

5. Research Foci

Our Faculty is an international leader in research and innovation and we are known for addressing complex global challenges. The impact of our research is local, national, and international in scale. Our multidisciplinary collaboration and ingenuity drive new technologies and processes that power economic development, improve lives and protect the planet. Our engineers are known as creators and innovators and at U of T Engineering we continue to distinguish ourselves as the premier engineering school in Canada and among the best in the world.

The innovation at U of T Engineering attracts top researchers and students from across Canada and internationally, and enables us to leverage the agency funding and industrial partnerships necessary to continue our groundbreaking work. In addition, our distinguished research institutes and centres contain unique facilities and expertise. Inherently multidisciplinary and collaborative, we bring together technical knowledge and diverse perspectives to solve the complex problems society faces today.

Our Academic Plan outlined a key goal with respect to our research portfolio: to increase our Tri-Council funding to \$25 million per year by 2015. We surpassed this goal three years early, reaching \$26.3 million in 2012–2013, and are making excellent progress toward our new goal of \$32 million by 2015–2016. The importance of this funding is underscored by the fact that the national reallocation of Canada Research Chairs (CRCs), which occurs every two years, is based on the proportion of Tri-Council and Networks of Centres of Excellence (NCE) funding that each university receives. CRCs represented \$3.5 million in revenue for the Faculty in 2013–2014, and \$3.9 million in each of 2014–2015 and 2015–2016. The growth in Tri-Council funding translated into U of T Engineering receiving an additional two Tier II equivalent CRCs in the 2015 reallocation.

In 2013–2014, U of T Engineering attracted \$81.6 million in research infrastructure and operating funds — the highest annual total in our Faculty’s history and a 21 per cent increase over the previous year. Through our collective efforts, we have pursued and attracted more support for our research programs, including \$3.1 million from the Canadian Institutes of Health Research (CIHR), which has tripled in the past decade from \$1 million in 2004–2005. This increase is in line with our Academic Plan goals and supports our world-renowned research in biomedical engineering and health-systems research. We have also received significant support to enhance our outstanding research infrastructure. In January 2015, six professors in our Faculty received a total of more than \$1 million from the Canada Foundation for Innovation’s (CFI) John R. Evans Leaders Fund to build their research capacity with new, cutting-edge equipment. The new infrastructure

will support research that will facilitate the creation of new telecommunications devices and the development and use of chemical isotopes to track emerging environmental contaminants, such as pharmaceutical products in wastewater.

In July 2015, the University of Toronto was awarded the first grant through the Federal Government's Canada First Research Excellence Fund (CFREF). The \$114 million initiative *Medicine by Design* is a collaborative project with U of T Engineering, our partner research hospitals, the Faculties of Medicine, Pharmacy and Arts & Science and other academic and industry collaborators. *Medicine by Design* will enhance U of T Engineering and U of T's position as leaders in transformative research and clinical translation in regenerative medicine. In addition, the initiative will enhance capability in synthetic biology and computational biology, will foster clinical impacts and will lead the evolution of Canada's global medical industry with the significant creation and supply of regenerative medicine technologies.

Our collaborations and partnerships with industry allow us to not only leverage funding opportunities but also enhance commercialization and knowledge transfer. In the past year, we attracted numerous corporate partners, including those leveraged through the Natural Sciences and Engineering Research Council's (NSERC) Strategic Partnership Grants (SPG), which seek to increase research and training in targeted areas that could enhance Canada's economy, society or environment. In 2014–2015, our Faculty received \$3.5 million in funding from the NSERC SPG program for eight new initiatives. These include research into new catalysts that can convert waste gas into useful fuels and a project investigating the use of nanofibre membranes for water filtration and treatment.

In total, more than 300 partners provide funding through sponsored research agreements or as part of consortia. In support of corporate outreach activities and new industry partners, this year we also created a series of insightful new research inserts in key areas of focus. These publications highlight the benefits of partnership with U of T Engineering and emphasize strategic research and development strengths within the Faculty. We also relaunched our main Faculty website — including a redesigned Research and Innovation page — to further support marketing to and communications with potential and existing partners. In November 2015, we will also hold our fourth annual Industry Partners Reception, our premier networking event to facilitate introductions that could lead to new partnerships and ideas for collaborative projects.

