown in a single layer,” Comfort said. “But humans are 3-D beings with systems where everything is moving. I want to use this grant to build a 3-D scaffold to support cell culture systems that mimic a human’s physiological flow using a pump to reproduce capillary flow rates.”

One model will have lung, liver and skin components to replicate how people inhale a material, which is filtered through the liver and settles in the skin. Another planned model will replicate an immune system. Comfort also hopes to have those systems communicate with each other.

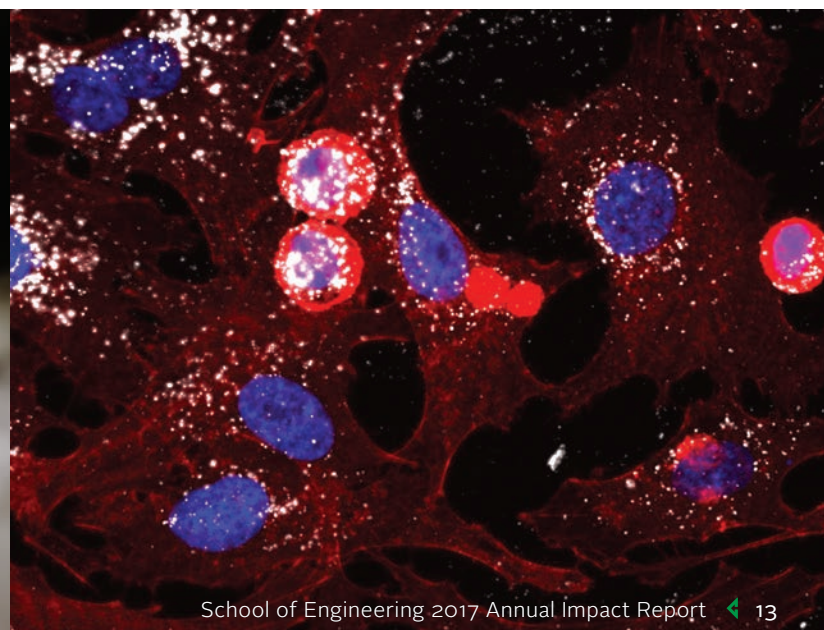
“How are the nanoparticles moving? Are the nanoparticles depositing where we want them? Do they pool in one spot or are they spread out?” Comfort said, spelling out some of the questions she’d like to answer. “That’s what I like about the multisystem; we will get a clearer picture of distribution in complex systems and whether a particular drug delivery mechanism can get to the cells to be effective. If we have 20 different drugs, this model can help us identify which one is able to be delivered to a target at high enough concentrations to be both effective and safe.”


Comfort said she feels this type of testing is necessary because testing in animals is costly and time consuming. This new system could allow for a faster way to screen potential drugs without the use of animals.

“Expanding from a simple cell system to a large animal system is where most models fall apart,” Comfort said. “In addition to ethical issues, the large number of nanomaterials and drugs that need to be tested means animal testing is not always an option. In our system, in addition to determining how the cells respond, we can capture the nanomaterials and examine their properties after they have been run through the system.”

Comfort will be able to employ a graduate student and two undergraduate students for the five-year term.

“What I like to do with students is give them a holistic approach to research, get them thinking about the scientific method, controls, why are we doing things, analysis and big-picture thinking. It’s more than just the results; for students, it’s also about the experience. If they have enough time in the lab, they will also have the opportunity to write up their results for a publication,” she said. “In addition to having the resources to carry out some really exciting and innovative research, I’m thrilled to be able to use the CAREER award to introduce science to a new group of students.”





Creativity and Entrepreneurship Take Hold in Engineering Education

From a certificate in creativity to passion projects to partnerships with local industries to create sustainable designs, things are changing at the School of Engineering. Departmental boundaries are breaking down as faculty members collaborate more and challenge their students with memorable experiences that go beyond the classroom.

