December 2023

Appendices: Faculty Self-Study for External Review

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

DEFY GRAVITY

Table of Contents

Appendices – Faculty Self-Study for External Review

Appendix A: 2017 Faculty Review Summary and Response

Report on the External Review of the Faculty of Applied Science and Engineering

University of Toronto

January 31- February 2, 2017

Reviewers:

Professor David C. Munson, Jr., President-elect, Rochester Institute of Technology; former Robert **J.** Vlasic Dean of Engineering, University of Michigan

Professor Indira Samarasekera, Distinguished Fellow in Residence, Liu Institute for Global Issues, UBC; former President and Vice Chancellor, University of Alberta

Introduction

The review of the Faculty of Applied Science and Engineering (FASE) occurred over a two and one-half day period and involved sessions with the Provost and Vice-Provost for Academic Programs, Dean Cristina Amon, department chairs and directors, administrators in charge of the undergraduate program, faculty in charge of cross-disciplinary educational programs, faculty in charge of the graduate programs, deans of cognate Faculties, tenured faculty, pre-tenure faculty, faculty in charge of departmental and collaborative research programs, leadership of the School of Graduate Studies (SGS), undergraduate students, graduate students, administrative staff, and alumni. In addition, we toured the new facilities of the Translational Biology & Engineering Program (TBEP). The reviewers sincerely thank the staff from the Office of the Provost and FASE who made preparations for the review and expertly facilitated the process.

The reviewers already were well aware that FASE has an outstanding faculty and student body and a worldwide reputation for excellence in research and education. Over the past decade, FASE has been ably led by Dean Cristina Amon, who is well recognized for her vision and ability to rally FASE around a progressive agenda. Other Faculty Deans were highly complimentary about Dean Amon regarding her ability to effect collaborative activities with them, including in Medicine, Public Health, and Dentistry. They report that it could not be easier to work with FASE and that they would be hard-pressed to identify any area where FASE has fallen short.

The sections below convey our observations and findings regarding Undergraduate Studies; Graduate Studies; Research; Faculty Matters; and Organizational Structure, Staff and Resources. Recommendations are highlighted in italics.

Undergraduate Studies

The undergraduate student body in FASE is outstanding, as is the undergraduate education being offered. Dean Amon has been providing leadership throughout Canada in thinking about the future of engineering as a field and its implications on how engineering education and academic research ought to develop in the future. Ideally, this is a conversation that will continue to be led by U of T.

FASE is properly focused on training the global engineer. FASE has increased undergraduate research experiences and provided improved professional education. The Institute for Leadership Education in Engineering is also providing significant added value, where the goal is to develop self-efficacy for students and teach them "how to influence others to get things done." The FASE Engineering Communication Program, which integrates communication across the engineering curriculum, is forward-looking and provides much-needed offerings to students. The programs in entrepreneurship are important and seem to be working well (the Hatchery, etc.). It is notable that an engineering business minor is now available to FASE students. However, it is surprising that FASE is offering the business minor itself rather than having the business faculty do so. The reported reason that there is "no room" in existing business classes for additional students is less than compelling.

Overall, the educational program is somewhat stove-piped within FASE. Some of the basic science and math is taught by FASE, which reduces opportunities for engineering students to have contact with faculty in other disciplines. And, FASE provides its own opportunities in music for FASE students. Students reported having few suitable practice spaces for music and conveyed the impression that liberal arts students have better access to music department facilities and faculty. One student described FASE as its own "internal university." This seems unhealthy. The initiative to develop a minor in Music for engineering students is a good one. FASE should collaborate more with Music, the Arts, and Architecture in the realm of creativity and design. *More broadly, FASE should work toward further integration of their student body and academic programs with the rest of campus.*

Diversity among the undergraduate student body has improved enormously in recent years. The entering class, with 40% women, is impressive. This is the highest percentage of women in an engineering class that we have encountered at a public university. *That said, further work is needed with respect to other underrepresented groups, including indigenous peoples.*

For freshmen, orientation week helps build student spirit. Varsity athletics does not have a large following among the student body, but the robust intramural sports program provides an opportunity for student interaction and building of relationships. Although students report a positive culture and adequate social and

research opportunities, the large fraction of commu ters among the undergraduate population makes it challenging to build the cohesive community that generally exists on residential campuses. As a result, many FASE students may be unaware of the elements of co-curricular education that they are missing. In addition to reducing the quality of education potentially obtained by many stude nts, this factor likely translates into reduced lifetime allegiance to U of T, which may negatively impact efforts in fundraising. *One suggestion from student s* is *to form an advisory committee of commuters to provide advice and recommendations on how to better engage students. For exam ple, it may be possible to hold FASE events in the Toronto suburbs. This type of beginning engagement may then stimulate deeper engagement on campus.*

U of T turns down some outstanding applicants from the U.S because they do not have two courses in chemistry, two courses in physics, etc. The requirements for admission to U ofT sound overly stiff. *Flexibility may be prudent. Alternatively, could a student be accepted conditioned on he or she taking an online course or two prior to matriculation?*

The new Centre for Engineering Innovation and Entrepreneurship, currently under construction, will be most welcome, providing space for active learning, student clubs and team-based projects, a light-duty maker facility, and space for interdisciplinary research centres. This facility project has been a longtime in the making and promises to be a vital addition to FASE.

FASE has a number of student project teams (Engineers without Borders , Solar Car , Formula SAE, Baja, etc.). The opening of the ME shop to allstudents has been very helpful to these teams. The Centre for Engineer ing Innovation and Entrepreneurship will add capability for some student teams requiring only light-duty "making." *Project teams requiring heavy infrastructure (floor-mounted milling machines, welding, etc.) would benefit by sharing common space and shop facilities in a single location so that members of the various student teams rub elbows continuously, sharing information and assisting one another.*

Some faculty in FASE are active in using modern learning technologies, producing M00CS and using flipped classroom methodology. In addition, FASE has an educational technology center with three staff members. And, as mentioned above, the Centre for Engineering Innovation and Entrepreneurship will have spaces for active learning and team-based project work. That said, *the proposed center for engineering education* is *needed, because there* is *still a long way to go regarding research and practice in engineering education, as* is *the case at nearly all universities.*

Students value having some professors who have real-world experience from industry. Conversely, students also appreciate having professors who are leading researchers in their fields and who expose students to where the fields are heading. The quality of teaching sounds reasonably high, but commitment to teaching is reported to be inconsistent among the faculty. Sometimes midterms and graded

homework are not turned back to students in a timely way. Because of this, in some cases students are unable to decide whether to drop a course prior to the drop deadline.

Students report that many of the educational course labs are too contrived - not open-ended enough to offer a real-world experience. (This is a problem at most universities.) Some department chairs feel that their departments already offer enough lab courses. We suspect, though, that some of these labs are too "recipe based." We note that there is no budget incentive to offer teaching labs. Labs are expensive and so incentives are needed. *Lab courses ought to receive extra weight (compared to lecture classes) in the FASE budget model.*

Also, more cohesion is needed in how design is taught throughout the curriculum in most departments. The freshman design experience is not connected to the later curriculum unless students seek out additional experiences. An exception is the MIE Department.

Students in MSE seem particularly pleased with their relationships to faculty members, including their joint work on updating the curriculum and the willingness of faculty members to explain why certain topics or software are important in the working world. There may be some best practices in this regard that could be applied in other departments.

The student appeals process is unclear to many students. It was not clear to some students howone gets off academic probation.

FASE has embedded mental health counselors from the central counseling services at U ofT. This is a best practice.

Engineering software is available to students on laptops via virtual machines, also a best practice.

Students have been extremely unhappy with the FASE career center, but recognize that improvements are under way. We were surprised to hear that a substantial fee is charged to students for using the portal to find a Professional Exper ience Year (PEY) internship position ($1000 for a match with a company). Due to the mix of jobs listed, many students end up settling for an ECE type job even though they are studying a different discipline. Students are displeased with this. *We recommend that the FASE career center work even harder at developing a more diverse set of co-op positions for students.* Students reported that they are incented to drop out of U ofT while they are on their internship. Otherwise, they must pay a fee to stay enrolled. We are unsure of the ramifications.

FASE needs better data on where its undergrads go upon graduation and what jobs they do, in an effort to describe and measure impact. This seems to be a problem across U ofT.

The accreditation board, CEAB, is said to be too restrictive with its requirements, creating heavy student loads that do not provide time for students to take enough courses outside of engineering, especially in the social sciences and humanities. We did not have time to investigate this claim.

Graduate Studies

The graduate programs in FASE are outstanding. They are highly competitive internationally, not just at the top in Canada.

The graduate programs vary quite a lot from department to department. That said, graduate student organizations seem to work well with the departmental administrations. Social events and professional development events are funded by the departments. Dinners for department faculty and graduate students are held and valued by students. Graduate Research Days are held for prospective students, and sometimes industry.

Orientations are held in the departments for incoming graduate students. We heard that the quality of these programs varies, with some being excellent and some much less so. *We recommend that departments learn best practices from one another in this area and implement them.*

The Graduate House offers a good living arrangement. There is also housing for married students and rental housing not far from campus. That said, many students commute long distances to save money. This severely cuts into their available time for research. Some PhD students do not come to campus every day during the week, undoubtedly creating a sense of isolation from their research group. It reportedly is hard for FASE graduate students to meet others outside their discipline, although intramural sports provide one medium. The MEng students are said to have the least community. They "show up and take 10 courses." *Instituting additional programs to build community among graduate students would provide a more holistic student experience and create stronger ties back to U of T after graduation.*

We were pleased to hear that SGS offers professional skills development workshops to graduate students. This is a newer trend at many universities.

We were surprised to learn that SGS primarily relies on the various Faculties (e.g. FASE) to monitor and improve diversity, equity and inclusion among graduate students. *Because sharing, and even enforcement, of best practices can be important, U ofT (and FASE) may benefit from more centralized activity and support in this area.*

It is challenging for FASE to increase the number of domestic students, especially at the PhD level. A difficulty with increasing the number of international students, who are available in good supply, is that Ontario does not provide any financial

support for international students. Some faculty reported that it is difficult to attract top PhD students, because Toronto is an expensive place to live and the stipends offered have only 2/3 of the value of those offered in the U.S.

The duration for completing a PhD degree is unusually long compared to other top universities. But, the faculty does not seem concerned. We were told by department chairs that many students view research as a 40-hour per week job and that work-life balance is valued. SGS is working to reduce time-to-degree for PhD students. They have a Progress Tracker, keyed to benchmarks along the path to a PhD, but use of this tool is not mandatory. We understand that a plan is under way to contact new PhD students to inform them of the expectations they should have of their advisers. *It is our opinion that average time-to-degree for PhD students should be reduced.*

The MEng program has grown enormously. There is much flexibility in these degree programs, with room for courses in business, entreprene urship, and leadership. Some MEng programs are quite specialized or have tracks that are specialized, with a view toward the future (e.g. aerial vehicles). The needs of industry can be well served by such programs.

The new PhD program in engineering education, offered in conjunction with the Ontario Institute for Studies in Education (OISE), is a worthwhile addition. A number of other major engineering schools are developing, or have developed, similar programs.

In most departments (Chem Eis an exce ption), students do not know the value of their stipend when they begin a new academic year. The offer letter states a minimum, but students often or usually receive more. Sometimes scholarship dollars are subtracted from the stipend and sometimes not. Some faculty advisers tell their students to ignore the letter, because the situation for the student will actually be quite different (presumably better). *Students need to know their stipend levels prior to the beginning of the school year so that they can plan financially. This information should be provided in a more timely way.* SGS has a set of best practices and template letters, but we are unsure whether they are used in all FASE departme nts.

PhD funding is guaranteed for only 4 years, but most students take 5 or more years to finish. *Students can apply for scholarships in their 5th or later year, with a high probability of funding , but more transparency and certainty should be provided to students .*

There seems to be a limited amount of aggressive recruiting of Canadian PhD students. This should be an "all-hands-on-deck " activity. The road show that travelsto other Canadian universities for the purpose of graduate recruitment is effective mainly for masters students.

Graduate career fairs are held by only some departments. *Graduate students should be served by the FASE career fairs and center.* At most universities, career services are provided for all students, with a web-based system that holds student resumes and facilitates interviews with companies, and hosting of large career fairs. It would be a simple matter to include graduate students. This is particularly important for masters students. Given the enormous growth in masters programs, this issue is now far more important than previously. As an aside, offering better service to industry in this regards helps strengthen university-industry relations. And, companies are generally happy to pay a fee to have access to a web database and career fairs.

FASE departments should communicate better with their graduate students on the topic of professional licensure. Many students seem unaware that study at the masters level counts toward licensure.

It is important that FASE do a much better job of tracking where their masters and PhD students go upon graduation. We are told that SGS currently is conducting a study on where PhD graduates go, and what work they undertake, in an effort to assure relevance of PhD programs and to point toward modifications where necessary.

Research

FASE is outperforming all other engineering schools at Canadian universities on peer-reviewed funding, citations and international rankings. The research funding increases garnered from NSERC Tri-Council agencies are impressive

Cross-disciplinary initiatives are thriving as a result of having access to the Dean's strategic fund (about $5M per year) as well as funding at the U of T level. There are many cross-disciplinary centers and strong partnerships with the School of the Environment and the Faculty of Forestry (in the area of sustainability) and especially with Medicine where significant funding comes from NSERC and CIHR. Several joint efforts have successfully obtained other forms of external funding, e.g. the Translational Biology and Engineering Program (TBEP - funded by the Ted Rogers Centre) and Medicine by Design (funded by CFREF). Long-term sustainability of these initiatives will be critical. Targeted growth areas include human health, data science, sustainability, water, robotics (including autonomy and AI), and entrepreneurship. Significant corporate partnerships were described with Huawei and in the area of electric vehicles. The Dean wisely has held aside a set of faculty positions for cross-disciplinary hiring.

This said, some faculty members feel that FASE needs more of a research vision in order to compete with the top schools in the U.S. And, we heard from some Deans that U of T needs to invest even more in interdisciplinary research. The current $10M annual fund at the U of T level to stimulate research is considered too small by

some. We were told that students are passionate about working on large interdisciplinary problems facing society, but that faculty need more incentive to work on such topics.

We suggest that FASE continue to work on a compelling research vision and building a case for large-scale initiatives in areas of strength or emerging opportunity to help further grow interdisciplinary cross-faculty collaborations, attract industry funding, and brand U of T as the "go-to place" for solutions to major challenges and for leadership in ground-breaking innovations that will transform society. In each area of emphasis, we recommend having a crisp story: What will FASE and U of T do? What will be the impact? Why U of T?

We were pleased to hear about the programs of the Centre for Global Engineering and the Institute for Sustainable Energy, which combine education with research and, in some cases, offer opportunities for student teams to contribute to engineering solutions in the developing world. The Centre for Aerial Robotics Research and Education, which was launched with NSERC funding, collaborates heavily with industry and supports projects where each student has co-advisers from two different departments. This type of advising is rare and may provide advantages regarding the types of problems that can be addressed.

Several faculty members are now working on research in engineering education and are involved in the ASEE (American Society of Engineering Education). This is laudable, given that almost no funding is available in Canada for research on engineering education. *This topic somehow falls between Canadian funding agencies, a problem that needs to be fixed.* The situation is very different in the U.S., where major funding is available from the National Science Foundation.

Industry funding has increased since the last review period. *We recommend that data be developed on how FASE is faring with respect to its peers in terms of overall industry funding, creation of large scale industry consortia, etc.*

Similarly, although FASE accounts for nearly half of U of T's activity in commercialization, *we recommend that data regularly be collected and analyzed regarding performance compared to peers in generation of intellectual property, licensing, and long-term performance of U of T spinoffs.* Doing so might strengthen the case for support from the Province and donors. As part of the analysis, it will be important to also consider data for the U of T medical school, because of the many joint commercialization activities possible, given the strong research ties between FASE and the medical school.

The fact that the indirect costs associated with conducting research are not fully compensated is a huge impediment to growing research programs at U of T. Of course, this is an issue with the Canadian research funding agencies. As one dean put it, "The more research we do, the more we suffer." It is impressive that U of T is able to surmount this difficulty to some fair extent.

The quality of space for research labs and student offices is said to be good. Certainly, the Ted Rogers Centre for Heart Research has space and facilities that are impressive by any standard. In general, however, space is in very short supply. For example, some research masters students are not able to have office space until the end of their first semester.

It is hard to arrange for continuing support of core facilities, e.g. a cleanroom or microscopy suite or high-performance computing cluster. Department chairs felt that U ofT core research facilities generally are not up to the standard of those in top U.S. universities. And, the chairs pointed out that Canada does not have a national lab system to enable the conduct of experimental work requiring special infrastructure. *We recommend that a study on core facilities be conducted to determine how a small number of such facilities, shared by a large number of research teams, can be supported in a sustainable way. Part of the answer may rely on industry partnerships.*

Faculty Matters

Pre-tenure faculty are very positive about their experience and the support they receive, including teaching loads and assistance in ramping up their research programs.

They report that the promotion and tenure policy is quite clear and that tenure rates are very high. Given the superb quality of the FASE faculty, this suggests that hiring and mentoring programs are working well. We were pleased to hear that SGS has representation on each promotion and tenure committee, which adds some diversity to the process

Finding suitable research lab space is sometimes a problem. In one case, a junior faculty member had been waiting for lab space for more than 6 months. Another faculty member initially had a shared office.

Research start-up packages are fairly comparable to what is offered at other top universities in Canada and the U.S.

Some tenured faculty members report an excessively high workload, but teaching loads sound reasonable for a public university: 3 courses per academic year for tenured and tenure-track faculty members, and fewer courses than this for beginning faculty members and for faculty members with administrative assignments.

The hiring of teaching-stream faculty members has been a welcome innovation. These faculty members carry a teaching load that is twice that handled by tenured and tenure-track faculty members, which helps take a load off the faculty members

most heavily engaged in research and also supplements the capability of the tenure-track faculty in applied areas such as design.

FASE has done an outstanding job in enhancing the number of honours and awards received by their faculty members. With only 6% of the engineering faculty in Canada, they are receiving 20% of the major national awards and also doing well internationally. Dedicating a full-time staff member to this activity was a smart move.

A common policy for parental leave needs to be strictly enforced across all FASE departments. We learned of some irregularity in this area.

Support for innovation in teaching is said to be good, including the latest software and technology.

Some faculty reported that the "optimized" course scheduler is causing major problems, with tutorial sections of large courses spread throughout the week. *This is said to greatly increase the workload for some faculty members who are in charge of large courses and it should be investigated.*

The requirement for registration of engineering faculty members as professional engineers in Canada is not viewed as positive by many faculty members. This requirement seems particularly problematic in biomedical engineering.

Organizational Structure, Staff and Resources

There appears to be strong cohesion among the department chairs and a consensus that FASE is running well. The new budget model, which flows more decision-making and authority down to the departmental level, is unanimously viewed as a success, despite skepticism expressed when FASE was last reviewed. One secret to making this model work is that FASE controls departmental enrollments fairly tightly.