In addition to our NSERC SPG success, in 2014–2015, U of T Engineering had the lead role on nine NSERC Collaborative Research and Training Experience (CREATE) grants, including two new grants awarded during the year. The CREATE program allows us to enhance our

capacity to develop highly qualified students and postdoctoral fellows through innovative initiatives that encourage collaborative and integrative approaches to research. Students and postdoctoral fellows will then be able to successfully transition into the workforce. In May 2015, Professor Hugh Liu received a \$1.65 million CREATE grant to train 150 new experts in the use of unmanned aerial vehicles (UAVs) for a variety of purposes, from agriculture to environmental monitoring. Liu's team, the Flight Systems and Control Research Laboratory, develops algorithms that can help UAVs respond intelligently to a variety of inputs. The CREATE grant will build on previous work and allow Liu and his collaborators to design UAVs for many other possible applications, including scouting for mineral deposits or other natural resources, monitoring pipelines or railways for damage, checking on crops and applying fertilizers. In July 2014, Professor Brent Sleep received a CREATE for the Remediation Education Network (RENEW). This award supports student training in environmental remediation, such as determining new methods for decontaminating groundwater.

Across U of T Engineering we have actively worked on numerous programs that will benefit our entire community, including faculty members at all stages of their careers, undergraduate and graduate students and our collaborative stakeholders in industry, academia and partner research hospitals. All our initiatives provide support and resources across the Faculty and ensure our continued success and excellence in research.

RESEARCH FOCI: YEAR 4 PROGRESS HIGHLIGHTS

5.1 Create new and support current research centres around strategic research themes that make significant, relevant impacts on society.

- Supported two U of T Engineering institutes submitting proposals to FedDev
- Assisted researchers and our Faculty-appointed Principal Investigator (PI) via Faculty participation in the Canada First Research Excellence Fund (CFREF); resulting in a \$114 million award to the U of T for *Medicine by Design*, a collaborative project enhancing U of T's position as a leader in regenerative medicine
- Supported NSERC CREATE applications
- Advanced U of T Engineering NSERC Strategic Research Networks
- Reinvested in the Centre for Healthcare Engineering (formerly the Centre for Research in Healthcare Engineering)

5.2 Increase our Tri-council funding level to \$25 million per annum by 2015.

- Met and surpassed goal three years early, reaching \$26.3 million in 2012–2013; made excellent progress toward new goal of \$32 million by 2015–2016, achieving a record \$27.4 million in Tri-Council funding in 2013–2014

5.3 By 2015, increase the number of Canada Research Chairs by eight (to a total of 30), increase Industrial Research Chairs by six (to a total of 10) and increase Endowed Chairs and Limited Term Chairs by 13 (to a total of 40).

- Actively worked to identify new Industrial Research Chair (IRC) and Endowed Chair prospects — currently we have 7 IRCs and 27 Endowed Chairs — across the Faculty we have a total of 71 research chairs held by 63 individual chairholders
- Increased number of CRC Tier II equivalents by 2 to 41 in 2014–2015
- Gained four new CRCs in 2014–2015, bringing the total to 27 across the Faculty
- Continued to share best practices through the Faculty’s Research Committee to foster growth of sponsored research, which in turn impacts the Faculty’s CRC allocation

5.4 Develop additional funding sources through the Social Sciences and Humanities Research Council (SSHRC), the Canadian Institutes of Health Research (CIHR), corporations, industries and international granting agencies.

- Hosted the third annual U of T Engineering Industry Partners Reception to celebrate existing collaborators and welcome new ones, with more than 120 people attending (November 2014)
- Pursued CIHR-NSERC partnerships funding such as CHRP (Collaborative Health Research Projects)
- Supported NSERC Strategic Partnership Grants applications
- Provided support to Ontario Research Fund–Research Excellence (ORF-RE) team applications and worked with faculty to build their industry consortia
- Focused on industry-sponsored research and matching funding for various granting agency competitions
- Actively pursued opportunities with top corporate prospects to leverage partnerships and add value to research and technology development

5.5 Support junior faculty members and emerging research leaders to ensure that they successfully secure external research funding from industry, federal and provincial sources.

- Worked with junior faculty, through the Faculty’s Research Committee and Directors of Corporate Partnerships, to identify and pursue industry partners
- Held a lunch-time panel series for faculty on best practices in research, including a session on collaborative and partnership research
- Prepared junior faculty to apply for Early Research Awards (ERA) by hosting a panel called “Succeeding in the ERA” and initiating an internal expert review during the competition to critique each of the Faculty’s applications
- Successfully supported faculty, resulting in six receiving Connaught New Researcher Awards

5.6 Raise awareness and promote our research contributions and breakthroughs with peers, funding agencies, industry and the public.