While engineering education looks a lot like it did 20 or 30 years ago, engineering educators at UD are embracing methods that encourage a more entrepreneurial mindset thanks to a grant from The Kern Entrepreneurial Engineering Network (KEEN). KEEN is a national consortium of universities dedicated to transforming the way engineering is taught at the undergraduate level. The University of Dayton is one of 30 partner institutions and has taken a leadership role in the network.

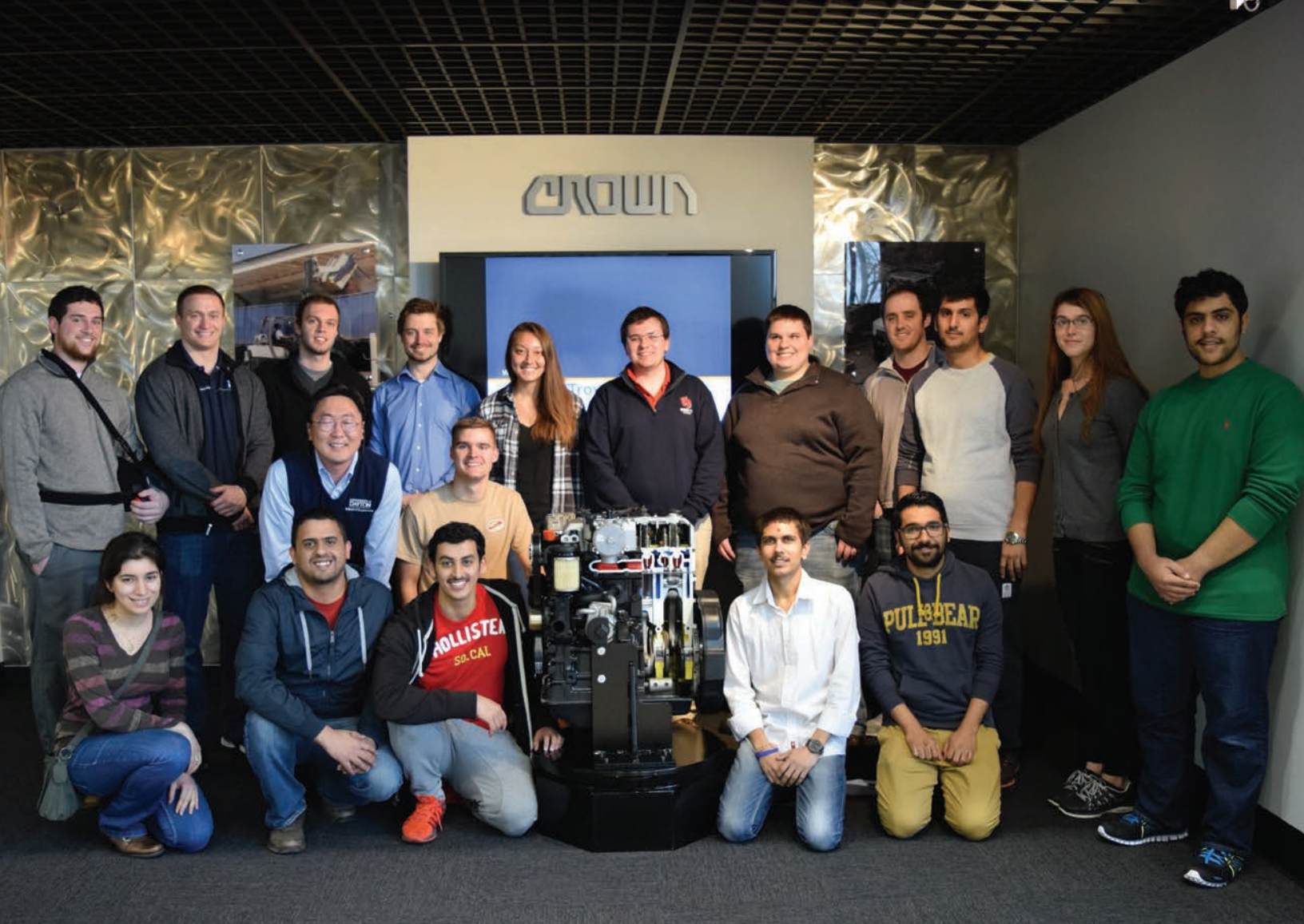
Thinking entrepreneurially starts in the classroom, which is why the centerpiece of the KEEN program at UD is the KEEN Fellows Program, now in its third year. The Fellows Program, which was funded by an institutional grant from KEEN, is the largest faculty development effort in the 100 plus year history of the School of Engineering.

