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The practice of engineering transcends borders. The next generation of engineering leaders must be well versed in the social, economic and cultural contexts in which their innovations will be applied. It is equally important for engineering teams to include voices and perspectives from across the globe, both to strengthen creativity and to ensure that technological solutions truly address the needs of local populations.

Our community includes students, professors, alumni and partners from more than 100 countries. Through strategic recruitment initiatives, including our U of T Engineering International Scholarships, we attract talented individuals from outside of Canada who strengthen our leading-edge collaborative research and innovative educational programs.

We provide every student with boundless opportunities to study, work and conduct research abroad. These include exchanges coordinated by U of T's Centre for International Experience as well as programs specific to our Faculty, such as the Engineering Science Research Opportunities Program – Global (ESROP-Global). Participation in ESROP-Global in the summer of 2019 was 50% higher than the previous year.

Many students choose to work abroad through the Professional Experience Year Co-op Program. Programs such as Summer Research Abroad and our international capstone course provide opportunities for our students to gain cultural fluency by collaborating with students and faculty members from peer institutions around the world. Our Centre for Global Engineering (CGEN) facilitates international projects at both the undergraduate and graduate level. CGEN also offers multidisciplinary courses on topics in global engineering.

For the last three years, we have hosted Global Engineering Week, an initiative that now goes beyond U of T. It includes course partnerships, a hackathon, and panel discussions that challenge students to engage with international issues.

Through these and many other initiatives, our graduates gain the global fluency and perspectives that enable them to take their place as leaders in a global engineering environment.

International Students and Exchanges

We attract top students from around the world via our international reputation for excellence in research and education, as well as strategic recruitment initiatives in targeted regions. In 2018–2019, our Engineering Student Recruitment & Retention Office conducted school visits, applicant events and information sessions in Brazil, Colombia, Dubai (UAE), Ecuador, Indonesia, Panama, Singapore, Trinidad and Tobago, Turkey and the U.S.

In 2018–2019, international applications for undergraduate studies rose 10.8% over the previous year and international applications for graduate studies also remained strong. Currently, 27.6% of our undergraduate students and 36.5% of our graduate students come from outside of Canada.

We also offer a number of scholarships and structured degree partnerships with specific institutions, countries or regions. These include:

- **International Foundations Program (IFP):** IFP enables academically strong students who do not meet the University's minimum English proficiency requirements to receive conditional offers of admission as non-degree students. After completing an intensive, eight-month English language program as well as our Engineering Strategies & Practice course, these students continue into a Core 8 engineering program. Thirteen students are currently enrolled in IFP and are expected to join the Faculty in the fall of 2019.
- **U of T Engineering International Scholar Award:** We established this award in 2014, and over the next four years provided eight international students with full support throughout their undergraduate degrees. The recipients came from Jordan, India, New Zealand, Singapore, Trinidad and Tobago, Turkey and the U.S. In 2018, following the establishment of the Lester B. Pearson International Scholarship, we redesigned this award to support international students from underrepresented regions. The first cohort joined U of T Engineering in September 2018 and included students from Mexico, South Korea, Trinidad and Tobago and Vietnam.
- **Lester B. Pearson International Scholarship:** Established in 2017, this University-wide, four-year undergraduate scholarship recognizes exceptional academic achievement, creativity, leadership potential and community involvement. In 2018, seven students in our Faculty received this award, representing countries such as Colombia, Jamaica, India, Mexico, Nigeria, Trinidad and Tobago, and the U.S. A total of 11 U of T Engineering students have received this award since 2017.

We provide a comprehensive suite of programs through which students spend up to 16 months working, studying or conducting research abroad. These include:

- **Professional Experience Year Co-op (PEY Co-op) Program:** PEY Co-op students work for 12 to 16 months at companies and organizations across Canada and around the world. In 2018–2019, 85 of these work terms — approximately one in 10 — took place outside of Canada. These included 64 in the U.S and 21 in other countries such as Belgium, Botswana, China, Japan, Switzerland and the United Kingdom. (*For more information on PEY Co-op, see Chapter 4: Cross-Faculty Education & Experiential Learning.*)
- **Summer Research Abroad, Structured Exchange Pathways and other exchange programs:** We offer a wide variety of programs that enable our students to conduct research internships or pursue academic courses at partner institutions abroad. Some of these programs are administered by U of T's Centre for International Experience while others, such as the Engineering Science Research Opportunities Program – Global (ESROP-Global), are coordinated by the Faculty. In 2018–2019, 89 students participated in these exchange programs.
- **Cross-cultural design:** Since 2011, the Department of Mechanical & Industrial Engineering has offered an international capstone course in which students collaborate with their peers at leading institutions worldwide on design projects brought forward by industry. Current partners include Shanghai Jiao Tong University and Tsinghua University, while past partners have included Beihang University, Peking University, Penn State University, the National University of Singapore and the University of California, Irvine.