- Awarded the third annual Research Leader Award to Professor Honghi Tran for leadership in interdisciplinary and multiple investigator initiatives that have enhanced the Faculty's research profile with the broader community
- Produced several new research inserts on water, advanced manufacturing, healthcare engineering, nanoengineering and sustainable mining to support corporate outreach activities and industry partnerships
- Launched a number of strategic initiatives, including proactive media outreach, an enhanced online presence and improved marketing materials, aimed at strengthening our visibility and our reputation for excellence
- Increased proactive pitching tied to breaking news and current affairs and secured media stories along strategic communications themes by proactively offering our professors as experts for media
- Celebrated with the University of Toronto community, the announcement of the largest CFREF award in Canada, *Medicine by Design*, with Minister of State for Science and Technology Ed Holder in attendance
- Participated in the University of Toronto Science & Engineering Engagement (SEE U of T) event for Sustainability & Engineering, with a presentation on "Environmentally Sustainable Aviation" (September 2015)

5.7 Generate synergistic research partnerships with peer institutions within Canada, and strategic international partners, while taking on leadership roles at the national and international levels.

- Enhanced collaboration and partnership with the Vice-President of University Relations and the Vice-President, Research and Innovation on international partnership development
- Partnered with multiple Canadian institutions on NSERC CREATE, Strategic Research Network, and CFREF applications
- Recruited a Director of Government, International and Corporate Partnerships

5.8 Increase participation and provide leadership on external review committees in granting agencies such as the Natural Sciences and Engineering Research Council (NSERC), Ontario Centres of Excellence (OCE), and the Ontario Ministry of Research and Innovation (MRI).

- Worked with the Office of the Vice-President, Research and Innovation (OVPRI) and the Ontario Council of University Research (OCUR), to successfully make the case to Ontario's Ministry of Research and Innovation to improve transparency in its review process for the ORF-RE program

- Continued engagement with the Ontario Centres of Excellence to provide matching support for the Heffernan Entrepreneurship Fellowships
- Presented highlights of U of T Engineering sustainability research to NSERC staff in Ottawa (February 2015)

5.9 Enhance multidisciplinary, collaborative research endeavors.

- Established the Translational Biology and Engineering Program (TBEP) in collaboration with the Faculties of Medicine and Dentistry (April 2015)
- Awarded the first federally-funded Canada First Research Excellence Fund (CFREF); the \$114 million grant to the U of T for *Medicine by Design*, a collaborative project among the Faculty of Applied Science & Engineering, the Faculties of Medicine, Pharmacy and Arts & Science, partner research hospitals and other academic and industry collaborators
- Attracted two new NSERC CREATE grants, bringing the total U of T Engineering lead roles to nine
- Ramped up the newly established Ontario Centre for Characterization of Advanced Materials (OCCAM), the Toronto Institute of Advanced Manufacturing (TIAM) and the Centre for Healthcare Engineering (CHE)
- Enabled 13 collaborative research centres and initiatives through the Dean's Strategic Fund, including the Centre for Aerial Robotics Research and Education, the Institute for Neural Engineering and EMH:Seed: Seeding Innovative Research Partnerships between Engineering, Medicine, and the Research Hospitals, the latter which provides seed funding to enable significant, externally-supported projects and encourage multidisciplinary collaborations
- Awarded eight NSERC Strategic Partnership Grants (SPGs), a 2014 success rate of 30 per cent, up from the 2013 success rate of 22 per cent, and improving over the typical Canadian national average of 23 to 25 per cent
- Attracted two new ORF-RE grants with total project value over \$30 million (of which \$9 million is from the Province of Ontario)

5.10 Engage more undergraduate and international graduate students in faculty research activities

- Hosted a roundtable on undergraduate research opportunities at the Dean's Town Hall (September 2015)
- Held the 2015 Undergraduate Research Day UnERD, a one-day research symposium for students to celebrate undergraduate engineering research carried out over the summer and allowing students to gain key competencies through abstract writing and collaborative networking (August 2015)
- Increased the number of international PhD graduate students to 278 in 2014–2015, from 256 in 2013–2014