The program brings together a cross-disciplinary cohort of faculty from inside and outside of engineering to learn about the entrepreneurial mindset and how it can be incorporated into the curriculum. Faculty are then given time over the summer to implement their ideas by redesigning a course they teach. To date, 55 faculty members — 42 from engineering and 13 from other areas—have participated in the three cohorts.

The results have been noticed both in the classroom, across campus and on the national level.

Jun-Ki Choi, assistant professor of mechanical

Organizational Impact

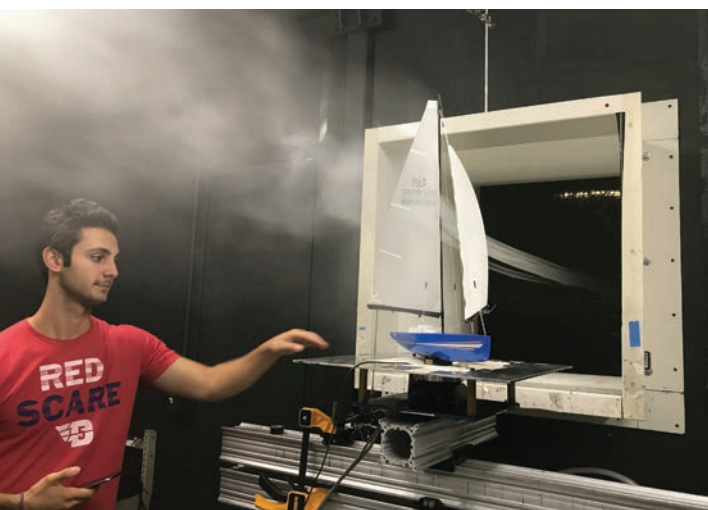


engineering and 2015 KEEN Fellow, created a course called Design for Environment that was featured in KEEN's national magazine this year. Choi partnered with Crown Equipment Corporation in New Bremen, Ohio, to give his students the opportunity to study design for sustainability over the product lifecycle, using real-world challenges supplied by Crown.

First year faculty member and 2017 KEEN Fellow **Sidaard "Sid" Gunasekaran** wanted the students in his aerodynamics course to find their passion and have an experience they would remember long after the class ended. So instead of a wide survey of the equations behind aerodynamic principles, he asked his students to create their own "passion projects" and take a deep dive into the subject matter.

Students had to study the equations related to their project and define a problem they wished to address.

The ambiguity of the assignment was challenging for many of the students, who are used to the problem being defined for them.



UD students are gaining real-world experience in aerodynamics and sustainable design as teaching methods shift to outside the classroom.



“In the real world, engineers need to put together projects with the resources available, and that’s what the students did with the passion projects,” Gunasekaran said. “Engineering is hands-on, not just memorizing equations.”

Numerous cross-campus and community collaborations have developed as a result of the School’s participation in KEEN.

One of those collaborations is a new academic certificate in applied creativity, the first of its kind in the nation. Sponsored by the School of Engineering and housed in the University’s Institute of Applied Creativity for Transformation (IACT) at ArtStreet, the certificate introduces students from engineering to the creative competencies that today’s job market demands.

Mechanical engineering major **Colin Joern** said the pilot certificate courses have improved his teamwork skills and pushed him to ask more questions in all his classes.

“It challenged me and gave me the confidence to challenge the norm on a lot of issues,” he said. “I began to see my engineering courses with a changed perspective and began to ask more questions of my professors on why problems are approached in a certain way and how I might find alternative methods.”