The office of the Vice-President, International has set a goal to increase the number of U of T students who participate in at least one outbound international experience by the time they graduate, from 19% in 2016 to 30% by 2022. We are well on our way to meeting this target, with 237 graduating students (22%) meeting this criterion in 2018–2019, up 20% from 197 students in 2017–2018.

Data and highlights in this chapter are presented by academic year (September to August).

International Agreements

Our strategic partnerships with peer institutions around the world create pathways for students to gain international experience and enhance their global fluency. These include course-based and research exchanges, as well as cross-cultural engineering design courses, dual-degree programs and opportunities for international students to streamline their applications to our graduate programs, such as the professional master's (MEng). As of June 2019, our Faculty has more than 25 active international agreements, with access to other top institutions through University-wide partnerships.

International Doctoral Clusters (IDCs) are research and doctoral education arrangements in well-defined areas that bring together a critical mass of complementary talent at U of T and partner institutions to form collaborations that further foster research innovation. In 2018–2019, we entered into new agreements to create International Doctoral Clusters (IDCs) with:

- Utrecht University and Chinese University of Hong Kong — IDC on Public Health and Cities
- National University of Singapore — Urban Water, Waste and Energy Solutions

In partnership with the Centre for International Experience, we continue to expand the number of leading institutions worldwide where our students can complete course-based or research exchanges. In 2018–2019 we signed new agreements with:

- Chulalongkorn University, Thailand
- École Polytechnique, France
- Pontifical Catholic University (PUC), Chile
- Sorbonne University, France
- University of Barcelona, Spain
- Università Cattolica del Sacro Cuore, Italy

Global Engineering

Our Centre for Global Engineering (CGEN) was founded in 2009 to empower faculty and students to develop transformative solutions to the profound engineering challenges that affect the lives of billions of people around the world. Through course offerings, capstone design projects, and immersive research initiatives, CGEN encourages students to engage with issues such as food security, water and sanitation, energy, infrastructure, and public health in low-income countries, as well as in resource-constrained communities in Canada. CGEN also offers fellowships for research with global impact.

With the support of the Dean's Strategic Fund (DSF), CGEN launched its first set of Global Engineering capstone design projects in 2018. These projects are carried out in partnership with social enterprises and NGOs working to address critical issues. Our students gain valuable international experience, and the partner organizations gain technical expertise they would not otherwise be able to access. Through collaborations, CGEN has identified 14 projects with 12 clients worldwide. These include:

- **Coconut paring for medium-scale production (Samar, Philippines)** — This partnership with Coco-Asenso social enterprise applies engineering innovation to enhance the efficiency of a coconut processing facility that uses a combination of manual and machine-assisted techniques. Students identified peeling as the rate-limiting step and are developing a low-cost, ergonomic solution that speeds up the process.
- **Solar dehydrator for cricket consumption (Siem Reap, Cambodia)** — Dehydrated cricket powder is being used by World Vision as a source of micronutrients for malnourished children in this community. A team of U of T Engineering students is developing a solar-powered system to quickly dehydrate crickets, enabling production to be localized and further reducing costs.

In 2018–2019, CGEN launched the Reconciliation Through Engineering Initiative (RTEI). The initiative's objectives are to build strong relationships with geographically disparate Indigenous communities across Canada. Together, we identify pressing engineering challenges facing those communities, and work with members of those communities to co-design sustainable solutions, build technical capacity and enable pathways for future participatory action research. *(For more on RTEI, please see Chapter 10 – Equity, Diversity and Inclusion)*

Selected International Education and Research Partnerships

U of T Engineering celebrates third annual Global Engineering Week

From March 11-17, 2019 Global Engineering Week (GE Week) challenged students at U of T Engineering and across Ontario to think critically about how they can make a difference on the world stage. Founded by alumnus Malik Ismail (EngSci 1T6 + PEY), now an associate at the Boston Consulting Group (BCG), GE Week was co-hosted by CGEN as well as the U of T Engineering chapters of Engineers Without Borders, Women in Science and Engineering and the Sustainable Engineers Association. Other partners included leading tech companies and NGOs, such as LEAP at the Pecaut Centre for Social Impact. Events during GE Week at U of T included a speaker panel on the role of artificial intelligence in global development, hosted by Professor Timothy Chan (MIE), as well as a student hackathon called “Hack the Globe.” In addition, we also hosted a global engineering fair and presentations in classes across all years of study. In its third year, GE Week has expanded to peer institutions including the University of Waterloo, Concordia University and Western University.