FASE is in good financial health and the Chairs seem optimistic about the future. The 27% international undergraduate enrollment and the growth of MEng enrollment from 150 to over 700 has contributed to revenue growth of 6%, which is exceeding expense growth. Provincial funding used to be 70% and is now 28%, but FASE has determined how to build a sustainable funding platform. At this point, student demand is high and FASE appears to be operating at a financial sweet spot at U of T, with its increased international and masters enrollments. But, there could be vulnerability to any downturn in these student numbers.

Building a sizable endowment for the long term will be an important strategy to guard against this and other financial threats. Fund raising has increased in recent years. The strategy for fundraising in FASE sounds right: a few big ideas pitched to

selected donors in the $10M - $SOM range, $1M - $SM is the bread and butter, and a desire to grow the annual fund from $2M annually to $4M. *Anaming gift for the Centre for Engineering Innovation and Entrepreneurship will be critical and it may be important for the University to be flexible with respect to the gift size required for the naming. Every path should be pursued to have a naming gift in place in time for the building opening celebration.*

Space is the biggest constraint on hiring more faculty. The new building will help alleviate some of the space issues temporarily.

Student-to-faculty ratio's are double what they are in elite private universities, but are comparable to good publics

The campus libraries are in transition, as is the case on all campuses. Many books will move out to a national facility that will keep only one hard copy of each. The libraries will be sources of information and contain quiet study spaces, with other space available for group workspaces and other uses. This is now the norm.

Staff member s are enthusiastic about their roles. They believe that FASE is an unusually fine academic unit within U of T. They feel that FASE is a supportive, helpful, and "gung-ho" organization.

U ofT needs more effective branding, which can be a challenge at a comprehensive university. U of T is undertaking a 2-year branding study with focus groups, which should be highly informa tive. With respect to Engineering, we heard consternation that many in Canada recognize Waterloo as #1 even though U ofT Engineering is recognized as #1 in rankings and in academic circles in Canada and abroad. Water loo has done an excellent job of creating focus and branding in the area of information technology. This suggests that *more work needs to be done to articulate the impact of FASE on society and the economy. To this end, measures on commercialization, companies started by alumni, alumni contributions, and major accomplishmentsof research impact need to be communicated more strongly, especially with government and influencers and opinion makers. At the nutsand bolts level, FASE does not have a videographer and not even a single full-time photographer. These deficiencies should be addressed. On the positive side, we were told that the Academic Plan hasbeen helpful to the Communications Office.*

To helpbuild the FASE profile, we suggest considering the establishment of a Presidential Visiting Committee, or expansion of the Deans Advisory Committee to include alumni , community elders and academics who will become advocates. Such advisers can help with increasing the visibility of FASE. Members of the caliber of Maria Klawe, President of Harvey Mudd College, former Dean of Engineering at Princet on,and a corporate board member,would raise the FASE profile in the circle of influencers and opinion makers.

Co ncl us ion

It was a pleasure to review the extraordinary education and research programs in Engineering at U of T. We thank the administrators, faculty, students and staff for their openness, friendly manner, and many suggestions made during our visit. We hope that this report will help, in some small way, to make an outstanding unit even better.

As FASE nears a transition in dean, it will be important to sustain momentum in a number of areas, including in corporate outreach and fundraising, and in programs related to diversity, equ ity and inclusion. These critical areas are sometimes seen as "add-ons" to the core work of a dean, but it has been FASE's good fortune that they are passions of Dean Amon. Continuity will rely on the vice-deans, department chairs and others stepping up to help transition relationships and maintain the climate.

More broadly, the current dean has been supportive of interdisciplinary work and open to a new vision of the pluralism of enginee ring and a new composition of the faculty, including teaching-stream faculty. She has placed a serious focus on undergraduate education, including research on engineering education . The biggest fear among some faculty is that a new dean will wish to focus only on standard disciplines and traditional research. It was suggested to us that the new dean, like Dean Amon, should be progressive, possess extraordinary vision, be ambitious, have an international perspective, and continue to broaden the type of education provided to students . We wish you every success in finding this new leader to keep FASE at the forefront , with the prospect of making an ever-larger difference in the world.

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

Cristina Amon, Dean

October 12, 2017

Professor Sioban Nelson
Vice-Provost, Academic Programs
Simcoe Hall
University of Toronto

Dear Sioban

I write in response to your letter of August 30, 2017 regarding the January 31 - February 2, 2017 external review of the Faculty of Applied Science and Engineering, commissioned by the Vice-President and Provost.

The review process is a valuable exercise that affords us the opportunity to take stock of the state of our Faculty. We are extremely pleased with the reviewers' positive assessment of our Faculty, including our outstanding faculty and student body and world wide reputation for excellence in research and education.

Below I address the issues raised by the reviewers and outlined in your request for an administrative response.

Teaching and Research - Undergraduate and Graduate Education

1. The reviewers noted undergraduate student concerns regarding the costs of [PEY] placements and the lack of availability of matches in some disciplines; they recommended better support for student placements and career services in all disciplines, including for graduate students.

The Faculty created a new position of Academic Director of the Engineering Career Centre (ECC) in 2016 to begin the process of restructuring it, specifically, to add professional development prior to the Professional Experience Year (PEY) internship program. To build a comprehensive professional development program for students, the ECC has partnered with the Institute for Leadership Education in Engineering (ILead) to address areas such as developing PEY learning outcomes, creating and delivering PEY programming for students, and redesigning PEY evaluation methods and tools. In addition, the Academic Director launched the inaugural PEY EDGE Conference in September 2017, where returning PEY students can share their experiences on a variety of topics.

An Interim Director of the ECC has recently been appointed and tasked with reviewing and improving the operational aspects of the ECC's PEY program. To address the lack of availability of internship placements in some of our disciplines, we are creating a position to proactively

Office of the Dean, 44 St George Street, Toronto, ON M5S2E4 Canada
Tel: +1 416 978-3131 • Fax +1 416 978-4859 • deanengineering@ecf.utoronto.ca • www.engineering.utoronto.ca

engage with existing and new industry partners to develop a broader selection of placement opportunities, both in Canada and abroad. This position will also collaborate with the FASE directors of corporate, government, international and foundation partnerships to leverage existing external relationships to market the PEY opportunity to partners that don't currently participate.

We recognize the need to provide better professional development and improved and more diverse placement opportunities for our graduate students, and have begun to expand placement opportunities for students in the Institute of Biomaterials and Biomedical Engineering's (IBBME) Master of Engineering and Master of Health Science in Clinical Engineering programs. To better meet the demand for graduate internships, IBBME hired a business development specialist in September 2017 to initiate a pilot project to search for placements opportunities for students. We will work with the ECC to extend this initiative to students in all our professional graduate programs.

While we believe the PEY internship fee is reasonable and certainly comparable to the fees of co-op placements at peer institutions, we acknowledge that some students have felt their expectations of the program have fallen short. As part of an overall review of our financial allocation for the ECC, we will also review the placement fee structure.

Short-term goals (within 1 year):

- Review the administrative operations and budget model of the ECC to ensure alignment with emerging professional development priorities.
- Appoint a full-time, continuing ECC Director.
- Create a new position in the ECC to focus on external relationships.
- Implement new professional development opportunities for undergraduate students and develop learning outcomes to better define and assess the value and attributes of experiential learning.

Medium-term goals (1-2 years):

- Foster partnerships to enhance the services provided by the ECC, including ILead, alumni, the *You're Next Career Network* (YNCN), and the University Career Centre.
- Further develop internship placement opportunities through the new position in the ECC, and connect with industrial liaison officers at the Faculty and departmental levels.
- Expand the breadth of international PEY internship opportunities.
- Expand professional development and internship opportunities to other graduate disciplines.
- Create an optional APS 1.0-1.5 FCE course for MEng students in some programs that includes an internship.

Long-term goals (3-5 years):

- Assess the impact of improvements made to the ECC's administrative operations and budget model.
- Build new relationships with industry, government and international partners to ensure that students across all disciplines have appropriate internship opportunities.

- Extend optional graduate internships to students in all graduate professional programs (MEng) in the Faculty.

2. ***To provide transparency and certainty to student s regarding funding, the reviewers strongly recommended that all students be informed of their stipend levels prior to the start of the academic year.***

The Faculty communicates minimum guaranteed stipend levels on our website, and has made significant efforts over the last two years to encourage academic units to communicate to their students their average funding levels and the funding sources that combine to make stipends. It is currently not possible to advise all students of their total stipend levels, above the minimum, prior to the start of the academic year because not all TA assignments are finalized at that time. We will endeavor to accelerate the assignment of teaching assistantships across the Faculty in order to provide this information to students in a more timely manner. We will also explore the development of template funding letters with the School of Graduate Studies in order to facilitate these communications.

Short-term goals (within 1 year):

- Work with graduate units to accelerate the assignment of TA positions.
- Work with graduate units to identify mechanisms to provide annual individualized funding information to each funded student.

Medium-term goals (1-3 years):

- Monitor that the process of assigning TA positions in academic units is done as timely as possible.
- Continue to work with graduateunits on annual individualized funding information.

3. ***The reviewers recommended reducing average time-to-completion for PhD students, a concern raised in the previous external review.***

Over the last several years, trends for the average PhD time-to-completion have been affected by the practice of many academic units to promote fast-tracking and direct-entry into their PhD program. This accounts for more than 30 percent of our students and may contribute to the inflation of average time-to-completion. *We* will survey students and professors to better understand and address this and other trends that mayimpact time-to-completion.

A key aspect of PhD student supervision that can decrease time-to-completion are mandatory annual supervisory committee meetings,where student progresscan be assessed and formally documented and remediation measures can be recommended. However, monitoring and compliance with these meetings have traditionally been uneven across our academic units. The recent introduction of progress trackers - whether provided through an SGS pilot project or developed by FASE graduate units - has helped units automate and monitor compliance.

Short-term goals (within 1 year):

- Ensure that all academic units comply with the requirement for annual supervisory committee meetings for PhD students.

- Analyse the PhD time data to understand the impact of that fast-tracking and direct entry may have on the average time-to-completion.

Medium-term goals (1-2 years):

- Ensure that all academic units adopt a progress tracker to make the process of determining PhD student progress accurate and efficient.
- Survey students and professors to understand and address the impact of any additional factors on time-to-completion.

Long-term goals (3-5 years):

- Decrease the average PhD time-to-completion by 10 percent.
- Support PhD students' research in ways that can positively affect their time-to-completion. This can include facilitating their use of library resources, thesis writing, statistical experimental design, and data analysis.

4. The reviewers made a number of suggestions around tracking the [employment] outcomes of graduates of the Faculty's undergraduate and graduate programs.

We agree with the reviewers' recommendation that we increase our efforts to track the employment outcomes of our students. We will use and expand on several recent initiatives to better collect and analyse this data on an ongoing basis.

These initiatives include our first exit survey of undergraduate students, conducted this spring. It has yielded a wealth of information on students' future employment plans, and we will refine and repeat it annually. Our new U of T Engineering CONNECT platform has now been rolled out Faculty-wide, allowing all our alumni to continuously update their career information. The School of Graduate Studies' extensive graduate employment dataset, the *Ten Thousand PhDs* project, includes information on U of T PhD students from 2000 to 2015, and has provided us with information on the distribution of our PhD graduates across multiple employment sectors and locations.

Short-term goals (within 1 year):

- Analyse data collected in U of T Engineering CONNECT to better understand the employment outcomes of our alumni across all academic units.
- Keep in touch with graduates through our Alumni office on an ongoing basis.

Medium-term goals (1-2 years):

- Continue to refine and administer the exit survey of undergraduate students.
- Analyse the data collected through the *Ten Thousand PhDs* project to better understand where our graduate master's and PhD students are employed.

Long-term goals (3-5 years):

- Elevate and complete the tracking of our undergraduate alumni to a University-wide initiative for the benefit of all Faculties at U of T.

5. ***The reviewers suggested ways to build community and support deeper engagement of undergraduate and graduate students, many of whom are commuters.***

Although approximately half of our first-year undergraduate class commutes to the University, we have no clear evidence that commuting significantly interferes with their ability to engage in our rich engineering community. The Faculty does, however, appreciate that commuting is a barrier to community engagement for some students, and we agree that more can be done to support their curricular and co-curricular experience.

To address this, we will partner with the Engineering Society to create a committee where concerns of commuting students can be raised, and we will gather input on students' commuting experience through Town Hall meetings and focus groups. We will also explore how we can use our spaces to build community and support the inclusion of commuting students in curricular and co-curricular experiences.

On the graduate side, we have launched a professional development program for our PhD students and postdocs called *Opportunities for PhDs: Transitions, Industry Options, Networking, and Skills* (OPTIONS). This includes a series of 11 workshops, held weekly, where students can share ideas about career pathways and professional skills with alumni, career management experts and professors, plus additional signature events that focus on developing networking skills. We will evaluate the success of the OPTIONS program and extend it to include workshops on additional career pathways.

Short-term goals (within 1 year):

- Develop a Commuting Student Advisory Committee in partnership with the Engineering Society to address issues of particular relevance to commuting students.
- Make specific efforts to better understand the experience of commuting engineering students through Town Hall meetings and focus groups.
- Monitor and evaluate the recently launched OPTIONS program and extend the program to offer additional career pathway-specific workshops.

Medium-term goals (1-2 years):

- Explore how our spaces can be used more effectively to build community and support the inclusion of commuting students in curricular and co-curricular experiences.

<u>Teaching and Research - Faculty</u>

6. ***. The reviewers flagged an issue around consistent approaches to parental leave across departments and urged the Faculty to ensure that policy is understood and applied consistently.***

While we are not aware of any specific instance where the parental leave policy was being applied in an inconsistent manner in the Faculty, we will take action to communicate this policy clearly to academic and administrative managers. Managers will also be encouraged to seek support through the Faculty's Human Resource office in applying this policy. In addition,

we will review all parental leaves through our HR office on an annual basis to ensure the policy is followed appropriately.

Short-term goals (within 1 year):

- Communicate policy to all academic and administrative managers in the Faculty.

Medium- to long-term goals (1-5 years):

- Review all parental leaves annually to ensure adherence to policy.

Relationships

7. ***The reviewers noted that cognate Deans appreciated FASE's collaborative style, but identified further opportunities for students and programs to benefit from interaction and integration with other divisions.***

To prepare our students for the ever-changing landscape of the engineering profession, we offer interdisciplinary undergraduate minors and certificates, many of which involve other Faculties. Our students can also take Arts and Science minors in disciplines such as math, economics and geography, among others, and professors in Faculties such as Arts and Science teach courses in several of our Engineering Science streams. At the graduate level, we partner with other Faculties to offer collaborative specializations such as in Engineering Education with OISE, Psychology and Engineering with the Faculty of Arts and Science, and Biomedical Engineering with the Faculties of Medicine, Arts and Science, and Dentistry. We will continue to explore the development of new interdisciplinary programs.

We collaborate extensively with other divisions on the research front, with many of our research institutes and centres enjoying strong ties with other U of T Faculties. Notable inter-divisional collaborations include Medicine by Design, which involves researchers and clinicians from the Faculties of Applied Science and Engineering, Arts and Science, Medicine, and Pharmacy and partner hospitals, and the Translational Biology and Engineering Program, which brings together researchers and their students from the Faculties of Applied Science and Engineering, Dentistry, and Medicine. We will expand our interdisciplinary research initiatives by continuing to support EM HSeed, an internal funding program that provides seed funding for cross-disciplinary collaborative research in partnership with the Faculty of Medicine and affiliated hospitals, and will continue to support cross-disciplinary research as synergies arise.

Short-term goals (within 1 year):

- Develop an Engineering Science stream and a minor in Machine Intelligence to launch in 2018, with elective courses taught by the Arts and Science departments of Computer Science, Statistics, and Mathematics.

Medium-term goals (1-3 years):

- Work with the Faculty of Music to develop a new minor and certificate in Music.
- Build upon our interdisciplinary research initiatives by continuing to support EMHSeed.

8. . The reviewers encouraged departments to share best practices to support engagement and student-faculty interaction across undergraduate and graduate programs.

While there are a number of ways in which students can engage with their instructors and the Faculty, we acknowledge that the effectiveness of these opportunities can be improved and that new avenues can be created.

To enable student feedback to be acted upon in a timely manner, we will make a concerted effort to encouragemore faculty to implement the SpeakUp platform, which was developed by the Engineering Society to allow "real-time" course-related feedback via mid-term course evaluations. The Faculty launched the *Meet Your Professor* event during the 2017 first-year orientation to enable students to meet and mingle with their fall-term professors in an informal setting. We will evaluate and refine this event, and continue to offer it in future orientations. Our recent review of maker spaces identified the types of spaces available to our students that can support prototyping and hands-on learning. We will use this information to support student collaboration and engagement by allowing better access to and awareness of these facilities.

The School of Graduate Studies recently developed graduate supervision guidelines for professors, which clearly set out quality standards and expectations regarding graduate supervision within departments. We will promote these guidelines throughout our Faculty. We have worked with our graduate student associations to organize an annual Graduate Career Fair, which is attended by industry partners and students seeking internships or permanent positions after graduation. We will build on the successof the fair by increasing the number of companies in attendance in the next two years.

Short-term goals (within 1 year):

- Promote the SGS graduate supervision guidelines in our Faculty.
- Evaluate the successof the *Meet Your Professor* orientation event and refine it for future years.
- Facilitate the sharing of best practices across the Faculty (including student clubs) to foster student engagement across academic units, and to increase the number of informal gatherings of students and faculty.

Medium-term goals (1-3 years) goals:

- Encourage more faculty members to implement midterm course evaluations through the SpeakUp platform.
- Use the outcome of the maker spaces report to improve awareness,coordination and accessto fabrication spaces, and consider the design and ergonomics of spaces within the Faculty as a means of encouraging student-faculty interactions.
- Grow the size of the annual Graduate Career Fair by 20 percent (number of companies attending the fair) over each of the next two years.

Resources

9. The reviewers made a number of recommendations to enhance the Faculty's profile and "brand".

The reviewers recommended that we increase our efforts to more strongly build our profile, increase our visibility, and better articulate our impact on society and the economy. They also recommended that we continue to develop a compelling research vision and build a case for large-scale initiatives in areas of strength or emerging opportunity.

We will sharpen our research focus on global challenges in water, energy, human health and the environment by developing transformative technologies in sustainability, data science, robotics, artificial intelligence, health technology and advanced materials and manufacturing. As stated in our response to recommendation 7, we will expand our interdisciplinary research initiatives by building on the success of EMHSeed, an internal funding mechanism for cross-disciplinary research between our Faculty and the Faculty of Medicine and our affiliated hospitals.

We will strengthen the advisory boards within our departments, institutes and extra-departmental units by more closely involving industry representatives. This will enhance the visibility and impact of our research, education and innovation, and the relevance and profile of our Faculty.

Our Strategic Communications group is integral to the development and communication of our Faculty's vision and brand, and they will continue to focus their efforts on increasing the visibility of our multidisciplinary, collaborative and innovative research initiatives. We will work with communicators within our Faculty and at the University level to ensure the consistency of our messaging, and will expand our network of media contacts and influencers in key geographic regions. To build upon the success of our marketing strategies, our Strategic Communications group will increase the understanding of key stakeholders and the Faculty's strengths and academic priorities.