Students studying aerodynamics were able to take a “deep dive” into the subject with passion projects.

““ Being able to run smoke and oil visualizations in an aerodynamics class was more valuable to me than just about any equation from class,” said Jared Martin, a junior mechanical engineering major. “So much of aerodynamics is experimental, so having the experience testing in a wind tunnel is important to me as someone who wants to remain in the field. ””





Experiential Impact



The ETHOS Center Broadens Students' World Views

From traditional co-op placements to makerspaces to international travel, engineering education is embracing experiential learning. Experiential learning is any learning that supports students in applying their technical knowledge to real world problems. At the University of Dayton it goes beyond technical problem solving to consider how technology impacts people and society.

Sixteen years ago, as an undergraduate engineering student, **Christine Vehar Jutte** dreamed of having an impact in India by working in Mother Teresa's ministry. That dream was not to be, but Jutte's trip to India with the University's Office of Campus Ministry and her passion for using her engineering skills to help others left a lasting legacy.

Jutte and three other students founded ETHOS, Engineers in Technical Humanitarian Opportunities of Service-Learning, after then chair of mechanical engineering **Kevin Hallinan**, challenged Jutte to design a program rather than a single piece of technology.

“I saw a need for a class and I wanted students to view their engineering skills as a vocation to help others,” Jutte said.

The basics of the program they designed — partnering with Non-Governmental Organizations (NGOs), sustainability, use of appropriate technology, classes to prepare students for the experience and 10-week summer immersions — are still in place. However, ETHOS has grown and changed as a result of the School’s Strategic Plan.

The ETHOS Program is now The ETHOS Center. Under the leadership of **Malcolm Daniels**, associate professor of electrical and computer engineering, the Center expanded its offerings to include graduate student immersions, domestic Semesters of Service in cooperation with the Fitz Center for Leadership in Community, a year-round immersion calendar to keep projects moving forward and 10-day immersions for first-year students.

The ETHOS Center is funded by the School of Engineering.

“People in Malawi value education above almost anything else,” said Matt Maroon, founder of Determined to Develop, a Karonga-based nongovernmental organization in Malawi. “I’ve seen mothers sacrifice food in order to pay school tuition for their children.”



Rob Greene, a graduate assistant with The ETHOS Center who was working on his master's in civil engineering with an emphasis on environmental engineering, was in Malawi this spring serving as a project manager for a new high school complex under construction in the Karonga District. When complete, Wasambo High School will offer a boy's school, a girl's school, a technical college and housing for students and teachers. The boy's high school will open this fall.

The project is being spearheaded by Determined to Develop, a NGO founded by University of Dayton graduate **Matt Maroon**, and funded by UD alumni and student fundraising efforts. Sixty-seven percent of Malawi's population is under the age of 24, yet the country only has the capacity for 18 percent of them to attend high school.

Greene was helping to oversee construction and consulting on future construction plans. ETHOS has had a presence in Malawi since 2011 and worked with Malawians on projects from renewable technology to potable water.



“One of the most meaningful things I have learned from my time in Malawi is that no matter who you are you can probably help someone, know someone that can help, or you have the resources to learn how,” said Rob Greene.

“At times, it seems like ETHOS has only complicated my plans, but now I understand that I don't only have an opportunity but also a degree of responsibility to act to better benefit my community and greater world community,” Greene said.

Rob Greene is pictured above and at right in red T-shirt, with members of the planning and work crew, including Matt Maroon, above right in blue shirt.