Engineers in Action build footbridge in Bolivia

In June 2018, the University of Toronto Engineers in Action team (formerly Bridges to Prosperity) constructed a 64-metre suspended footbridge over the Gonchu Mayu river in Bolivia, their third bridge project since 2016. The latest project began in January 2018 when Engineers in Action was asked to design and build a bridge for Tablas Monte, a village of 140 families located on the tropical slopes of the Andes. To complete the bridge, students faced a 40-minute commute to the site, requiring them to wake before sunrise and work until after sunset each day. Challenges included the river profile, which varied greatly from the survey that they originally received; and the necessity to use an anchor in dynamited rock. Despite these unexpected developments, the team completed the bridge as scheduled, working alongside a local engineer and masons.

UTIAS professor addresses global demand for robotics and AI education

In March 2019, Professor Jonathan Kelly (UTIAS) travelled to Yangon, Myanmar, where he partnered with a startup accelerator to teach robotics to 25 local university students. The teaching opportunity was part of an initiative by Phandeeyar, an organization that aims to expand the pool of tech talent in Myanmar in order to accelerate the country’s social and economic development. Rapid growth in Myanmar has given rise to a new generation of aspiring engineers, computer scientists and entrepreneurs who have been empowered to become part of the country’s technology sector, including fields such as robotics. Kelly’s week-long course included an introduction to robotics and a few days dedicated to artificial intelligence and how to program software for self-driving vehicles. In January 2019, Kelly, along with Professor Steven Waslander (UTIAS) partnered with Coursera to develop and deliver an online four-course specialization in self-driving car technology. Of the more than 4,800 learners the specialization has attracted so far, 97% are from outside of Canada.

Engineering Education for Sustainable Cities in Africa (EESC-A)

EESC-A is supported by the Dean’s Strategic Fund and began in 2016. Our goal is to explore U of T Engineering’s role in helping to educate future “sustainable cities engineers” who will shape the direction of Africa’s growing megacities. The project involves both community building and the creation of flexible, adaptable course materials that can be delivered online. The Toronto-based EESC-A team members travel frequently to various African countries to build and maintain a network of institutions and academics with expertise in sustainable cities. Collectively, they have visited approximately 30 engineering schools in 10 countries since 2016. The program has also funded four African “roaming scholars” to travel within the continent, further strengthening these bonds through interactions and collaboration. In fall 2018, three of these four scholars — along with their students — participated in a project known as the Global Classroom, through which an online course was delivered simultaneously across multiple institutions. Students moved through the content with their respective professors, then met once a week via videoconference with the entire team. The team has received very positive feedback about the first iteration of the course, which was run as a not-for-credit trial. Future online courses may offer full course credit, either at U of T or the partner institutions.

First study of traffic-related pollution in Trinidad and Tobago reveals high levels of black carbon

A new U of T Engineering study has measured significant concentrations of traffic-related air pollution near major roadways in Trinidad and Tobago, reaching levels comparable to highways in Toronto and Detroit. The research was led by Kerolyn Shairsingh (ChemE OT8, PhD 1T8) under the supervision of Professor Greg Evans (ChemE, ISTEP). Shairsingh was motivated to research local concentrations of black carbon in Trinidad and Tobago after years of experiencing asthma attacks every time she travelled back to her home country. When she visited in February 2018 she brought air-quality monitoring equipment with her, setting up 10 monitoring sites across Trinidad and Tobago over a three-week period, including near oil and gas refineries, urban residences, and major roads. She found that levels of black carbon around industrial areas on the islands were elevated to levels comparable to the Macdonald-Cartier Freeway outside of Toronto, one of the busiest highways in North America. Levels near major roads in Trinidad and Tobago were significantly higher. Although the country passed air pollution legislation in 2014, the guidelines do not include monitoring of vehicles. Shairsingh's research, which was published in *Science of the Total Environment*, will be the first step toward improving air quality, either through cleaner fuel sources or through retrofitting of large vehicles such as buses and trucks.

Putting power in the hands of the people

Olugbenga Olubanjo (CivE MASc candidate) and his collaborators have created a startup designed to bring clean, affordable and portable power to places where the electricity grid is either unavailable or unreliable. Olubanjo was inspired by the experience of calling relatives in his native Nigeria from Toronto; calls would often be cut off due to a loss of power. His startup, Reeddi Inc., envisions a standalone, solar-powered structure with removable, rechargeable lithium-ion battery packs. Customers would rent the packs for periods of up to 24 hours, returning them when depleted. Olubanjo has received support and mentorship from The Entrepreneurship Hatchery as well from Professor Yu-Ling Cheng (ChemE, CGEN) and other colleagues across U of T Engineering. The startup has won a number of awards, including the North American Regional Award for the Best Emerging Startups in Decentralised Energy Track at the IEEE Empower a Billion Lives Challenge held at Georgia Tech in February, 2019, and the MIT 2019 Clean Energy Prize (National Grid Energy Delivery Track). In May 2019, Reeddi Inc. was a runner-up in the Cisco Global Problem Solver Challenge. The team aims to have a micro-scaled pilot with five interactive Reeddi capsule prototypes in Nigeria by August 2019.