The University's brand marketing team will undertake a comprehensive, multi-stakeholder assessment of the University brand health in 2017. We will use these findings to consider whether further Faculty-level market research on perceptions and beliefs is necessary for more informed marketing strategies.

Short-term goals (within 1 year):

- Adopt a campaign-based model of marketing and communications to enhance the visibility of the Faculty.
- Develop an intranet platform to facilitate and enhance internal communication and consistency of messaging.
- Focus our research activities on addressing global challenges through the development of transformative technologies.

- Continue internal EMH Seed funding to support collaborative research involving the Faculty of Applied Science and Engineering, the Faculty of Medicine, and affiliated hospitals.

Medium-term goals (1-2 years):

- Our Strategic Communications group will develop a quantitative and qualitative understanding of key stakeholders to improve marketing activities, and train and support their staff in ways to stay abreast of the Faculty's strengths and academic priorities.
- Expand the Faculty's network of media contacts and influencers in key geographic regions.
- Develop a Faculty brand around interdisciplinarity, collaboration and innovation.
- Review the advisory boards of FASE departments, institutes and EDUs with the aim to enhance industry engagement.

Long-term goals (3-5 years):

- Develop a robust, quantitative reporting cycle that reflects the impact of marketing and communications activities against benchmark data provided by market research.

Diversity

10. The reviewers commended the enormous improvements made in diversity among the undergraduate student body. They noted that further work is needed with respect to other underrepresented groups, including indigenous peoples.

Over the past decade, the Faculty has significantly increased both gender and cultural diversity within our undergraduate student population and our professoriate, with the percentage of both female undergraduate students and members of our faculty nearly doubling over this time. We have also worked hard to increase our reputation as a premier destination for undergraduate studies, and this has resulted in an over 300 percent increase in applications from international students since 2007.

While we will continue our successful efforts to increase gender diversity and inclusion in our Faculty in the coming years, we will also focus on increasing representation from Indigenous, Black and other communities underrepresented in engineering programs. For example, we will consider key recommendations of the *Eagle's Longhouse: Engineering Indigenous Initiatives Steering Committee,* which we established in 2017 with members from across the Faculty and the Oneida Nation to recommend immediate and ongoing actions to improve the relationship between the Faculty and Indigenous communities.

Short term goals (within 1 year):

- Continue our successful efforts of increasing gender diversity in our Faculty, and work toward increasing representation from Indigenous, Black and other underrepresented communities.

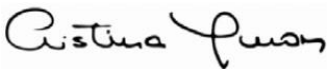
- Act upon key recommendations from the Eagle's Longhouse steering committee. These include establishing an Indigenous Engineering Office, and expanding our admissions pathways to make them more accessible for students with non-traditional backgrounds.
- Build upon our outreach and programming efforts to strengthen relationships with underrepresented communities.
- Establish U of T Engineering scholarships for Indigenous students.
- Partner with the American Indian Science and Engineering Society's recently-founded Canadian Indigenous Advisory Council to grow our Indigenous network and hiring pool, and support the first AISES meeting to be held in Canada in February 2018.

Medium- and long-term goals (1-5 years):

- Maintain efforts to increase gender diversity and representation from Indigenous, Black and other underrepresented communities.
- Review our admissions process to mitigate barriers to admission for students who have followed non-traditional pathways.

Thank you for the opportunity to respond to the report of the external review team. Their comments and recommendations have helped sharpen the vision and future priorities for the Faculty of Applied Science and Engineering.

Sincerely



Cristina Amon
Dean

cc: Daniella Mallinick, Director, Academic Programs, Planning and Quality Assurance
Cora Mccloy, Acting Coordinator, Academic Planning and Reviews
Caroline Zieg ler, FASE Governance and Programs Officer

Appendix B: Academic Plan 2017-2022

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

ACADEMIC PLAN 2017–2022

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

TABLE OF CONTENTS

STATEMENT OF ACKNOWLEDGEMENT OF TRADITIONAL LAND

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people and we are grateful to have the opportunity to work on this land.

EXECUTIVE SUMMARY

The Faculty of Applied Science & Engineering's *2017 – 2022 Academic Plan* was developed through a highly consultative strategic planning process with our community of stakeholders. This plan articulates and affirms U of T Engineering's priorities, setting out the five-year measurable goals that we will pursue with dedication and commitment. This plan provides the structure for both administrative and academic units to enhance the contributions to our Faculty and to our broader community. It allows us to measure, assess and adjust initiatives within U of T Engineering and beyond, while maintaining support for our overall mission: to lead in transformative teaching and learning, ensure an outstanding student experience and advance impactful research through creativity, multidisciplinary collaboration and innovation. In addition, in each area of the Faculty, we will continue to focus on our culture of excellence, diversity and globalization.

We believe academic planning is an ongoing process and every year we assess our progress and achievements to ensure we reach our stated goals and create new opportunities as they arise. Our *2017 – 2022 Academic Plan* is a living document and as a Faculty we work

extensively throughout the academic year, with our standing committees, undergraduate and graduate societies, working groups and task forces to ensure we continue evaluating, improving and creating. Each fall, we also publish the *Update to the Academic Plan*, which reports our progress not only to the Faculty, but also to the U of T community. In the next five years we will continue with this annual reporting, with the aspiration to engage our Faculty in ongoing and open discussions about the progress towards our goals.

The Faculty has created a number of strategic initiatives over the past five years to address the recommendations stemming from our 2010 self-study and external review, and respond to feedback from consultations that occur throughout each academic year. The *Overview* section of this document outlines the key initiatives that allowed us to assess challenges and create opportunities within the Faculty and provides the context of this Academic Plan.

From January 31 to February 2, 2017, the Faculty of Applied Science & Engineering was the subject of an external review. In preparation for the review, and to lay the groundwork for our next academic plan, we prepared a self-study — a comprehensive and critical overview of the Faculty in accordance with the *Guidelines on Divisional Academic Planning*. The self-study, in addition to the *Terms of Reference*, provided a framework for the external review. Also guiding our academic planning process was the University of Toronto's *Three Priorities* and *Towards 2030: The View from 2012*. The external reviewers' final report spoke to the outstanding faculty and student body, and to our worldwide reputation for excellence in education and research. While acknowledging these strengths in our Faculty, we have translated the recommendations from the report into new goals and opportunities for this next phase of academic planning.

To facilitate the creation of the *2017– 2022 Academic Plan*, representatives from across the Faculty, in conjunction with academic and administrative leaders, developed the *2017– 2022 Academic Planning Framework*. Initiating the process in early 2016, we created the framework from an extensive body of work — the self-study, external review, working and focus groups, ongoing evaluation and extensive consultations. With thoughtful consideration we identified where we were, and now, together as a Faculty, where we want to go. The *2017– 2022 Academic Plan* which follows is the culmination of this work.

The Faculty of Applied Science & Engineering is dedicated to *Transformative Teaching & Learning*. We will continue to strengthen our highly regarded undergraduate and graduate programs and will strive to provide outstanding learning experiences. Our goal is to ensure a wealth of opportunities that are multidisciplinary, collaborative and internationally focused. We will graduate the U of T 21st Century Engineer, the global engineering leader of tomorrow. The Faculty will continue developing innovative programs, such as the new Engineering Science Major in Machine Intelligence. We will also work with our departments and institutes through the *University of Toronto Quality Assurance Process* and the Canadian Engineering Accreditation Board to ensure high-quality educational programs and to ensure students graduate with strong competencies.

We will continue to provide rigorous foundational learning in engineering principles and we will enrich students' learning experiences by integrating professional competencies such as multidisciplinary design, communication, business, entrepreneurship, leadership and global

engineering into the curricula. We will also promote and support opportunities for students to engage in meaningful international experiences, research and Professional Experience Year (PEY) internships so they can use their technical knowledge in other settings — gaining experience in the workplace, research laboratory or abroad. Our goal is to ensure our students have outstanding technical and professional competencies, in addition to strong multicultural fluency — attributes needed in today's complex and quickly evolving world.

To meet the goals of our *2017–2022 Academic Plan*, we must continue to attract the brightest students and faculty, both here in Canada and from around the world. We must also continue our efforts to improve gender diversity within our Faculty, and enrich the socio-economic, ethnic and cultural diversity within U of T Engineering, especially underrepresented groups. We look forward to receiving the recommendations from the *Eagles' Longhouse: Engineering Indigenous Initiatives Steering Committee*, which will guide us in our outreach, recruitment and programming efforts. We will work to leverage this diversity, ensure that our curricula and learning are inclusive to all students, faculty and staff and foster an environment in which each member of our community can excel, contribute and benefit from each other's perspectives. With the opening of the Centre for Engineering Innovation & Entrepreneurship (CEIE), we will enter a new era for technology and learning, and we will continue to improve our infrastructure to support innovative teaching. We will work towards balancing our undergraduate-to-graduate-student ratio, reducing time-to-completion for our research-stream graduate students, and further integrating active learning pedagogies into curriculum delivery to encourage life-long learning and knowledge creation.

Student Experience and *Transformative Teaching and Learning* work together, inside and outside of the classroom, to support student learning and the development of global engineering leaders. U of T Engineering is dedicated to supporting faculty-student engagement and a vibrant student community. We strive to not only create an outstanding educational environment, but also extensive opportunities to engage in co-curricular activities and Faculty research.

Actions in the *2017–2022 Academic Plan* include strengthening the connection and community of students, including MEng students and our student commuters, many of whom travel long distances to reach our campus. We will also continue to support our student clubs, and their transition into the new CEIE space, when it opens in 2018. Out of the two decanal task forces on Academic Advising and Mental Health, we have committed to improve the quality and delivery of academic advising and also create resources and initiatives that support good mental health and well-being.

The U of T Engineering research community is defined by its commitment to generating transformative knowledge, research excellence and global impact. To support these goals, we worked extensively through our Faculty's Research Committee and academic planning focus groups to solidify our four main research themes. Our faculty members' research touches upon one or more of the themes: *Data Analytics and Intelligent Systems*, *Advanced Materials and Manufacturing*, *Sustainability* and *Engineering and Human Health*. We will leverage our strengths to develop a compelling research vision with the mandate to enhance our impact by leading research benefiting the Province of Ontario, Canada and global society through creativity, multidisciplinary collaboration, entrepreneurship and innovation.

Our *Influence, Collaborations and Partnerships* include relationships across Engineering and other U of T Faculties, and also linkages with our diverse city and internationally through our student body and global research. The priorities for the next five years include inspiring education and learning in science, technology, engineering and math for K-12 and also strengthening the connection with our more than 50,000 alumni. We will continue our leading role in pre-university outreach programming within Canada and work towards enhancing our presence as an influential thought-leader within the K-12 engineering curriculum. We will also foster new cross-disciplinary collaborations and create strategic partnerships with key institutions and industry partners.

Driven by academic and research priorities, our *Organization and Strategic Resources* support all aspects of the Faculty's mission. Our goals include diversity in our faculty and staff complement, infrastructure and IT renewal, new advancement priorities, strong fiscal management and utilizing our communications to inform, celebrate and connect our U of T Engineering community.

The *2017 – 2022 Academic Plan* was developed through the dedication and efforts of faculty, graduate and undergraduate students, staff, alumni and our University of Toronto partners. In the next five years, we will continue our commitment to a culture of excellence, diversity and globalization. To remain the #1 engineering school in Canada, and one of the best in the world, we will measure and evaluate our progress towards our goals, throughout the year, each year. Together, we will work to strengthen our Faculty and continue our pursuit of excellence, but also remain adaptable to creating new opportunities for our students and faculty.

CHAPTER 1

OVERVIEW

Founded in 1873, the Faculty of Applied Science & Engineering at the University of Toronto is Canada's #1 engineering school and one of the best in the world. The Faculty is a leader in multidisciplinary collaborative research, and innovative teaching and learning. The University of Toronto is one of the top ten publicly funded universities worldwide, and our Faculty is a vital component of its diverse and vibrant community.

At the time of the Faculty's *2011 – 2016 Academic Plan*, the University had launched its long-term strategic initiative *Towards 2030* (www.towards2030.utoronto.ca). In September 2011, the University started to assess its progress with respect to the *Towards 2030* goals and examine new and continuing challenges and opportunities for the future. The broader University of Toronto community engaged in an extensive consultation process resulting in the publication of *Towards 2030: The View from 2012*. In addition, in October 2015 President Gertler articulated the *Three Priorities* for the University of Toronto:

- Leverage our urban location(s) more fully, for the mutual benefit of University and City;
- Strengthen and deepen key international partnerships by means of a well-defined strategic focus; and,
- Re-imagine and reinvent undergraduate education.

▲ Maker spaces allow engineering students to bring their creativity to life, whether they are designing a prototype for a new business idea or a vehicle that will compete internationally. Published in May 2017, the Faculty's *MakerSpace Report* will ensure students have the space and facilities they need to innovate.

The University of Toronto's *Three Priorities* and *Towards 2030: The View from 2012* have continued to inspire and guide us in the development of our *2017 – 2022 Academic Plan*.

Starting in early 2016, we initiated our Faculty self-study as the precursor of the academic planning process to:

- Facilitate cross-Faculty discussions for our academic priorities for the next five years;
- Ensure a cohesive strategy across all units;
- Highlight our most important foci and consider how these will evolve to reach new levels of excellence across the Faculty; and,
- Galvanize us as a community dedicated to the highest standards of research, transformative teaching and learning, and an outstanding student experience.

The Faculty's planning process is directed through the University's *Guidelines on Divisional Academic Planning*. In addition, the *Policy for Approval and Review of Academic Programs and Units* and the *University of Toronto Quality Assurance Process* (UTQAP) support the cyclic review process to monitor the academic standards of undergraduate and graduate programs, and to ensure ongoing enhancements. For U of T Engineering, the Canadian Engineering Accreditation Board (CEAB) is responsible for accrediting all engineering undergraduate programs, and we will undertake a CEAB audit in the fall of 2018.

While international rankings are only one measure of excellence, they do highlight our reputation as one of the top engineering schools in the world. As a Faculty, we also realize that these highly publicized rankings influence faculty and students in their decision to come to U of T Engineering.

Remaining cognizant that we are one of the preeminent engineering schools in the global rankings influences the approach we take in setting our academic priorities. Therefore, excellence in engineering education and teaching, multidisciplinary collaborative research, a diverse student body that excels professionally and personally, committed faculty and staff, and engaged alumni are all priorities in our plan.

Since we published our *2011 – 2016 Academic Plan*, we have assessed our progress and achievements to ensure we reach our stated goals and create new opportunities as they arise. Each fall, we publish the *Update to the Academic Plan*, which reports our progress to the Faculty and the U of T community. Over the past five years, as part of this ongoing assessment, the Faculty has created a number of strategic initiatives, which have allowed us to prepare for the *2017 – 2022 Academic Plan*.

The *Decanal Task Force on Mental Health* was created in July 2015 to examine the existing mental health support systems for the Faculty's students. Within the task force we conducted an assessment of the Faculty's current performance and initiatives in relation to each of the strategic priorities within the University of Toronto's *Student Mental Health Strategy and Framework* (released in October 2014). Our final report was published in January 2017.

The *Dean's Task Force on Academic Advising* was struck in the fall of 2015, and identified the need to review student counselling as an action item within the strategic theme of

Student Experience. The task force reviewed academic and student advising and made key recommendations for our future direction. The final report was issued in August 2016.

The *Core Curriculum Review Task Force* was created in 2013 as a decanal task force to formally review the content and delivery of the Faculty of Applied Science & Engineering first-year (core) curriculum for the Core 8 and TrackOne (Undeclared) programs from the perspective of students, faculty and external evaluators. It compared these offerings to best practices and recommended changes to meet the evolving foundational education needs of our programs. The final report was published in December 2014.

The Faculty-level *Engineering Strategies and Practice I and II Review Committee* was created in the fall of 2016 to review the cornerstone sequence of Engineering Strategies and Practice I and II within the Core 8 and TrackOne (Undeclared) programs. This review was in response to one of the recommendations of the *Core Curriculum Review Task Force*. The final report was issued in June 2017.

Published in May 2017, the *Faculty of Applied Science & Engineering Maker Space Report* identifies what equipment and facilities are available, and what we need to complement existing resources, including supervision and safety.

U of T ENGINEERING IS COMMITTED TO DEVELOPING THE NEXT GENERATION OF MAKERS, INNOVATORS AND ENGINEERING LEADERS, AND TO ENSURING THAT THE REQUIRED FACILITIES EXIST TO DO SO.

This report was key to our strategy development to support the design of courses and other student activities.

The *Bibliometrics Working Group Report* was published in March 2017. This working group was established to determine how bibliometrics could effectively be deployed within the Faculty to assess research excellence.

The *U of T Robotics Strategic Planning Committee: Final Report* was completed in July 2017. This report was a collaborative effort between U of T Engineering, the Department of Computer Science and UTM. The committee was tasked to strengthen U of T as the best robotics school in Canada and make it one of the top five in the world.

Recommendations of the *Eagles' Longhouse: Engineering Indigenous Initiatives Steering Committee* and the *Information Security & Protection of Digital Assets Steering Committee* are both expected early in 2018.

The Faculty of Applied Science & Engineering's *Annual Report of Performance Indicators* was first published in 2009, and tracks progress towards the goals laid out in the Faculty's Academic Plan. Each publication is a data-rich, systematic examination of our educational programs, research and co-curricular initiatives. A breadth of information is provided, including detail on admissions, enrolment, research funding, awards, world rankings, advancement, communications, resources, diversity, international initiatives and cross-faculty education and experiential learning. Through concrete metrics and statistics, the Annual Report provides a comprehensive picture of Faculty initiatives and program development over the past year, in addition to a comparison of progress over the past 10 years.

As part of the larger U of T academic planning and accountability process, the *Faculty of Applied Science & Engineering Self-Study* is a broad-based and reflective report that allows for a critical analysis of the Faculty and our strengths and challenges. The *Self-Study* was published in January 2017 and reports on the status of, and progress within, the Faculty and identifies future opportunities.