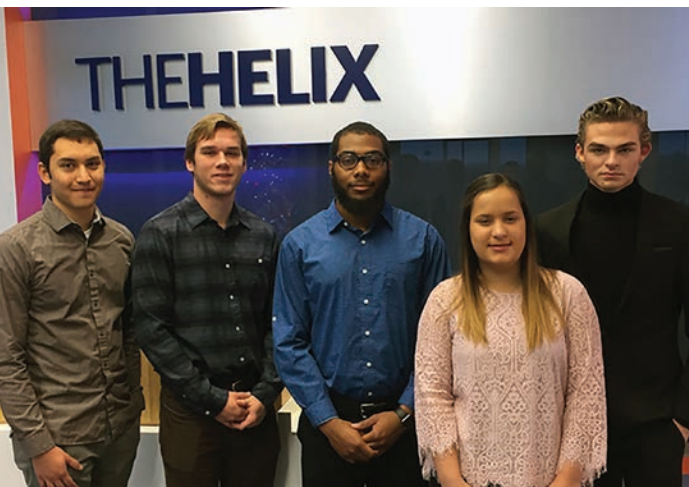
LEARNING

FROM THE BEST



Five University of Dayton students received the first Emerson Innovation Scholarships sponsored by The Helix Innovation Center on the University of Dayton campus. They will work with Emerson engineers and industry leaders to develop innovations in the heating, ventilation, air conditioning and refrigeration industry.

Each student received \$10,000 to support their work and be assigned a mentor at The Helix. The students are:



- ★ Frances Corujo, a mechanical engineering major from Toa Alta, Puerto Rico
- ★ Kieran Holland, a computer engineering major from Maple Heights, Ohio
- ★ Nicholas Schlueter, an accounting and finance major from Montgomery, Ohio
- ★ Kenneth Selby, a mechanical engineering major from New Lebanon, Ohio
- ★ Jesse Thompson, a visual arts major from Franklin, Tennessee

“The collaboration with the University of Dayton is an important part of our mission at The Helix. We want these students to become part of our collaboration community. So it was very important that we include students from majors outside our traditional engineering path,” said Rajan Rajendran, vice president of system innovation and sustainability for Emerson’s commercial and residential solutions platform.



The University of Dayton Institute of Applied Creativity for Transformation at ArtStreet also is a partner in the Emerson Innovation Scholarship program. It is the institute's first scholarship.

The 40,000 square-foot Helix contains six simulated environments that will provide University of Dayton students a real-world research playground — a fully-functioning and furnished home, a model supermarket, a light commercial environment, a commercial kitchen, a data center and an industrial chiller.

“I plan on taking advantage of the mentorship opportunity and learning different ways I can apply what I’m learning in school to help better the world. I hope to be more creative in my thinking,” Holland said. “I look forward to developing a great relationship with my mentor that goes beyond education.”

The Helix scholarship program is an extension of the hands-on work University of Dayton students and Emerson have done together since the early 1980s.

“Emerson’s influence is woven throughout the fabric of the School of Engineering,” said School of Engineering Dean Eddy Rojas. “We deeply value our relationship with Emerson, as it has provided students with scholarships, hands-on projects in our Design and Manufacturing Clinic and Innovation Center, and co-ops and internships.”

“Our relationship with Emerson provides tremendous value to a University of Dayton education and improves student outcomes. Opportunities our students will have in The Helix will only add to that.”

In all, Emerson funds eight scholarships for University of Dayton students.

In addition to scholarships, an Emerson grant in the mid-1990’s helped establish the School of Engineering’s Design and Manufacturing Clinic, which evolved into the School of Engineering’s Innovation Center. That partnership is providing uncommon opportunities

for experiential learning. Nearly 3,000 students have conducted more than 1,200 projects for more than 200 companies in the Design and Manufacturing Clinic or the School of Engineering’s Innovation Center, meeting or exceeding expectations 85 percent of the time. Emerson has sponsored 91 of those projects. Within the School of Engineering’s Innovation Center is the Emerson Product Innovation Laboratory established with a \$1 million commitment.

“Emerson has been very generous with the support it provides our students,” said Becky Blust, University of Dayton School of Engineering Innovation Center director. “Emerson helps us show our students that entrepreneurship and innovation are not just limited to academic exercises in classrooms.”

The support has extended to significant job opportunities for students while they’re in school and as they start careers. Nearly 200 students have worked as co-ops or interns at Emerson. Many of them — more than 100 alumni holding more than 150 degrees — have gone on to jobs in Emerson companies.



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