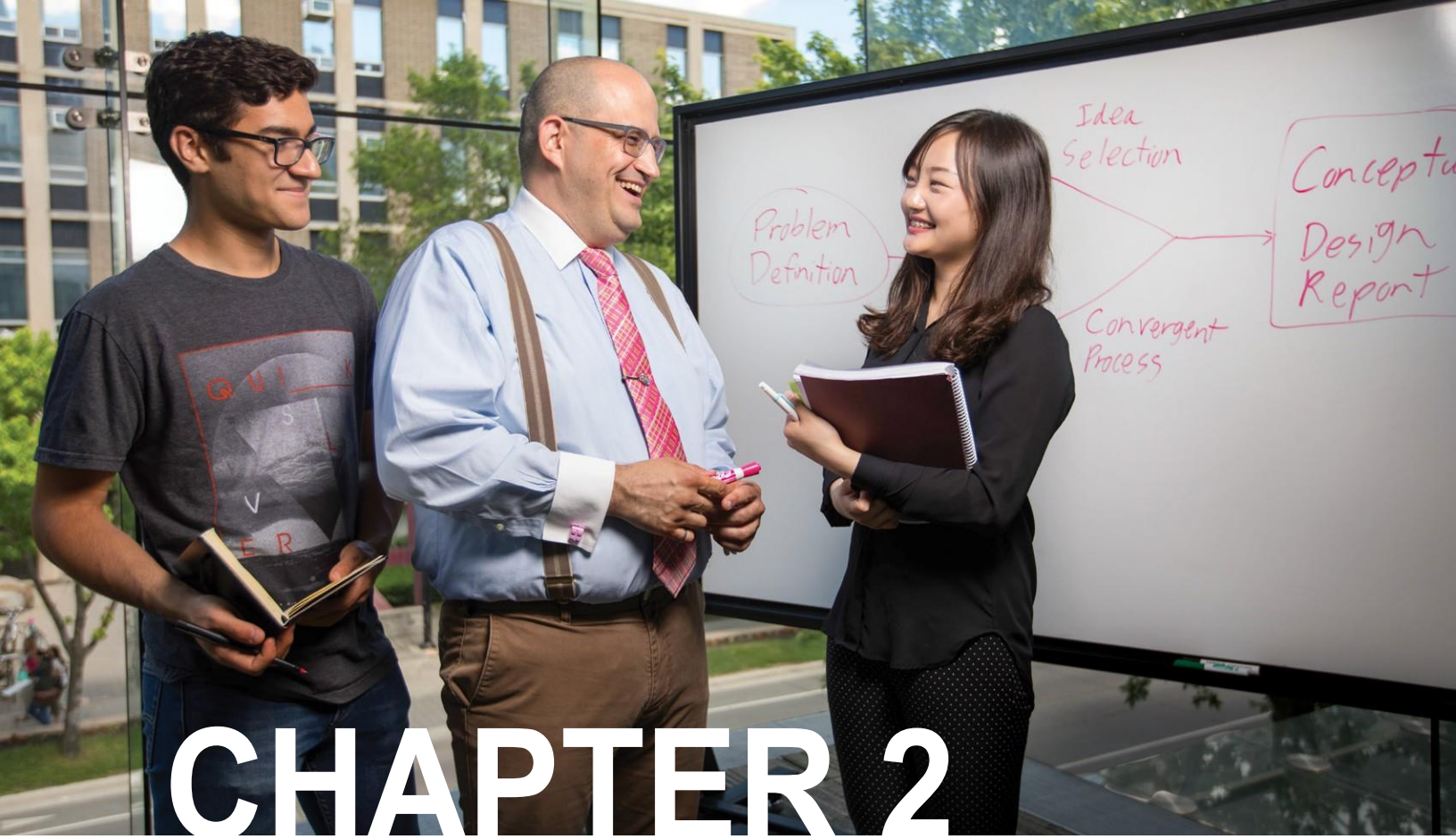
In 2017, our Vice-Dean, Research established four Faculty *Academic Planning Research Focus Groups*. These groups, with representatives from every department and institute, formed our academic plan research themes, each with important and emerging sub-themes. Areas of expertise across the Faculty, in addition to the goals in the University of Toronto's *Strategic Research Plan*, were brought together to set our focus for the next five years.

From January 31 to February 2, 2017, the Faculty's external reviewers, commissioned by the Provost, met with University and Faculty leadership, faculty members, students, staff and alumni. The external reviewers' final report spoke to the outstanding faculty and student body and to our worldwide reputation for excellence in education and research. The report also provided thoughtful and comprehensive recommendations, which have been incorporated into our Academic Plan goals and actions.

To facilitate the creation of our *2017 – 2022 Academic Plan*, stakeholders from across the Faculty, in conjunction with academic and administrative leaders, first developed the *2017 – 2022 Academic Planning Framework*. Initiating the process in early 2016, we created the framework from a comprehensive body of work — the self-study, external review, working and focus groups, ongoing evaluation and extensive consultations. The Faculty's academic planning process has relied heavily on our U of T Engineering community through assessment, consultation, analysis and planning. From this framework, we worked together to complete the plan. The *2017 – 2022 Academic Plan* is a result of broad and iterative consultations with the Faculty's leadership, Chairs and Directors of academic units, Associate Chairs and Directors and standing committees of Faculty Council, Faculty Council members, faculty members, undergraduate and graduate students, staff, alumni and University of Toronto stakeholders.

Our plan sets our academic priorities and administrative direction within the University's strategic context for the next five years and aims to achieve our goals for new levels of excellence in research and transformative teaching and learning. We are dedicated to academic excellence, impactful research, global outreach and visibility, student, staff and faculty diversity and inclusivity, enriching student experiences, and strengthening our collaborative partnerships, both locally and internationally.

The *2017 - 2022 Academic Plan* was presented to U of T Engineering's Faculty Council on December 12, 2017.



CHAPTER 2

TRANSFORMATIVE TEACHING AND LEARNING

The Faculty of Applied Science & Engineering offers nine fully accredited undergraduate programs — with students obtaining either a Bachelor of Applied Science (BASc) or Bachelor of Applied Science in Engineering Science. In first year, students can choose between three entry points: Core Programs (Core 8) , TrackOne (Undeclared) or Engineering Science. Our programs are highly competitive, and they attract some of the brightest students — from here in Canada and from around the world.

For those pursuing graduate studies, our Faculty offers two research degrees, the Master of Applied Science (MASc) and the Doctor of Philosophy (PhD). These research-stream programs provide unparalleled opportunities to work alongside our world-renowned faculty members. We also offer the Master of Health Science (MHSc) and the Master of Engineering (MEng) professional degree, which can be customized through 13 emphases. These include Sustainable Engineering, Forensic Engineering, Robotics and Mechatronics, as well as an Emphasis in Analytics that starts in January 2018. Professional students may also pursue an MEng in Biomedical Engineering or Cities Engineering and Management.

▲ Professor Jason Bazylak (middle) teaches Engineering Strategies & Practice and serves as the Dean's Advisor on Indigenous Initiatives as co-chair of the Eagles' Longhouse. Bazylak is one of six Hart Teaching Innovation Professors.

The U of T 21st Century Engineer not only needs a strong technical foundation, but also a breadth of professional competencies in areas including leadership, entrepreneurship, communication and business. Therefore we have proactively created several options for students, to complement their academic programs in high demand areas of interest. These include the emphasis in Entrepreneurship, Leadership, Innovation and Technology in Engineering (ELITE) for MEng students, a choice of eight undergraduate minors including Engineering Business, and nine undergraduate engineering certificates including Global Engineering, Communication, Entrepreneurship and Engineering Business.

WHETHER OUR GRADUATES ARE DESTINED FOR A CAREER IN ACADEMIA, INDUSTRY OR THE PUBLIC SECTOR, WE STRIVE TO PROVIDE AN OUTSTANDING LEARNING EXPERIENCE, ONE THAT OFFERS DIVERSE AND GLOBAL PERSPECTIVE, AND IS RICH WITH OPPORTUNITIES THAT ARE MULTIDISCIPLINARY AND COLLABORATIVE.

Inspiring and nurturing the U of T 21st Century Engineer continues to be our goal.

For admissions, in the 2015 cycle we started a three-year pilot for our Broad Based Admissions (BBA) process, which considers high school performance in the context of non-academic factors. Marks alone do not provide a complete picture of a student's potential and the BBA allows our Admissions Committee the opportunity to learn more about each candidate's strengths and interests, including their ability to articulate their thoughts and ideas, dedication to learning and overall excellence. In this next phase of academic planning, we will complete the pilot review and implement a permanent BBA system to fully integrate the process into all admissions decisions. To further enhance our admissions tools, we will also implement a new *Admissions Portal*, which will be used by the Admissions Committee and staff to assess domestic and international applicants and will provide better dashboard information and analytics to aid with the decision process.

Our admission and recruitment strategy for the Faculty also focuses on enhancing gender diversity and working towards increasing representation from Indigenous, Black and other communities. Part of this approach is to continue to adapt and improve our recruitment and admissions process to reduce the barriers for students that take alternative pathways into engineering. Supporting us in this goal will be the recommendations of the *Eagles' Longhouse: Engineering Indigenous Initiatives Steering Committee*, which will issue its final report in 2018.

U of T Engineering is dedicated to transformative teaching and learning, and creating and implementing initiatives that speak to our culture of excellence and legacy of innovation in curricula and course delivery. In support of this mission, the Faculty works with the Office of the Vice-Provost, Academic Programs who oversees quality assurance under the *Policy for Approval and Review of Academic Programs and Units*, and more specifically under the *University of Toronto Quality Assurance Process* (UTQAP). In the context of quality assurance, the Faculty and the University of Toronto are "committed to being an internationally significant research university, with undergraduate, graduate, and professional programs of excellent quality."[1] The bachelor degree programs in the Faculty of Applied Science & Engineering are also accredited by the Canadian Engineering Accreditation Board (CEAB). Our Faculty will undergo a CEAB audit in the fall of 2018, which will provide us an opportunity to further review

1 University of Toronto Quality Assurance Process (UTQAP), September 21, 2012.

and refine our academic programs to ensure they continue to meet the high standards required for engineering licensure and professional mobility, and develop within our graduates the full complement of engineering attributes that prepare them to take leading roles in addressing the world's major challenges.

Our *2017– 2022 Academic Plan* is the culmination of years of preparation and groundwork within our U of T Engineering community. The goals and actions we have chosen to pursue over the next five years arise from many sources. In addition to consultations for the self-study and external review, ongoing Dean's Town Halls and working groups, the decanal *Core Curriculum Review Task Force* formally reviewed the content and delivery of the Faculty of Applied Science & Engineering first-year (core) curriculum for the Core 8 and TrackOne (Undeclared) programs from the perspective of students, faculty and external evaluators. As a result of the recommendations, we appointed an *Engineering Strategies and Practice I and II Review Committee* to review the sequence of cornerstone courses Engineering Strategies and Practice I and II within the Core 8 and TrackOne (Undeclared) programs. Recommendations from both these initiatives will continue to be implemented, ensuring we continue to meet the evolving rigorous foundational education needs of our programs.

The Faculty remains committed to innovation in education, and ensuring we develop best practices in new technologies and methods. Within the *2017– 2022 Academic Plan*, we will expand or implement several programs and initiatives. These include the *Technology Enhanced Active Learning (TEAL) Fellows* Program, created in 2017, and the *Hart Teaching Innovation Professorships*, which support innovation in engineering education and Indigenous outreach. We will continue our successful *Engineering Instructional Innovation Program*, which aims to foster curriculum innovation through strategic investments to improve teaching pedagogies and the student experience. We will also establish a new extra-departmental unit, the Institute for Studies in Transdisciplinary Engineering Education and Practice (ISTE2P). This institute will focus on three themes: (1) investigating the application of successful practices from other domains to engineering education; (2) cross-disciplinary competencies; and (3) guiding and supporting innovation in pedagogy.

During our external review, and during the consultations for the self-study, reducing the average time-to-completion for PhD students was recommended by many of our stakeholders. Over the last several years, trends for the average PhD time-to-completion have been affected by the practice in many academic units of promoting fast-tracking and direct-entry into the PhD program, as well as the dedication of supervisors and students to keep with regular committee meetings. Therefore, with the goal to properly account for time-to-completion, we will be assessing the impact of fast-tracking and direct-entry. In addition, we will encourage stricter monitoring of compliance for a mandatory annual supervisory committee meeting, so student progress can be assessed and remediation measures implemented, if required.

An important role of the Faculty is to educate and prepare the next generation of research leaders. A central aspect of research is to design studies and analyze data to draw conclusions. Therefore, we will have a goal of improved access to statistical expertise for complex studies, which may also help to decrease time-to-completion and allow for better use of time and resources. During the self-study consultations, graduate students

noted the desire for additional resources to design experiments. Therefore, we will work on integrating statistical consulting with library resources and writing support.

Transformative Teaching and Learning focuses on the academic curriculum, while *Student Experience*, the next chapter in the *2017–2022 Academic Plan*, looks to student engagement and fulfillment, both in the classroom, for academic advising and mental health, to outside the classroom for co-curricular interests, such as student clubs, and providing for meaningful international exchanges and experiences. *Transformative Teaching and Learning* articulates our education and curriculum-based goals and actions, especially related to innovative teaching, technology and the infrastructure in support of such pursuits.

GOALS

Over the next five years, the following goals will drive us to establish U of T Engineering as a leader in pedagogical development and teaching innovation in undergraduate and graduate education. We will be dedicated to excellence in engineering education and course delivery, and multidisciplinary collaborative opportunities that will create the U of T 21st Century Engineer — an engineer who will work towards addressing the world's most pressing challenges, and have the competencies to create technological change for the betterment of society.

1. Establish U of T Engineering as a global leader in pedagogical development and teaching innovation in engineering education.
2. Continue to develop rich opportunities for experiential learning and professional development for undergraduate and graduate students, including interdisciplinary fluency and working effectively and collaboratively across cultures.
3. Further integrate active learning pedagogies into curriculum delivery to encourage life-long learning and knowledge creation.
4. Prepare students with the technical and transdisciplinary competencies necessary for them to identify, learn, and apply these along with engineering practices to resolve global challenges, create new technologies and contribute to the prosperity of society.
5. Leverage the Centre for Engineering Innovation & Entrepreneurship's state-of-the-art facilities, as well as instructional technology tools, to further enrich our students in the active learning experience in engineering design and prototyping, and in collaborative, multidisciplinary learning.
6. Attract diverse, outstanding students from a wide range of backgrounds; and leverage all types of diversity to promote inclusivity and create opportunities to experience working collaboratively across cultures.
7. Ensure U of T Engineering remains a leader in the promotion and support of research training for graduate and undergraduate students.

CHAPTER 3

STUDENT EXPERIENCE

Our undergraduate and graduate students come from diverse backgrounds and have a wide range of academic and personal interests. Both inside and outside the classroom, U of T Engineering is dedicated to supporting faculty-student engagement and a vibrant student community to ensure a dynamic educational environment and extensive opportunities to engage in co-curricular activities and research.

Beyond standard supports and infrastructure, we are dedicated to providing a comprehensive and quality experience — one that not only speaks to the diversity and international outlook of our students, but also keeps with our culture and pursuit of excellence.

Academic planning is an ongoing process and we have received input from our undergraduate and graduate students through many channels. This includes consultations for the Faculty's self-study and external review, Dean's Town Halls, and recommendations from decanal task forces and working groups. In this cycle of academic planning we worked to ensure we reached all stakeholders, including meeting with postdoctoral fellows and engaging in more robust MEng student consultations.

Complementing the academic goals and plans in *Transformative Teaching and Learning*, our five-year plan will strengthen our undergraduate and graduate programming to ensure an

▲ A Professional Experience Year (PEY) intern uses a virtual reality headset to validate the performance of a new graphics card at Advanced Micro Devices (AMD). Each year, over 700 engineering undergraduates and 325 employers participate in PEY, the largest paid internship of its kind in Canada.

enriching *Student Experience*. There are many initiatives within *Student Experience*, including enhancing entrepreneurship, providing more experiential learning opportunities (both locally and abroad), and integrating multidisciplinary collaborations into student activities. To ensure students succeed, academically, personally and professionally, we have created new and improved programs and support systems for academic advising, mental wellness and healthy lifestyles. In addition, with the Centre for Engineering Innovation & Entrepreneurship, our students will have dedicated student-club space for co-curricular activities, new design studios, prototyping and fabrication facilities.

THE QUALITY OF THE *STUDENT EXPERIENCE* IS IMPORTANT FOR OUR UNDERGRADUATE AND GRADUATE STUDENTS WHILE THEY ARE HERE IN OUR FACULTY, BUT IT ALSO HAS A LASTING IMPACT WHEN THEY BECOME ENGINEERING ALUMNI.

Engagement inside and outside the classroom broadens each student's perspective, contributes to the development of the attributes expected of engineering graduates, and ultimately allows them to better manage and succeed in today's complex global environment. Academic credentials are no longer sufficient; equally important are work experience, a network of colleagues and friends, and a co-curricular record that demonstrates the development of professional and personal competencies in areas such as communications, professionalism, project management, finances, leadership, teamwork and problem solving. Therefore, our focus over the next five years supports the personal, professional and technical development of engineering students, enriching and enhancing their opportunities for a lifetime of success.

Through the self-study and external review consultations, it was recommended to provide more certainty to graduate students regarding their funding. While the Faculty communicates minimum guaranteed stipend levels on our website, we will endeavour to accelerate the assignment of teaching assistantships in each department and institute in order to provide this information to students in a timelier manner. These steps are articulated in our implementation plan.

In this chapter, we outline the goals to support both our undergraduate and graduate students to ensure that the experience they have here at U of T Engineering is not only dynamic and memorable, but also prepares them to succeed professionally and personally in our broader community. We are dedicated to graduating the U of T 21st Century Engineer.

GOALS

Taking a comprehensive view of the student educational experience as encompassing curricular, co-curricular and extra-curricular components, we will offer unparalleled opportunities to our students to develop the attributes expected of a U of T 21st Century Engineer. This includes a broad range of competencies and skills such as leadership, communications, business, entrepreneurship, professionalism, fostering inclusivity and equity, and with a global perspective and commitment to ethics and integrity. We are also dedicated to providing a student experience that will stay with our graduates forever. This includes the passion for life-long learning, a diverse network of fellow alumni and friends, and continued pursuit of their co-curricular and

extra-curricular interests. The following goals will guide the Faculty's initiatives to enrich the student experience and provide support to students during their studies.

1. Create a Centre for Engineering Student Success — a "one stop" point of access for information, resources and assistance.
2. Encourage all undergraduate students to participate in a significant co-curricular experience and enhance programs to further undergraduate professional development: increase the number and diversity of PEY internships, summer research internships and international experiences.
3. Improve the quality, accessibility and delivery of academic advising services.
4. Leverage and create resources, and develop policies and procedures to support mental wellness, assist students in need and promote healthy lifestyles.
5. Build on the pilot professional development program for graduate students (i.e. professional development for PhD students) and promote industrial interactions.
6. Encourage participation in, and support the activities of, co- and extra-curricular student activities, such as the competitive student design teams and other student clubs and groups.
7. Ensure that infrastructure (space and IT) supports are in place to facilitate collaboration and innovation within student teams and clubs.
8. Support deeper engagement and community among graduate and undergraduate students, in addition to enhanced faculty-student interaction across undergraduate and graduate programs.
9. Equip students, staff and faculty with the competencies necessary to navigate cross-cultural communications and interactions, thereby creating an enriching inclusive environment where everyone will excel and flourish.

CHAPTER 4

INNOVATIVE RESEARCH AND ENTREPRENEURSHIP

The Faculty of Applied Science & Engineering is a vibrant research community and is defined by creativity, multidisciplinary collaboration, innovation and entrepreneurship. U of T Engineering is an integral part of the University of Toronto's success as the #1 university in Canada and among the world's best. Our Faculty is committed to generating transformative knowledge, research excellence and global impact.

Initiatives in the Faculty are interdisciplinary by design, connecting our engineering researchers with each other, with faculty across the University of Toronto, and externally. A community of outstanding graduate and undergraduate students, research associates, postdoctoral fellows, laboratory technicians and staff, support and facilitate our research mandate. Our faculty members have continued growing provincial and federal research funding received, in addition to increasing the amount of financial support secured from industry partners and endowments. U of T Engineering is home to 90 Research Chairs, a growth of 30% over the past five years. We have embarked on major research initiatives both nationally and internationally, created spinoff companies, expanded our collaborations with industry and government, and advanced our culture of innovation and entrepreneurship through our startup incubators.

▲ Professor Angela Schoellig (left) and her students test drones in the Dynamic Systems Lab at U of T's Institute for Aerospace Studies. In 2017, she was named one of MIT's Innovators Under 35 and awarded a Sloan Teaching Fellowship to advance her research on autonomous aerial vehicles.

Paramount to our Faculty's mission of multidisciplinary collaborative research, the Research Committee, one of Faculty Council's Standing Committees, acts as an advisory body to support our culture of excellence and advance innovation. Each department and institute has an appointed Associate Chair or Associate Director, respectively, and they consult with each other and their constituent department on research matters pertaining to strategic planning, and support implementation of the goals and actions in the Academic Plan. Members of the committee coordinate research, entrepreneurship and innovation activities within the Faculty, in addition to supporting and strengthening relationships with other Faculties, external institutions and industry. To further support our external engagement, we have created two new positions: a Director of Foundation & Corporate Partnerships and a Director of Corporate, Government & International Partnerships. Both roles are focused on building strategic partnerships to drive technology development, leverage government research funding programs and maximize our impact globally.

Within the Faculty, our researchers develop and create innovative technologies and solutions for the most pressing health challenges; ensure the sustainability of our urban environment; provide novel solutions for advanced manufacturing; and look beyond our world to aircraft flight and space exploration. The themes of each department and institute are noted in **Table 1.**

OUR DEPARTMENTS AND INSTITUTES, EACH WITH THEIR UNIQUE INDIVIDUAL STRENGTHS, PROVIDE AN EXCEPTIONAL ENVIRONMENT TO SUPPORT CUTTING-EDGE RESEARCH, NURTURE LEADERSHIP AND PROMOTE MULTIDISCIPLINARY TRAINING.

Our achievement in fostering multidisciplinary and collaborative research activities is illustrated through our 26 centres and institutes, 11 of which were created in the past five years. These include the Institute for Water Innovation, Centre for Healthcare Engineering and the University of Toronto Transportation Research Institute. Cross-Faculty initiatives are a result of strategies to nurture innovation and new partnerships. The Translational Biology & Engineering Program of the Ted Rogers Centre for Heart Research and Medicine by Design are two such initiatives launched in U of T Engineering in 2015 that build on the expertise from several U of T Faculties along with research hospitals and other partners. Looking externally, our centres and institutes also collaborate with more than 300 industry partners, from startups to global multinationals.

Through our self-study, external review, numerous task forces, working groups and consultations, we actively sought new opportunities to refine our Academic Plan. From this ongoing work, and to solidify our *2017 – 2022 Academic Plan*, we created a research steering committee overseeing four focus groups. These focus groups had the mandate to discuss the corresponding four main themes to represent our cross-Faculty research foci. From these themes, we have structured corresponding sub-themes, which are detailed below. Our research themes align with the University of Toronto's goals and priorities, allow for the expansion of research funding and infrastructure, create an environment for innovation and entrepreneurship, and support and strengthen local and international partnerships. During the self-study consultations, it was noted that despite the great success we have had in securing research funding, there are untapped opportunities to significantly grow sponsored research funding. Accordingly, we have developed specific goals and actions in the Academic Plan to seize this potential.

Table 1: Areas of Research Expertise by Department/Institute

Department of Chemical Engineering & Applied Chemistry	• Biomolecular and biomedical engineering • Bioprocess engineering • Chemical and materials process engineering • Environmental science and engineering	• Informatics • Pulp and paper • Surface and interface engineering • Sustainable energy
Department of Civil Engineering	• Structural engineering • Transportation engineering and planning • Environmental engineering	• Building engineering • Mining and geomechanics
The Edward S. Rogers Sr. Department of Electrical & Computer Engineering	• Biomedical engineering • Communications • Computer engineering • Electromagnetics	• Electronics • Energy systems • Systems control • Photonics
Department of Materials Science & Engineering	• Advanced coating technologies and ceramics • Bio materials and biotechnology • Metals and alloys, composites, polymers and hybrid materials • Computational materials engineering • Electronic materials and systems	• Electrochemical energy conversion and storage devices, systems and technologies • Materials fracture and failure • Materials processing and modelling • Advanced manufacturing • Nanomaterials and nanotechnology
Department of Mechanical & Industrial Engineering	• Advanced manufacturing and materials engineering • Applied mechanics and design • Biomedical engineering • Energy and environmental engineering	• Human factors and ergonomics • Information engineering • Operations research • Robotics, mechatronics and instrumentation • Thermal and fluid sciences engineering
Institute of Biomaterials & Biomedical Engineering	• Neural, sensory systems and rehabilitation • Engineering in a clinical setting	• Biomaterials, tissue engineering and regenerative medicine • Nanotechnology, molecular imaging and systems biology
University of Toronto Institute for Aerospace Studies	• Aerodynamics, fluid dynamics and propulsion • Aircraft flight, structures, design and optimization	• Space systems engineering • Engineering physics

Each department and institute will have research corresponding to one or more of the four themes. The interdisciplinary nature of our research bridges these themes, thereby enabling us to more effectively address today's complex challenges, enhance our Faculty's achievements and scientific and socio-economic impact. The research themes also support

our internationally recognized Research Chairs and allow our undergraduate and graduate students to gain research competencies. The four research foci will serve as platforms to further strengthen external partnerships, and increase our capacity to create opportunities to draw donor support that will further enable research initiatives.

DATA ANALYTICS AND INTELLIGENT SYSTEMS

Our world is more connected today than ever before due to the central role that data plays in all major fields of physical and life sciences, and in technology. Over the years, we have learned how to efficiently sense, store, and communicate more data, and how to draw "intelligence" from it as to create autonomous systems such as self-driving cars, to improve human health through personalized medicine, and to better our lives through smart connected systems. Our research in this area can be divided into four sub-themes:

AUTONOMOUS SYSTEMS AND ROBOTICS

Our research in autonomous systems and robotics focuses on developing and integrating systems that will have an enormous impact on our daily lives through such applications as self-driving cars, unmanned aerial and mobile vehicles, robotic surgery, assistive and rehabilitation robots and devices, smart homes and appliances, and advanced manufacturing. Our researchers are also working on developing new actuator, control, artificial intelligence, and sensory technologies, which will enable individual and teams of autonomous systems and robots, from the nano to the macro size scale, to do things never before possible.

INTELLIGENT WELLNESS TECHNOLOGIES

Intelligent Wellness Technologies are meant to improve the well-being of humans by adopting the leading-edge technologies and sciences. Specific topics include personalized medicine, digital medicine, wearable monitoring devices, health-care analytics, and predictive health-care delivery.

SMART CONNECTED SYSTEMS

Our research in smart connected systems addresses the design of intelligent distributed systems in which interconnectivity plays a crucial role. These systems typically involve gathering, dissemination and storage of large volumes of sensor data, extraction of intelligence via analytics and machine learning, and support a wide gamut of smart applications. Examples include smart grids, smart homes, intelligent transportation, "Internet of Things" and intelligent manufacturing. These ultimately lead to the design of smart cities where overarching socio-economic challenges such as energy efficiency, air quality and carbon footprint are addressed.

ENABLING TECHNOLOGIES FOR INTELLIGENT SYSTEMS

Computing systems are "learning" to "think," "see," "hear," "read," "write," and in general to interact with the physical world in ways that we typically associate only with humans and high intelligence. In part, regular and exponential advances in semiconductor technologies enabled the emergence of these intelligent systems over the past four to five decades. Our plan moving forward is to work on enabling technologies for intelligent systems, including but not limited to technologies for data sensing, storage, communications, security and privacy, analytics and management, optical communication and networks, distributed systems and hardware/software co-design.

ADVANCED MATERIALS AND MANUFACTURING

Our Faculty is strategically located in Southern Ontario, which is a major manufacturing hub in Canada. Therefore, the main objective of this theme is to leverage U of T Engineering's knowledge and expertise in advanced materials and manufacturing and our partnerships with the Canadian manufacturing industry. The goal is to scale up advanced materials and manufacturing technologies and develop innovative manufacturing practices for the 21st century. The mission is to expedite the research and development of advanced materials and manufacturing technologies by creating multidisciplinary, multi-departmental networks focused on sharing knowledge, ideas and resources. Operating under the University of Toronto strategic priority area, our Faculty will strive for global leadership in advanced materials and manufacturing by translating lab-based technologies into commercial, scaled-up processes, and contributing to education and the training of High Qualified Personnel (HQP) in the materials and manufacturing sector. The strategic area of Advanced Materials and Manufacturing will take shape through three sub-themes:

MANUFACTURING OF ADVANCED MATERIALS

This sub-theme covers the complete range of knowledge involving the processing, structure, properties, performance, and design of advanced materials. In particular, it focuses on the development of an innovative and new class of materials with unique properties and far-reaching applications in the key sector of materials and manufacturing, which includes structural, electronic, surface, energy, bio and green materials. New emphasis in this theme will be given to super macromolecules materials, materials for wearable technologies, and electrical and autonomous cars. The development of cost-effective high-performance materials could potentially result in a large number of applications that are innovative, multi-functional, sustainable, and environmentally benign.

ADVANCED MANUFACTURING PROCESSES AND SYSTEMS

These are knowledge-and capital-intensive techniques and facilities employed to manufacture classes of materials and structures in a novel, more efficient or more effective manner. Examples are additive manufacturing, rapid prototyping, digital manufacturing, subtractive manufacturing, rapid manufacturing, and bio printing. In order to achieve optimal performance for these processes, precise placement of materials in space is required. Advanced manufacturing systems are applicable to many processes and materials, and add further knowledge intensity to organize or control a set or series of manufacturing processes.

MANUFACTURING PLANNING AND MANAGEMENT

In addition to research in physical materials and processes, this sub-theme will focus on the representation of knowledge in advanced manufacturing processes, materials and products. Such representations will support automated reasoning and analysis techniques, leading to better predictive and diagnostic models. This knowledge-based approach will enable the integration of data and knowledge from physics-based models of processes and materials, including optimization modules, artificial intelligence, neural networks, design of experiments (DOE) and design for manufacturability (DFM), to engineering and control systems used in making decisions about design and production within the enterprise.

SUSTAINABILITY

Engineers have long been aware of — and have strived to reduce — the impact of activities on the biosphere, lithosphere, hydrosphere, and atmosphere. Achieving a sustainable future and mitigating the adverse effects of climate change require the responsible use and protection of our natural and built environments through the development of clean technologies. The three sub-themes of Water, Air, Soil; Sustainable Energy; and Built Environment are included in this overarching research theme; these frequently intersect and are inter- and cross-disciplinary research subsets:

WATER, AIR, SOIL

This sub-theme includes research related to drinking water, municipal wastewater, industrial water, surface and ground water supplies, storm water management and low impact development, water reuse, water accessibility and security, water footprints, air quality, air pollution monitoring and control, carbon management, capturing and repurposing CO_2, minimizing air emissions from urban centres and industrial operations, municipal solid waste reduction and management, industrial solid waste reduction, and soil remediation.

SUSTAINABLE ENERGY

The Faculty's research strengths include energy distribution systems and renewable energy, particularly in the areas of solar, fuel cells, hydrogen production, bio-fuels and wind, electrochemical energy conversion, and energy storage. We also have foci in energy recovery, and in sustainable use of energy in aerospace, industrial processes, green information technology, grid management, and energy transportation.

BUILT ENVIRONMENT

Our interdisciplinary approach to research provides an excellent position to address the increasingly complex issues associated with built environments, including resilient infrastructure, transportation systems, structural engineering, energy efficient and healthy buildings, sustainable materials, sustainable industrial processes, product life cycle, advanced recycling, reducing carbon footprint, and clean technologies for mitigating climate change.

ENGINEERING AND HUMAN HEALTH

Technology is rewiring all of society and engineering is well positioned to strengthen its role in addressing health challenges. Health research has experienced exponential growth due in part to technological advances, with engineering playing an integral role in leading and advancing these technologies. The Faculty of Applied Science & Engineering has particular strength in the areas of aging, neural engineering, human factors, medical robotics, pain management, regenerative medicine, and natural and urban environments. The broad research in this theme can be divided into three general categories:

BIOENGINEERING

Bioengineering is the integration of engineering principles with medicine and biology. This sub-theme includes clinical engineering, rehabilitation engineering, tissue engineering, stem cell engineering, neural engineering, synthetic biology, endogenous regeneration, biomaterials, therapeutics materials, nutraceuticals, electrotherapeutics,

electromagnetic therapy, and mechanobiology. Bioengineers in our Faculty are working towards diagnostics to detect diseases easier and earlier using optical detection systems, image analysis of diseased tissues and anatomy, hardware/software development, communications and signal processing, machine learning, medical imaging, and mobile devices. Our bioengineers are also working towards therapies to treat diseases including wound-healing materials, organ-specific targeted stimulation, robotic surgery, electromagnetics, using electricity to stimulate organisms, and nanomaterials.

HEALTH TECHNOLOGY

Technological advances are critical to driving new biological discovery. Engineers are at the forefront of developing technology that interfaces with biology, including medical and assistive robots, robotic surgery, wireless diagnostics, wearable or disposable diagnostics, medical electronic devices and implantables, point of care molecular diagnostics, optical diagnostics, image analysis of disease tissues and anatomy, sensing and medical imaging, mobile health technology. Our Faculty is also looking for ways to improve how technology interfaces with humans, including developing healthy infrastructure related to the maintenance of the water, air, food and transportation system; the design of healthy buildings; the supply of water and air; and the communication of smart cities (e.g. wireless diagnostics, coordination, scheduling).

PUBLIC HEALTH

Engineers in the Faculty of Applied Science & Engineering use wide-ranging design principles to improve public health in multiple ways: smart healthy cities and communities; sensors and analytics for public health; healthy aging; neural aging; impact of urban environments on aging; advanced care solutions; pain management; remote health monitoring; impact of air pollution on human health and climate; role of transportation, industrial plants and cities in pollutant emissions; technologies to monitor and reduce human exposure to pollution; healthy infrastructure for clean and safe water, air, food, nutrition, energy and transportation; indoor air quality; health in remote areas; health in Indigenous communities; impact of genomic, epigenetic and exposomic factors on health; machine learning and intelligent health technologies; and all-connected health systems.

GOALS

The following goals will drive our Faculty's research activities over the next five years. We will continue to develop a compelling research vision with the mandate to enhance our impact by leading research benefiting the Province of Ontario, Canada and global society through creativity, multidisciplinary collaboration and innovation.

RESEARCH EXCELLENCE

1. Increase our support of transformative cross-disciplinary collaborative research that inspires innovation.

2. Continue fostering multidisciplinary collaborative research and education so it becomes an integral part of our culture.

3. Lead impactful multi-institutional research collaborations in strategic areas that will address local and global needs, in addition to creating new technologies that will act as an engine of prosperity and economic development.

4. Create a vibrant research ecosystem, which is nurturing, collaborative and inclusive, with centres/institutes focusing on impactful priority areas.

5. Expand our mentorship programs for early-career researchers.

6. Increase our reputation and visibility, and be recognized for excellence and the impact of our contributions.

INTERNATIONAL OUTREACH

7. Enhance our impact through international institutional and industry research cooperation that addresses global challenges.

8. Increase our leadership and participation in internationally significant and impactful projects.

9. Develop/expand faculty and research student international mobility programs (e.g. *Named Opportunities* for Visiting Professors) and HQP international exchange capacity to educate and prepare the next generation of global leaders.

INDUSTRY AND ENTREPRENEURSHIP

10. Strengthen our research impact via the translation of basic discovery to application through increased industry partnerships and support for entrepreneurship initiatives.

INFRASTRUCTURE AND SPACE

11. Create a forward-looking plan for our research space and infrastructure renewal, both in quality and quantity.

12. Devise and implement a sustainable model for research support and for the operation of major research infrastructure in the Faculty of Applied Science & Engineering.

CHAPTER 5

INFLUENCE, COLLABORATION AND PARTNERSHIPS

Since its beginnings in 1873, with the creation of the School of Practical Science, then as a Faculty in 1906, the Faculty of Applied Science & Engineering has had deep roots within the University of Toronto and our diverse and dynamic city. One of the oldest engineering schools in Canada, it is home to undergraduate and graduate students seeking strong academic and research opportunities within the Faculty and University, connections with our alumni, and interactions with the external world, through international experiences, Professional Experience Year internships and community involvement. Our faculty members are leaders in engineering education and research, both here in Canada and internationally. Many of the Faculty's 50,000+ alumni are actively involved as mentors, volunteers and generous donors towards our philanthropic initiatives.

▲ Prime Minister Justin Trudeau meets with elementary school students who spent the day designing the neighbourhood of the future at a workshop held by U of T Engineering Outreach. The project was part of an announcement by Waterfront Toronto and Sidewalk Labs to design a new community on Toronto's Eastern Waterfront.

Locally, we are dedicated to our pre-university outreach programs, to inspire all young women and men to explore a career in engineering. Our outreach initiatives also include leadership camps, to nurture future engineers and leaders, and work with K-12 educators to enhance the presence of engineering thinking in the elementary and high school curriculum.

THE STRENGTH OF OUR U of T ENGINEERING COMMUNITY, AND OUR MULTIDISCIPLINARY COLLABORATIVE APPROACH, ALLOWS US TO WORK WITH SOME OF THE MOST INNOVATIVE COMPANIES, PEER INSTITUTIONS AND LEADERS IN EDUCATION AND RESEARCH.

In *Innovative Research and Entrepreneurship*, we detailed our research-focused industrial partnership goals that will further develop and strengthen these collaborations. Partnerships are essential in creating outstanding opportunities for knowledge exchange between the Faculty and industry, student internships and multidisciplinary initiatives.

Influence, Collaboration and Partnerships articulates our goals and actions in relation to how we connect with each other at the Faculty and University, and also how we interact externally with our broader community. How effectively we connect with others has an important impact within the Faculty on our ability to attract the brightest students and faculty members, and also externally in addressing complex engineering challenges and creating new technologies for global prosperity.

U of T Engineering is dedicated to connecting with others outside the Faculty through many outreach initiatives to:

- Educate and inspire pre-university students to pursue careers in engineering;
- Foster enhanced education in science, technology, engineering and math (STEM);
- Develop strong partnerships with other Faculties, and between the City and the University;
- Employ engineering students as instructors in our outreach programs, providing them with first-hand experiences as engineering educators;
- Support the recruitment of prospective undergraduate and graduate students;
- Connect prospective students with current students to facilitate their decision process;
- Encourage engagement of alumni and volunteers within our vibrant U of T Engineering community;
- Continue to develop meaningful relationships with donors, and expand the network of philanthropic supporters;
- Support faculty and staff participating in government and funding agency panels and committees, professional academic or administrative organizations and groups;

- Better society through all our initiatives, with emphasis on those from the Centre for Global Engineering, the Food & Nutrition Security Engineering Initiative and the Institute for Water Innovation.

U of T Engineering supports extensive multidisciplinary **collaboration** and **partnerships**, with the goal to connect, facilitate, create and innovate. These include:

- Relationships with over 300 industry partners, representing all engineering disciplines;
- Offering of cross-Faculty undergraduate minors and certificates;
- Offering of collaborative graduate specializations such as Engineering Education with the Ontario Institute for Studies in Education, Psychology and Engineering with the Faculty of Arts & Science, and Biomedical Engineering with the Faculties of Medicine, Arts & Science, and Dentistry;
- Integration with other divisions through our cutting-edge research, such as Medicine by Design with the Faculties of Medicine, Pharmacy, Arts & Science and the Translational Biology Engineering Program with the Faculties of Medicine and Dentistry;
- Fostering student and faculty mobility, through exchanges and research with Canadian universities and international institutions;
- Nurturing essential professional competencies such as leadership and entrepreneurship through the Institute for Leadership Education in Engineering, Start@UTIAS Entrepreneurship Program and The Entrepreneurship Hatchery;
- Through extensive consultation and collaboration with the Faculty of Arts & Science, creation of the *Interdivisional Teaching Agreement* — which has allowed us to work in partnership for excellence in teaching and pedagogy, and improve access to courses to better the student experience;
- Working with industry partners, such as Google and AMD, and Canadian organizations, such as Actua, to create and deliver effective outreach programming to local and remote communities.

Outreach activities, collaborations and partnerships allow U of T Engineering opportunities to **influence**, in a measureable and impactful way. The Faculty influences with commitment to:

- Create new technologies that will act as an engine of prosperity and economic development;
- Generate transformative knowledge, research excellence and global impact;
- Educate the next generation of global engineers who will be influential leaders in their chosen careers and in society;
- Promote excellence in the engineering profession and public understanding of engineering and its impact on society.

GOALS

To strengthen collaborations and create impactful partnerships, we have set the following goals to direct our Faculty's efforts in these areas for the next five years.

1. Inspire and influence education and learning in science, technology, engineering and math (STEM) for K-12, while enhancing the student experience for undergraduate and graduate students.
2. Create connections within our community to enrich the City and the University.
3. Strengthen the relationship with alumni and increase interactions between alumni and current students.
4. Foster a stronger sense of community with alumni and donors who volunteer and provide philanthropic support to the Faculty.
5. Continue nurturing cross-disciplinary collaborations with other University of Toronto Faculties.
6. Develop strategic partnerships with key institutions and industry (local, national and international).
7. Increase the Faculty's impact through advocacy to and support from government agencies and industry; contribute to shaping the Canadian and global research agenda by influencing federal and provincial R&D priorities.
8. Raise the profile of the Faculty by actively participating in and providing leadership to professional societies, editorial boards and external research committees.
9. Provide outstanding leadership and influence for excellence in education.
10. Monitor and measure the impact of the Faculty's outreach, collaboration and partnerships.

CHAPTER 6

ORGANIZATION AND STRATEGIC RESOURCES

Our ability to achieve the important and ambitious goals we have set out in our Academic Plan is enabled by our Faculty's organization and resource allocation. Our philosophy is to effectively and strategically use our key resources to advance our innovation in research, support faculty and staff, and create an extraordinary learning environment for our students.

The self-study consultations, external review, decanal task forces, working groups and other ongoing initiatives have allowed us to develop our organizational priorities for the next five years. Particular studies relevant to resources allocation include the Faculty's *Strategic Facility Plan*, *Report on Information Security & Protection of Digital Assets* and the *Faculty of Applied Science & Engineering Maker Space Report*.

U of T Engineering attracts top scholars whose research and teaching inform and shape our Faculty's goals. Our faculty members synergistically combine teaching, research and service. Teaching activities share leading-edge knowledge and inspire future generations of engineering leaders. While at the same time, our research endeavours attract funding, strengthen our Faculty's collaborations and outreach, enhance student education, and allow the Faculty to address the most pressing global issues of our time.

▲ When it opens in 2018, the Centre for Engineering Innovation & Entrepreneurship will provide a new home to several multidisciplinary research hubs as well as technology-enhanced classrooms, prototyping facilities and dedicated space for student clubs and teams.

In 2009 our *Divisional Space Review* confirmed that the Faculty's space no longer met our needs as a world-class engineering research and education institution. In 2018 the Faculty will open the Centre for Engineering Innovation & Entrepreneurship (CEIE). The CEIE will create a stimulating ecosystem to facilitate and celebrate multidisciplinary collaboration to the fullest. Here, students, researchers, alumni, industry partners and staff will work together to foster and accelerate technology innovation and entrepreneurship. Within the CEIE, there will be multidisciplinary research hubs to bring together innovative teams across the Faculty and our broader community. Many of our space concerns will be addressed within the nine floors of the building, which will also include new prototyping and fabrication facilities for students and faculty entrepreneurs. There will be a state-of-the-art 500-seat auditorium, dedicated student club space to enhance co-curricular experiences, eight design studios and five Technology Enhanced Active Learning (TEAL) rooms to enable dynamic group learning.

While the CEIE is a significant component in our strategy to alleviate our urgent space issues, we also continue to improve our existing facilities and infrastructure. In the past five years, we have invested more than $200M in major cross-Faculty renovations and upgrades, including those in the Wallberg, Lassonde Mining and Sandford Fleming Buildings. In the implementation of the Academic Plan, we include actions to continue revitalizing and redesigning our historic spaces. One of our key goals is to continue creating new infrastructure and improving the utilization and flexibility of space to support research, educational and co-curricular initiatives.

OPPORTUNITIES FOR LEADERSHIP IN ENGINEERING ADVANCEMENT

While we continue to be strategic and prudent in managing our resources, advancement remains a critical part of ensuring we can support our research, academic and capital priorities. In Chapter 4 we outlined our research foci that will allow us to further strengthen external partnerships, and increase our capacity to create opportunities to draw donor support. From the research themes, we have selected three main priorities for advancement:

SUSTAINABILITY

From renewable energy generation, energy storage, electric vehicles, emissions reduction, capture and storage to air quality and livable cities, U of T Engineering researchers are leaders in ensuring the ongoing health of our planet. With over 35% of our faculty working in some capacity in these areas, we have the critical mass of research excellence to create opportunities for global change. Coupled with both industrial and public sector awareness and drive, our Faculty is in an outstanding position to continue leading and creating new *Sustainability* initiatives.

WATER

Canadians find themselves in a paradigm of plenty when it comes to water resources, but U of T Engineering researchers recognize that in a global context, water scarcity rather than abundance is the norm. With that in mind, our researchers tackle challenges related to municipal water reuse, industrial water remediation, drinking/irrigation water accessibility and water resource accounting and resilience. Our faculty members travel from South America to Europe to Asia to address research questions that arise from the global need for freshwater resources and are an indispensable asset to the global water community. As these water-related issues become increasingly intertwined, our researchers are finding that complementarities in our expertise represent a pathway towards the next generation of breakthroughs.

ROBOTICS

Southern Ontario is a region already established as a leader in automotive and health-care R&D. U of T Engineering has strong connections with these two sectors and continues to actively create new research collaborations and partnerships. Led by researchers in U of T Engineering and in the Department of Computer Science, we also have strengths in artificial intelligence. Our cohort of researchers have the expertise to create a comprehensive robotics ecosystem within the University. From autonomous vehicles to personal and assistive robotics to next-generation surgical tools, we are developing systems that incorporate computer vision, electromechanical control theory, mechanical design and application-specific considerations.

FINANCIAL RESOURCES

Strategic increases in revenues together with responsible fiscal management have allowed us to invest in our pursuit of excellence in research, innovation, education and the student experience. This approach, coupled with the Faculty's budget model we developed in 2009, has also enabled us to strengthen our financial position and infrastructure capacity, and increase unencumbered operating contingency reserves.

Even in light of declining overall government support, U of T Engineering has enjoyed double-digit revenue growth over the past several years through enrolment expansions, research intensification, and an increase in funding and industry partnerships. Such growth has given the Faculty greater capacity towards sponsoring new initiatives and expanding existing ones.

We are proud of the success we have enjoyed with the development and adoption of our hybrid *Responsibility Centered Management Based Budget Model*, and going forward we will continue with our prudent budgeting and fiscal management in support of our academic priorities and investments for the future. U of T Engineering must ensure the continued creative use of finite resources while prioritizing the quality of teaching, student experience and research. Our faculty and students are creative and driven, often seeking to do things that have never been done before. Rigorous financial management through education and working within our budgeting framework will aid in these efforts.

COMMUNICATIONS

Our strategic communications team aims to create and facilitate meaningful communication among all our stakeholders and advance our Faculty's academic mission. We work in partnership with over 30 communicators across the Faculty, who comprise the Engineering Communications Network, and with colleagues across the University of Toronto. We strive to establish new standards of excellence in higher education for creative, strategic communications and in support of the institution's vision of global leadership in university communications.

Our goal is to create innovative strategies and high-quality content that inspires action while advancing the reputation and visibility of U of T Engineering among all stakeholders. We will:

- Reinforce our message of diversity and inclusivity;
- Build the profile of U of T Engineering in strategic priority areas with key global audiences, including students, leaders, influencers, policymakers, peer institutions, alumni and donors;
- Enhance our communications capacity in support of our academic mission;

- Utilize our communications network and intranet to facilitate knowledge exchange in our U of T Engineering community and to share best practices in support of excellence in teaching, learning, research and administration.

HUMAN RESOURCES

Championing the Faculty's priorities are our dedicated administrative and technical staff. Supporting every facet of our operations, our staff maintain our culture of excellence and provide a stable and efficient environment for our students and faculty members to thrive. No matter what their function is, the Faculty's staff members are committed to providing outstanding service and to supporting the U of T Engineering community.

Our professoriate stands at 261 faculty members, and among these members 21.1% are women, up from 9.8% in 2006. Diversity is a core value of U of T Engineering, and we believe that diversity deepens the creative process, enriches the learning experience and brings different perspectives to better solve global challenges. Our goal over the next five years will be to continue our efforts to improve diversity in our faculty complement. This includes gender diversity, and other groups that are underrepresented in the Faculty, particularly Indigenous and Black academic staff.

INFORMATION TECHNOLOGY

In 2017, we established a steering committee on Information Security & the Protection of Digital Assets. Under the scope of this initiative is the Faculty's IT plan. This report will be published in 2018 and will include recommendations on Information Security, professional development in the use of new technology and setting a base level of IT support across the Faculty.

GOALS

Strategic use of our resources will allow us to support the Faculty's academic priorities over the next five years.

1. Expand opportunities for staff development to address the evolving needs of our Faculty, to provide appropriate tools to increase effectiveness and to create innovative approaches for staff advancement.
2. Emphasize diversity and cross-disciplinary strategic research themes when recruiting faculty and become a magnet for world-class talent.
3. Continue to enhance teaching and design facilities, improve laboratory and research space and provide co-curricular space for undergraduate and graduate students.
4. Strengthen our network of faculty, staff, students and alumni for the betterment of the Faculty and our broader community.
5. Continue to increase the quality of our communications and key messaging, and increase the Faculty's visibility to target audiences.
6. Create a base level of IT services across the Faculty and enhance professional development for staff and faculty in the use of new technologies.
7. Ensure operating budgets, capital plans and fundraising continue to align with our academic mission and priorities, and invest strategically for the future.

OUR COMMITMENT

U of T Engineering's *2017 – 2022 Academic Plan* has been brought together through the efforts of our outstanding community of students, faculty, staff, alumni and other key stakeholders. With our five-year goals established, we will concentrate on the actions related to these goals, as detailed in our implementation plan. We will also establish timelines and metrics, by which we will measure our progress. We will accomplish our initiatives, together, as a Faculty, through our philosophy of collaboration, inclusivity, dedication and commitment.

Over the next five years, the Faculty of Applied Science & Engineering will be focused on pursuing and reaching the goals articulated in the *2017 – 2022 Academic Plan*. Although we have outlined our goals and implementation plan, we know that the Academic Plan is a living document. Each year we will continue to monitor and refine our current actions, while setting new ones to capture emerging priorities. By concentrating on educating the U of T 21st Century Engineer, and advancing our innovative research, we will continue to collaborate on multidisciplinary and diversity initiatives that will allow us to not only address global challenges but create new technologies for local and global prosperity.

ADDITIONAL RESOURCES

1. 2017 Self-Study:
   www.uoft.me/selfstudy2017
2. 2017 – 2022 Academic Planning Framework:
   www.uoft.me/academicplanningframework
3. Towards 2030:
   www.towards2030.utoronto.ca/synth.html
4. Three Priorities:
   www.threepriorities.utoronto.ca
5. Policy for Approval and Review of Academic Programs and Units:
   www.uoft.me/gcacademicprograms
6. Guidelines on Divisional Academic Planning:
   www.uoft.me/guidelinesacadplanning
7. University of Toronto Quality Assurance Process (UTQAP):
   www.uoft.me/utqap
8. 2017 Annual Report of Performance Indicators:
   www.uoft.me/AR2017

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

OFFICE OF THE DEAN

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

416-978-3131
dean.engineering@ecf.utoronto.ca
www.engineering.utoronto.ca

Appendix C: By The Numbers

By the Numbers 2023

Explore comprehensive visual data about the Faculty in this companion piece to our 2023 Impact Report

Available as a link only.

Appendix D: Sample Course Evaluation Form

Printer Friendly Version

Office of the Registrar

F,0 .ilt)· OI'Ai,pl it'd Scicnc,e
& Enginc-.cri
35 St. Gcoq;c Street,
Tc,romc,,ON M5SlA4
IIIIIIIIII

Print this page

Notes:

Format for Core and Faculty Student Evaluation of Teaching In Courses Questions

(Administrative !I esponsibitity	Questions	Detail s
½re institutional uestions(8)	t. 1 fo und the co urse intel lectually stimulating. 2. The cour!le prcwided me \,it h adeeper understandingof thesubject matter. 3.The instructor tte ated a course atm06phere th.at wru.oonduci\'e to my learn ing. 4. Course projectc.i, a. gn m ents, t est<.i and/ or e:c:am!I impm\'edn) understanding orthe oour!>t? material. 5. Course pro jects, ass.ignments, tests and/ore:c:am!I providedopportunityfor me to de monst ra te an unde rstand ing of the course material. Scale(Questions 1- 5): Not at all» Somwhta>>Moderately » Moitly » A great deal 6. O\•eral the qualityof mylearning experienre in this course was-.: Scale : Poor» Fair» Good >>Vel'} good » Excellent 7. Pleasecomment on the overall qualityof inst ructionin this course. Open---ended. 8. Please comment on any a<isinance tha t was a\' t1ilab le to su p po rt yourlearning in the course. Open-ended.	ncluded in all UofT ''onns
	9. The cour!le helped me impfO\•e Ill)' ability to fonnulate, analy,:eand i;olve prob lems. to. The instructor relatedcour!leconcepts	

{ acnlty of Applied iience& Engineering Questions (7)	to practical applicationsand/o r current resean:h. 1t. The coursee\:panded my understanding lof the et hical and enviro n me ntal i.s.ciues looncem ing en gineering in society. 12 The instructor explained how the jcoorseconcepts related to other cou r!les. 13 Thefeedback I rereived on tesLci, assignmenLci,Labs, and/or projects provided guidance to improve my understandingof coo.rse materials. 1.4.The instm ctor exp la ined what students are expected to le.am in the course. Scale(Questions 9-14): Not at all » Somewhat >> Moderately » Mostly » A !great deal 15. Wb.atis your overall ratingof the instructor as a teacher? Scale(Question 15)-: Poo r » F a ir » Good » Verygood » Excellent	o be included o n all Fa' culty of Applied)Ciience & En gineering orms
{ ac n lty -le\'el q uestion-.. (depending on typeof r!le, asidefified by the inst ructor) (1to 2)	Lecture-based COllrse!I: 16. The instmctor used appropriate means to deli\'er the material in a clear and jorganiud manner. Project-based conrsec.i: 16 Thecourse encouragedinno\'ation in the project. 17. The course pro\ided opportunities to improvecommunication skills. Labora to ry- only cour!les: 16. The laboratory enhanced my understanding of science and/or jengi:nee ring concep ts . Scale: NO(a t all » Som ewhat >> Moderately » MostL)• » Agreat deal	
Department-level/ ctorQ<1estion, (3)	Department-level and instructorquestions lean be introd uced acilongas the total numberofquestionsis 20orless.	,..1es tio ns (qua ntltat lVe/ ualitative)maybe rawn from thecentral question bank.

Appendix E: Library Report

UNIVERSITY OF TORONTO LIBRARIES

University of Toronto Libraries Report for Faculty of Applied Science & Engineering, 2023

Context: The University of Toronto Library (UTL) system is the largest academic library in Canada and is currently ranked third among academic research libraries in North America.[1] The UTL has an annual acquisition budget of $36.2 million. Its research and special collections comprise over 12.5 million print volumes, 5.6 million microforms, over 5,200 print journal subscriptions, and rich collections of manuscripts, films, and cartographic materials. The system provides access to more than 3.2 million electronic books, 199,400 electronic journals, and rich primary source materials.[2] Numerous, wide-ranging collections, facilities and staff expertise reflect the breadth of research and instructional programs at the University and attract unique donations of books and manuscripts from around the world, which in turn draw scholars for research and graduate work.

Major North American Research Libraries					
	2016-2017	**2017-2018**	**2018-2019**	**2019-2020**	**2020-2021**
ARL RANK	**UNIVERSITY**	**UNIVERSITY**	**UNIVERSITY**	**UNIVERSITY**	**UNIVERSITY**
1	Harvard	Harvard	Harvard	Harvard	Harvard
2	Yale	Yale	Yale	Yale	Yale
3	Michigan	**Toronto (3rd)**	Columbia	**Toronto (3rd)**	**Toronto (3rd)**
4	Columbia	Columbia	**Toronto (4th)**	Columbia	MICHIGAN
5	New York	Michigan	Michigan	Michigan	COLUMBIA
6	**Toronto (6th)**				

Top 5 Canadian Universities in the ARL Ranking of Major North American Research Libraries				
2016-2017	**2017- 2018**	**2018- 2019**	**2019-2020**	**2020-2021**
RANK/UNIVERSITY	**RANK/UNIVERSITY**	**RANK/UNIVERSITY**	**RANK/UNIVERSITY**	**RANK/UNIVERSITY**
6/Toronto	**3/Toronto**	**4/Toronto**	**3/Toronto**	**3/Toronto**
29/Alberta	29/Alberta	30/Alberta	39/Alberta	29/British Columbia
37/British Columbia	33/British Columbia	40/British Columbia	40/British Columbia	39/Alberta
40/McGill	38/McGill	47/McGill	51/McGill	42/MCGILL
75/Calgary	69/Manitoba	62/Ottawa	75/Calgary	70/CALGARY

Space and Access Services: The UTL's 40 libraries are divided into four administrative groups: Central, Departmental/local, Campus (UTM & UTSC) and Federated and Affiliated College Libraries. The UTL provides a variety of individual and group study spaces for students. Study space and computer facilities are normally available twenty-four hours, five days per week at one location, Robarts Library, with additional extended hours during study and exam periods at both UTSC and UTM. Web-based services and electronic materials are accessible at all times from campus or remote locations.

Equity, Diversity and Inclusion (EDI): EDI is a high priority at UTL. UTL has developed an EDI Statement, an Anti-Racism Statement and a Collections Diversity Plan. These statements are supported by a concrete action plan, which UTL is committed to achieving. UTL is prioritizing staff diversity, staff cultural competencies and awareness of systemic biases, building and improving relationships with Indigenous and other underrepresented

[1] As per Association of Research Libraries Statistics.

[2] Figures as of January 2022

communities, incorporating the principles of the Accessibility for Ontarians with Disabilities Act in its services, and working with the University's Equity Offices to remove barriers in support of our community members who seek to fulfill their academic, research, and employment goals. Engineering & Computer Science Library staff are active members on the Engineering Equity, Diversity, and Inclusion Action Group and work with other partners in the Engineering and U of T community to contribute to the ongoing EDI work of FASE and the wider university.

Teaching, Learning & Research Support: Libraries play an important role in the linking of teaching and research in the University. To this end, information literacy instruction is offered to assist in meeting FASE's degree level expectations in the ability to gather, evaluate and interpret information. Librarians collaborate with instructors on assignment design, provide student research consultations, and offer just-in-time student research help in person, by phone, or through online chat. Librarians are also available to support curriculum mapping initiatives. Special initiatives, such as the Libraries Undergraduate Research Prize, and an annual forum for student journal editors, extend information literacy beyond the classroom. These services align with the Association of College and Research Libraries (ACRL) *Framework for Information Literacy for Higher Education*.[3]

Program Specific Instructional Support: Instruction occurs at a variety of levels for engineering students and is provided by the faculty liaison librarians for the engineering programs. The Engineering & Computer Science Library facilitates formal instruction integrated into the class schedule and hands-on tutorials related to course assignments, including in courses such as APS111/112, Praxis I & II, BME330, BME346, CHE499, CHE1102, CIV220, ECE297, ESC301, MIN250, MIE242, MIE490, MSE298. The Engineering & Computer Science Library, through its liaison librarians, customizes feeds of library resources which appear prominently in Quercus course pages. For example, the course guide for CHE430, which is viewed well over a thousand times during the term. The Engineering & Computer Science Library also maintains online subject guides for aerospace engineering, biomaterials and biomedical engineering, chemical engineering, civil engineering, electrical and computer engineering, mechanical and industrial engineering, metallurgy and materials science, mining, and materials engineering, as well as standards and codes and patents. The library is also developing an "Equity, Diversity, and Inclusion in Engineering" guide to assist researchers and students with accessing up-to-date information and resources in this important area.

Collections: Many college and campus libraries collect materials in support of engineering; the largest collection of materials is centrally located in the Engineering & Computer Science Library. Collections are purchased in all formats to meet the variety of preferences and styles of our current students and faculty. The University of Toronto Library is committed to collecting both print and electronic materials in support of FASE at the University of Toronto.

Journals: The Library subscribes to most of the top 25 journals listed in Journal Citation Reports (JCR)[4] in subject categories relevant to engineering. Of these titles, almost all are available electronically to staff and students of the University. We prioritize acquisition of online journals where possible. The following table shows a sample of categories relevant to FASE's research and instructional activities and the number of subscriptions UTL maintains of the top 25 journals in those areas:

[3] Association of College & Research Libraries. Framework for Information Literacy for Higher Education. ACRL, 2016. http://www.ala.org/acrl/sites/ala.org.acrl/files/content/issues/infolit/Framework_ILHE.pdf

[4] 2023 Journal Citation Reports® (Thomson Reuters, 2023)

Category	Subscriptions to JCR top 25 - 2023
BIOTECHNOLOGY & APPLIED MICROBIOLOGY	25
CHEMISTRY, APPLIED	25
COMPUTER SCIENCE, SOFTWARE ENGINEERING	25
CONSTRUCTION & BUILDING TECHNOLOGY	23
ENGINEERING, AEROSPACE	25
ENGINEERING, BIOMEDICAL	25
ENGINEERING, CHEMICAL	25
ENGINEERING, CIVIL	25
ENGINEERING, ELECTRICAL AND ELECTRONIC	25
ENGINEERING, ENVIRONMENTAL	25
ENGINEERING, GEOLOGICAL	24
ENGINEERING, INDUSTRIAL	24
ENGINEERING, MANUFACTURING	25
ENGINEERING, MECHANICAL	24
ENGINEERING, MULTIDISCIPLINARY	25
ENVIRONMENTAL SCIENCES	25
ERGONOMICS*	21
FOOD SCIENCE & TECHNOLOGY	25
MATERIALS SCIENCE, BIOMATERIALS	24
METALLURGY & METALLURGICAL ENGINEERING	25
MINING & MINERAL PROCESSING	21
NANOSCIENCE & NANOTECHNOLOGY	24
POLYMER SCIENCE	25
ROBOTICS	25
TELECOMMUNICATIONS	24
TRANSPORTATION	25
TRANSPORTATION SCIENCE & TECHNOLOGY	25

*Category contains 22 journals in total

Monographs: The UTL maintains comprehensive book approval plans with 43 book vendors worldwide. These plans ensure that the Library receives academic monographs from publishers all over the world in an efficient manner. For engineering, monographs are purchased in electronic form where possible, and the Library currently receives all current e-books directly from the following publishers: Springer, Elsevier, IEEE, Wiley, Taylor & Francis.

Knowledge Synthesis: Libraries are key partners in research through their collaborations with faculty in completing knowledge syntheses projects, Systematic and Scoping Review Collaboration (SSRC), and providing consultations to faculty and students on comprehensive searching for method driven reviews.

Preservation, Digitization, and Open Access: The UTL supports open access to scholarly communication and research information through its institutional research repository (known as T-Space), its Downsview print repository, its open journal services, subscriptions to open access publications, and support for preservation of research materials in all formats. In addition to acquiring materials in support of engineering, the Library has digitized its monograph holdings published before 1923. These books are available without charge to any Internet user. For the past several years, the Engineering & Computer Science Library has been supporting the open access efforts of all researchers in the Faculty of Applied Science & Engineering by assisting with uploading peer-reviewed publications to TSpace (in accordance with publisher copyright agreements). This service enables researchers to comply with the Tri-Agency Open Access Policy on Publications.

Key Databases: *Compendex, Scopus, Web of Science, IEEE Xplore, Techstreet, ACM Digital Library, SciFinder Scholar*

Special Collection Highlight: Special collections relevant to engineering, such as standards and codes, are purchased online where possible, and the Library currently maintains subscriptions to all available current and historical standards from IEEE through its IEEE Explore online subscription, and all available current and historical standards from ASHRAE, ASME, CSA, IEC, ISO, and UL through its Techstreet online subscription.

Other Library-departmental engagement: Engineering & Computer Science librarians actively participate in FASE committees, such as Faculty Council, the Undergraduate Curriculum Committee, the Engineering Equity, Diversity, and Inclusion Action Group, and the Engagement and Development Network. A faculty member representative from each department in FASE participates on the Engineering & Computer Science Library's Faculty Advisory Committee, which meets twice a year.

Prepared by: Angela Henshilwood, Head, Engineering & Computer Science Library, August 30, 2023

Submitted by: Larry Alford, Chief Librarian, University of Toronto Libraries, August 30, 2023

Appendix F: Graduate Degree Requirements, Curriculum Areas and Research Themes

Appendix F1: Graduate Degree Requirements

The degree requirements for the research stream degrees (PhD) and the professional stream (MEng) differ primarily in the nature of the required number of courses and in the required thesis for doctoral stream students. The professional stream students take significantly more classes than those in the research stream; the courses provide the MEng students with exposure to a broad range of material to enhance their industry experience. The research stream students, on the other hand, take fewer and more focused courses which naturally lead into a doctoral thesis, which is supervised by a faculty member, or co-supervised for collaborative programs.

The course requirements for the various degree programs are tabulated by graduate unit in **Table F1.1**. In most departments, a portion of the MEng course requirements can be met by doing an independent project, but this is optional. The number of courses that can be covered by the project is also given in **Table F1.1** (indicated in parentheses). MEng programs also have requirements for the ratio of technical to non-technical courses, and the number of technical courses that are taken in the home department. For example, in Chemical Engineering and Applied Chemistry (ChemE), a minimum of 6 of the 10 courses must be technical and 3 must be in ChemE. A maximum of 3 may be nontechnical and a maximum of 3 can be 500-level courses (undergraduate courses open to graduate students that are either technical or non-technical). In Civil and Mineral Engineering (CivMin), 6 of the 10 courses must be taken in the home department with a maximum of 4 outside of the department and two may be taken outside of the U of T as a visiting student at another institution.

Table F1.1 Graduate Course Requirements, by Degree Program

Graduate Unit	MEng (Project)	PhD (With Masters/Direct Entry or Transfer)
AER	10 (1)	4/7
BME	7 (practicum)	2/6
ChemE	10 (3)	4/6
CivMin	10 (1 or 2)	4/9
ECE	9 (3)	5/8
MIE	10 (3)	5/7
MSE	10 (3)	4/7

Appendix F2: Description of Degree Program Curriculum Areas or Research Themes

University of Toronto Institute for Aerospace Studies (AER) - 2023

- Aeronautics: Aircraft design, systems, and control
- Experimental methods: Laser diagnostics, structural/material analysis, field testing of robotics and aircraft
- Flight simulation: Full motion-based flight simulation with virtual reality capability
- Fluid dynamics: Flow of gasses over aircraft and in engines
- Numerical methods: Computer modeling for fluid flows, structures, design, and optimization
- Orbital mechanics: Satellite/spacecraft dynamics and control
- Propulsion systems: Jet and rocket engines, turbomachinery, combustion science
- Robotics and autonomous systems: Ground, air and space-based systems
- Spacecraft design and construction: Design, construction, and launch of satellites
- Structures and materials: Structural design and optimization, material testing.

Institute of Biomedical Engineering (BME) - 2023

- Biomaterials, Tissue Engineering and Regenerative Medicine
- Engineering in a Clinical Setting
- Nanotechnology, Molecular Imaging and Systems Biology
- Neural/Sensory Systems and Rehabilitation

Chemical Engineering & Applied Chemistry (ChemE) - 2023

- Biomolecular and Biomedical Engineering
- Bioprocess Engineering
- Chemical and Materials Process Engineering
- Engineering Informatics
- Environmental Science and Engineering
- Pulp and Paper
- Surface and Interface Engineering
- Sustainable Energy

Civil & Mineral Engineering (CivMin) - 2023

- Cities & Infrastructure
- Complex Systems
- Energy & Environment
- Mining & Subsurface Systems

- Transformative Technologies

These themes encompass the traditional civil engineering areas of Structural Engineering; Transportation Engineering; Environmental Engineering; Building Engineering and Construction Management; and Mining and Geomechanics.

Electrical & Computing Engineering (ECE) - 2023

- System Control
- Biomedical Engineering
- Communications
- Computer Engineering
- Electromagnetics
- Electronics
- Energy Systems
- Photonics

Materials Science & Engineering (MSE) - 2023

- Advanced Manufacturing & Coating Techniques
- Adaptive Materials
- Biomaterials & Biotechnology
- Computational Materials Engineering
- Electronic Materials & Systems
- Materials Fracture & Failure
- Nanomaterials & Nanotechnology
- Optoelectronics
- Photovoltaics
- Process Metallurgy
- Surface Engineering
- Sustainable Mineral & Materials Processing

Mechanical & Industrial Engineering (MIE) - 2023

- Advanced manufacturing and materials engineering
- Applied mechanics and design
- Biomedical engineering
- Energy and environmental engineering
- Robotics, mechatronics and instrumentation
- Thermal and fluid sciences engineering
- Human factors/ergonomics
- Information engineering
- Operations research

Appendix G: Research Centres and Institutes

Appendix G: U of T Engineering Research Centres and Institutes

U of T Engineering is home to 31 multidisciplinary research centres and institutes that bring together world leading expertise from across our Faculty. The complete list is below. Note the list does not include the Institute of Biomedical Engineering (BME), the University of Toronto Institute for Aerospace Studies (UTIAS) or the Division of Engineering Science (EngSci) as these function as autonomous academic areas.

Research Centre/Institute	Chair/Director	Website
BioZone	Emma Master	https://biozone.utoronto.ca/
Building Innovation ReserchResearch Centre (formerly Building Tall)	Brenda McCabe	https://buildinginnovation.utoronto.ca/
Center for Advanced Diffusion-Wave and Photoacoustic Technologies (CADIPT)	Andreas Mandelis	https://cadipt.mie.utoronto.ca/
Centre for Advanced Coatings Technologies (CACT)	Javad Mostaghimi	https://cact.utoronto.ca/
Centre for Advanced Nanotechnology	Harry E. Ruda	http://sites.utoronto.ca/~ecan/
Centre for Aerial Robotics Research and Education (CARRE)	Hugh Liu	https://www.utias.utoronto.ca/aerial-robotics/
Centre for Analytics and Engineering (CARTE)	Timothy Chan	https://carte.utoronto.ca/
Centre for Applied Power Electronics (CAPE)	Reza Iravani	https://www.ece.utoronto.ca/research/centres/centre-applied-power-electronics-cape/
Centre for Computational Science and Engineering (CCSE)	David Zingg	https://www.utias.utoronto.ca/centre-for-computational-science-and-engineering/

Research Centre/Institute	Chair/Director	Website
Centre for Global Engineering (CGEN)	Amy Bilton	https://cgen.utoronto.ca/
Centre for Healthcare Engineering (CHE)	Vahid Sarhangian	https://che.utoronto.ca/
Centre for Maintenance Optimization & Reliability Engineering (C-MORE)	Chi-Guhn Lee	https://cmore.mie.utoronto.ca/
Centre for Management of Technology and Entrepreneurship (CMTE)	Yuri Lawryshyn	https://www.cmte.utoronto.ca/
Centre for Microelectronics Assembly and Packaging	N/A	N/A
Centre for Power and Information (CPI)	Deepa Kundur	https://www.ece.utoronto.ca/research/centres/cpi/
Centre for Research in Sustainable Aviation (CRSA)	David Zingg	http://www.utias.utoronto.ca/centre-for-research-in-sustainable-aviation/
Centre for Resilience of Critical Infrastructure (CRCI)	Jeffrey Packer	http://crci.utoronto.ca/
CRANIA Neuromodulation Institute (CNMI)	Taufik A. Valiante	https://www.engineering.utoronto.ca/research-innovation/research-institutes-and-centres/crania-neuromodulation-institute-cnmi/
Identity, Privacy and Security Institute (IPSI)	Dimitris Hatzinakos	http://www.ipsi.utoronto.ca/
Institute for Multidisciplinary Design & Innovation (UT-IMDI)	Kamran Behdinan	https://imdi.mie.utoronto.ca/
Institute for Sustainable Energy (formerly the Centre for	Timothy P. Bender (Acting Director)	https://energy.utoronto.ca/

Research Centre/Institute	Chair/Director	Website
Sustainable Energy)		
Institute for Water Innovation (IWI)	Frank Gu	https://water.utoronto.ca/
Intelligent Transportation Systems (ITS) Centre and Testbed	Baher Abdulhai	https://uttri.utoronto.ca/research/research-groups/its-centre-and-testbed/
Lassonde Institute of Mining	Lesley Warren	https://lassondeinstitute.utoronto.ca/
Open Centre for the Characterization of Advanced Materials	Charles Mims/Doug Perovic	https://occam.utoronto.ca/
Pulp and Paper Centre	Honghi Tran	http://www.pulpandpaper.utoronto.ca/
Robotics Institute	Yu Sun	https://robotics.utoronto.ca/
Southern Ontario Centre for Atmospheric Aerosol Research (SOCAAR)	Greg Evans	https://www.socaar.utoronto.ca/
Toronto Institute of Advanced Manufacturing (TIAM)	Hani Naguib	https://tiam.engineering.utoronto.ca/
Toronto Nanofabrication Centre (TNFC, formerly ECTI)	Wai Tung Ng	https://tnfc.utoronto.ca/
Troost Institute for Leadership Education in Engineering (Troost ILead)	Emily Moore	https://ilead.engineering.utoronto.ca/

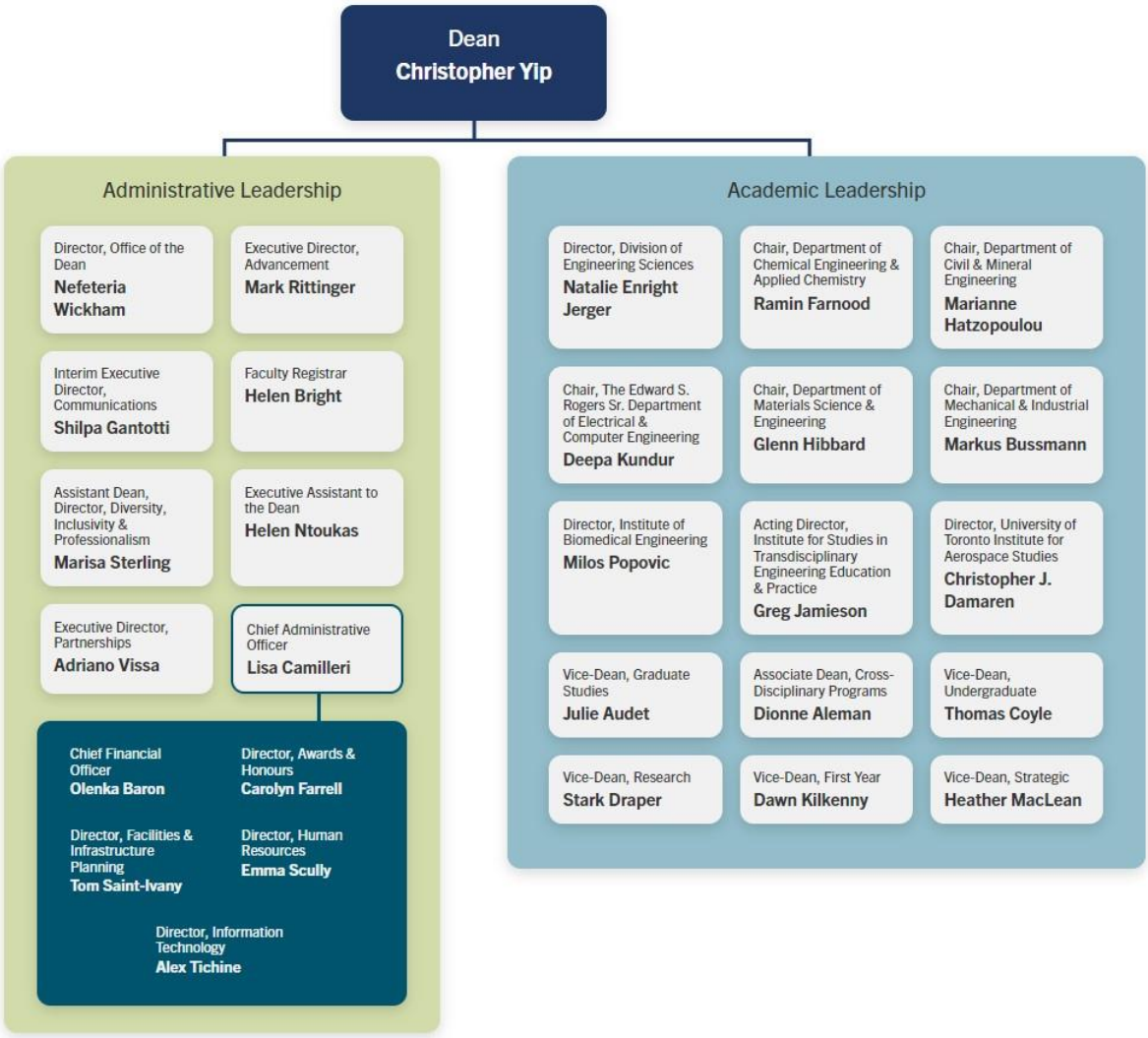
Cross-Faculty Research Centres and Institutes:

Research Centre/Institute	Chair/Director	Website
Centre for Nanostructured Polymeric and Inorganic Materials (CNPIM)	N/A (Lead by the Faculty of Arts & Science, Department of Chemistry	N/A
Institute for Optical Sciences	N/A	N/A
Terrence Donnelly Centre for Cellular and Biomolecular Research (CCBR)	Stephane Angers	https://thedonnellycentre.utoronto.ca/
University of Toronto Transportation Research Institute (UTTRI)	Eric Miller	https://uttri.utoronto.ca/

Sources: https://www.engineering.utoronto.ca/research-innovation/research-institutes-and-centres/ (August 31, 2023) and the Office of the Vice-Dean, Research

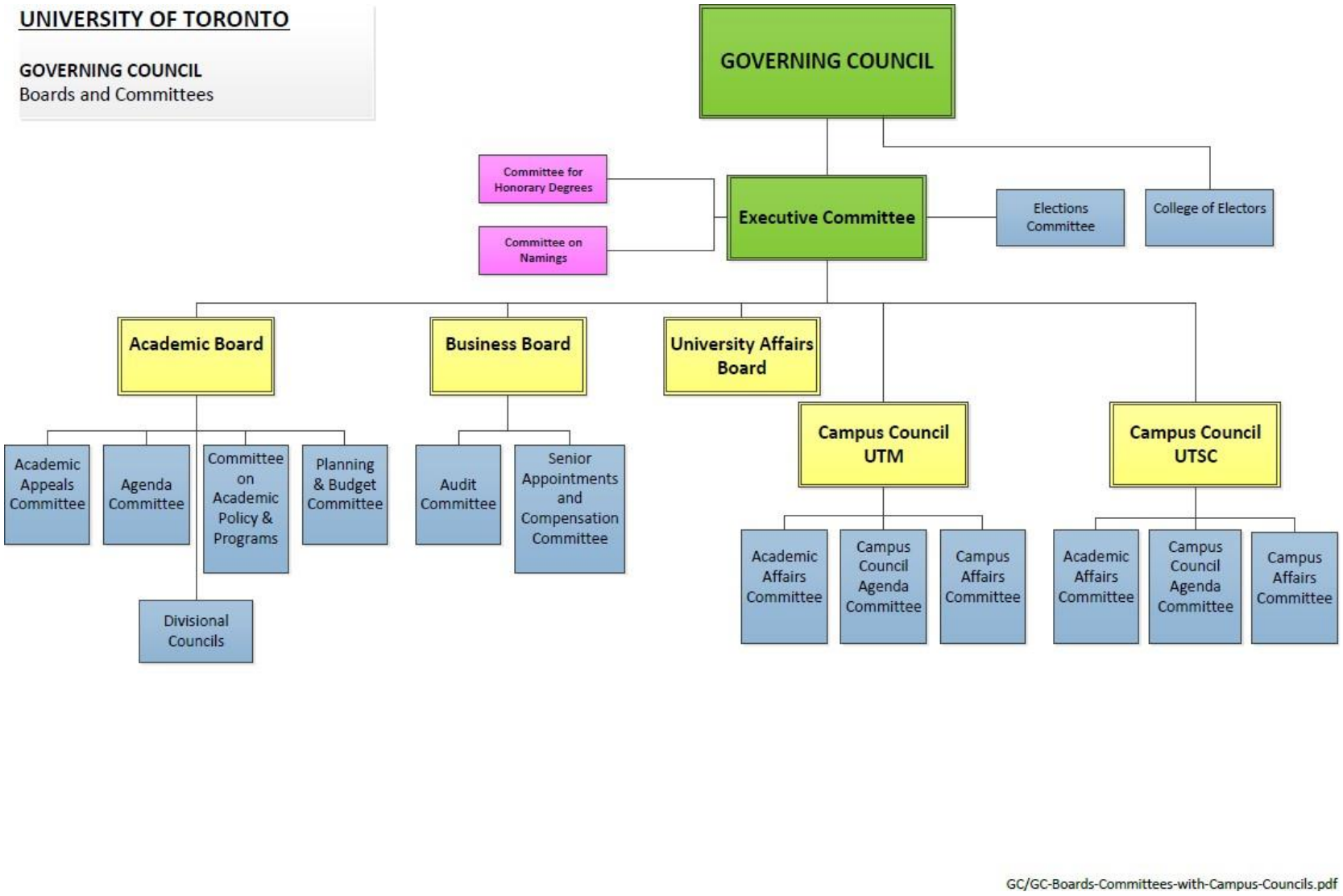
Appendix H: University of Toronto Engineering Organizational Chart 2023

U of T Engineering Office of the Dean Organizational Chart



Source: https://www.engineering.utoronto.ca/about/office-of-the-dean/office-of-the-dean-chart/ (September 6, 2023)

Appendix I: Governing Council



Source: https://governingcouncil.utoronto.ca/governance-bodies; downloaded August 31, 2023

Appendix J: Advancement Priorities

Appendix J: Advancement Priorities

Overview:

In 2023, the Faculty of Applied Science & Engineering is deeply embedded in the University's ongoing fundraising and alumni engagement campaign, *Defy Gravity: The Campaign for the University of Toronto* which intends to harness the power of our global community to fuel transformational work.

The Campaign has two ambitious goals. For the first time in U of T history, the campaign will include a goal for alumni engagement: to inspire 225,000 alumni to get involved as volunteers, mentors, donors, participants, and leaders and encourage them to contribute their time and talent to the university one million times collectively. The campaign will also seek to raise $4 billion for the university's highest priorities.

The Faculty of Applied Science & Engineering has committed to raise a total of $400M towards this overall goal and to engage more than 20,000 alumni - a goal commensurate with our excellence, the breadth of our aspirations, the global footprint of our faculty, students, alumni, and donors, and our potential for life-changing impact.

U of T Engineering Priorities Related to Advancement:

This document outlines U of T Engineering's philanthropic plan to financially support the following efforts, core to its mandate:

- Attract and engage a diverse, talented, and creative body of undergraduate and graduate students from around the world whose contributions will further strengthen our diversity and global perspective;
- Recruit and retain an internationally renowned faculty, characterized by the quality of their teaching, the significance of their research, and caliber of the honours and funding they secure;
- Be recognized internationally for the intellectual innovation, collaborative approach, and creativity of our educational and research programs, specifically in the areas of sustainability, health, AI, and Robotics.
- Create new and enhance existing facilities that reflect the aspirations and quality of our students and faculty.

Attracting and empowering the finest faculty, staff, and students depends on U of T Engineering's ability to provide an environment that fosters creativity and inspires twenty-first-century learning and discovery. Success in our mission requires outstanding minds to undertake these endeavours.

Raising funds to endow academic chairs, deliver support for students and research is crucial to secure our place among the world's leading research centres and to provide our students with faculty mentors. Scholarships are fundamental to our ability to attract the most talented undergraduate and graduate students from Canada and around the world.

Finally, our success in pursuing new areas of scientific inquiry has created the need for specialized work areas, more laboratories, and new kinds of classrooms. Some of our more

historic buildings need to be updated to accommodate contemporary learning technology that will assist faculty in bringing new dimensions of sight and sound to their lessons while bringing diverse academic units closer together. New buildings and the thoughtful renovation of our cherished spaces will also provide faculty, undergraduates, and graduate students with powerful incentives to choose the University of Toronto.

U of T Engineering Advancement Thematic Pillars:

To support this mandate, and recognizing the Faculty's traditional and emerging strengths, the Faculty put forward the following four thematic pillars, developed through extensive cross-Faculty consultations in 2020:

Sustainable Thriving Global Communities:
U of T Engineering is taking on climate change by training the next generation of engineers to tackle climate-related issues, developing cutting-edge climate solutions, and supporting game-changing partnerships focused on checking the threats to our planet.

Building Heathy Societies:
U of T Engineering is training tomorrow's leaders in biomedical engineering, pursuing novel and exciting ways to enable clinicians to diagnose, treat and prevent a wide range of diseases and partnering with clinical networks to protect the health of communities in Canada and around the world.

Designing Intelligent Machines For Good:
Working at the forefront of robotics, advanced manufacturing, AI and data analytics, U of T Engineering is equipping the next generation of engineers with the skills they need to usher in a new age of robotics while revolutionizing how we transport people and care for the most vulnerable among us.

Educating The 21st Century Engineer:
U of T Engineering is training the next generation of engineers from diverse backgrounds and experiences to become the silo-breaking leaders and innovators needed to tackle our most pressing challenges.

In the pages to follow, these thematic pillars are further conceptualized and supported by key funding priorities, details of which may change over time to respond to emerging needs and changing priorities over the course of the decade-long *Defy Gravity* initiative.

Sustainable Thriving Global Communities:

***Overview*:**
The Faculty is meeting the climate crisis head-on and helping create sustainable and thriving global communities by educating the engineers the future needs to protect our ecosystems; conducting groundbreaking research that advances knowledge in sustainable energy and water; and devising cutting edge and practical climate and environmental solutions.

U of T Engineering's deep expertise spans areas like advanced manufacturing, alternative fuels, carbon management, drinking water, energy-from-waste, energy storage, remote development, smart grid, sustainable aviation, transportation, urban development, water accessibility and much more. From creating a fabric coating that could drastically reduce microplastic pollution produced by washing clothes, to developing 'liquid windows' inspired by squid skin that could

help buildings save on energy costs, to exploring a new, more sustainable method for recycling lithium-ion batteries to meet electric vehicle demand—our faculty members and students are working tirelessly at the forefront of innovative sustainable energy and clean water technologies and policies.

Research, Chairs and Student Support Priorities:

The Climate Positive Energy Initiative
U of T Engineering is home to the Climate Positive Energy Initiative, a major hub that is leveraging transdisciplinary research and training the next generation of leaders to drive sustainable energy innovation and develop socially informed, equitable energy solutions. What's unique about this transdisciplinary research ecosystem is the way it's grounding these solutions in an understanding of complex political, human and societal factors—to ensure that they are equitable and just.

More than 100 faculty from multiple disciplines across U of T's three campuses, along with partners in industry, community, and government, are part of this bold initiative, which will play a critical role in transforming Canada from one of the highest CO_2 emitters per capita to a sustainable energy model for the rest of the world. Ultimately, the Climate Positive Energy Initiative will help the world meet 2050 greenhouse gas emissions targets and forge a path toward a just, climate-stable future.

- *Endowed and Expendable Research Fund: $10M*
- *Endowed Master and Doctoral level scholarships: $15M*
- *Endowed and Expendable Community, Outreach, Engagement and Knowledge Translation, Innovation Fund: $5M*
- *Endowed Chairs, Junior Chairs, Professorships, and other Faculty support: $10M*
- *Endowed Chair, Sustainable Energy: $5M*
- *Energy Transition Lab: $10M*

Chair, Technologies for Global Development
The Electrical and Computer Engineering (ECE) Department in collaboration with the Centre for Global Engineering (CGEN) is well positioned to affect global change through bringing ECE education perspective and helping level the playing field for developing nations. This chair will manage equity issues on this broader global scale where Canada can have an influence in addressing global challenges through knowledge and application of technologies. Part of the funds will be allocated to hire graduate students from developing countries who would be educated at U of T and will take their knowledge and expertise back home to train a new generation of engineers equipped to have direct impact in their communities.

A chair position in this area would amplify the work currently taking place in this emerging field with several Faculty members in Engineering.

- *Chair: $5M*

Mixed Support for Students, Teaching and Research
U of T Engineering is at the forefront of sustainable alternative technologies. We are creating new ways to harvest energy from the sun and wind, and efficiently store it. We are developing cleaner, more efficient vehicles and we are designing better ways to move people to make our urban environments more livable.

Our leading-edge research is helping companies make better use of resources and enabling access to new technologies for a cleaner, greener, and more sustainable future.

Priorities in this area span several Departments, Divisions and Institutes including:

- *Sustainable Aviation at UTIAS: Wind Tunnel, $3M*
- *Graduate Scholarships: $1M*
- *Centre for Global Engineering in ISTEP: Water and Food Security/Water and Sanitization Fund, $3M Chair, Global Water, Food Security and Sanitization, $5M*
- *Graduate Scholarships: $2M*
- *Electrification Hub and Thermal Management Systems (TMS) Lab in Mechanical and Industrial Engineering: Research Fund: $5M*
- *Lab Renovation (MC120): $3M*
- *Graduate Scholarships: $2M*

Southern Ontario Centre for Atmospheric Aerosol Research (SOCAAR)
SOCAAR is a multidisciplinary centre that is investigating how air pollution impacts environment, climate, and human health. Research uses advanced instrumentation and modelling to understand spatial and temporal trends in the concentration, composition, and origins of air pollution.

- *SOCAAR Research Fund: $1.5M*
- *Graduate Scholarships: $1.5M*

Mobility Lab at UTTRI/School of Cities
Transportation and mobility touch virtually all aspects of our lives. The Innovative Mobility Lab (IML) is a multidisciplinary, collaborative, and diverse network of mobility researchers that connects the University of Toronto's exceptional strengths in data sciences, engineering, and social sciences to address the technological, social, and environmental and heath disruptions facing society globally. Through interdisciplinary basic and applied research IML will identify pathways to more equitable and efficient urban mobility, provide the evidence and decision-support needed for effective and lasting societal change, and have profound implications for individual well-being, resilient, sustainable, and just urban growth and prosperity, and, ultimately, our planet's future.

- *Research Fund: $2.5M*
- *Graduate Scholarships: $2.5M*

Structures Testing Facility
This newly upgraded cutting-edge lab will let engineers test next-generation infrastructure designed to be resilient in the face of natural disasters, from hurricanes to earthquakes. Testing will happen at very large scale and will include the world's first fully movable, adjustable, multidirectional, large-scale, and large-capacity loading frame.

- *Capital Infrastructure Fund: $3.5M expendable*
- *Faculty and Student Support Collaboration/Travel Fund: $500K*

Building Healthy Societies:

Overview:

As an international leader in biomedical engineering, U of T Engineering is training the next generation of engineers, finding novel and exciting ways to fight illnesses, and developing groundbreaking solutions to some of the most vexing problems in health-care systems. From using "human factors" engineering approaches to better understand disproportionate rates of racial and ethnic maternal health disparities, to engineering a fortified hibiscus beverage to reduce iron deficiency in sub-Saharan African women— U of T Engineering's faculty and students are bringing the power of engineering to bear on a range of illnesses and health-care challenges.

Located in the heart of downtown Toronto, adjacent to the city's largest research hospitals and U of T's health faculties, U of T Engineering is uniquely positioned to harness the tools of engineering to help improve health, enhance health-care systems, and save lives.

Research, Chairs and Student Support Priorities:

The Centre for Health-Care Engineering
U of T Engineering is home to the Centre for Health-Care Engineering (CHE), which uses data-driven research to develop decision support tools and ultimately improve the quality and efficiency of health care in Canadian hospitals. CHE engineers have improved operating-room flow to meet wait time targets and get more patients the care they need faster. They have forecasted the long-term need for medical personnel and optimized the procurement of surgical supplies for operating rooms. During the pandemic, the Centre's engineers developed and implemented a model to predict how many patients could be booked for ambulatory care without compromising COVID-19 safety protocols.

The CHE has become an international leader in making an impact on healthcare systems—and is improving the lives of Canadians from coast to coast.

- *Endowed and Expendable Research Fund: $2.5M*
- *Endowed Master and doctoral level scholarships - $2.5M*
- *Endowed Chairs, Junior Chairs, Professorships and other Faculty support - $5M*

Endowed Chair, Healthcare Engineering
The potential for increased efficiency in the delivery of healthcare services, and corresponding reduction of costs, is enormous. Healthcare engineering seeks to replace silos with a broad system view and coordinate people, departments, and institutions to make optimal use of limited resources and taxpayer dollars. Furthermore, research in this area will improve the safety, quality, efficiency, and cost of medical diagnostic and treatment protocols and devices. This research will not only transform the present state of healthcare operations, but also educate professionals to sustain it.

- *Chair: $5M*

Biozone
BioZone's vision is to transform biology and engineering for a sustainable society, realizing its bold mission through applied bioscience and bioengineering research. The Centre's multi-disciplinary team consists of internationally renowned researchers who work at the interface of biology and engineering and share a common vision: to use the most advanced and innovative biotechnology to address urgent societal needs in energy, environment, and health.

- *Endowed Director: $5M*

- *Research Fund: $3M endowed*
- *Graduate Scholarships: $2M endowed*

Institute of Biomedical Engineering (BME)
A marquee initiative for Engineering, the Institute of Biomedical Engineering is building the next generation of devices to diagnose and treat heart disease, cancer, infectious diseases, and bone degradation. Unlike classical approaches in medicine, our Faculty takes an engineering strategy to solving diseases. The Faculty's long-standing affiliation with the University Health Network will ensure students tackle relevant and pressing issues within the medical research community.

The Institute of Biomedical Engineering aims to be a global leader in developing technologies to detect and treat diseases. We aim to redesign and develop state-of-the-art research facilities. These spaces will enable researchers to do ground-breaking research in biomedical engineering. Our new facility will rival the best in biomedical engineering research in the world. This expansion will create a wet-lab facility to allow our students to specialize in biomedical topics.

Expansion of the BME labs will meet urgent unmet need for micro-scale biochemistry. These labs will be the Faculty's premier bio "wet" labs to accommodate demanded to unique capabilities in the biospace.

- *Infrastructure: $10M*
- *Endowed and Expendable Research Fund: $20M*
- *Endowed Masters and Doctoral-level Scholarships: $5M*
- *Endowed Chairs (2): $10M*

Centre for Research and Applications in Fluidic Technologies (CRAFT)
CRAFT strengthens the entire value chain of microfluidic device manufacturing, making Canada a world-leader in creating and deploying microfluidics-enabled medical devices that improve the health of all Canadians. CRAFT:

- Pushes forward the science and technology of microfluidics;
- Accelerates the creation, commercialization, and adoption of leading-edge microfluidic technologies for biomedical applications;
- Provides Canadian graduate students and postdoctoral fellows with unparalleled hands-on learning opportunities and;
- Stimulates industrial activity for large-scale manufacturing of these technologies in Canada, thereby creating good jobs to help retain talent in Canada.

CRAFT supports research and development activities in its facilities through catalyst funds and fellowships and promote new international collaborations. The Centre accelerates technology transfer and increase accessibility of CRAFT facilities such as the Device Foundry and Tissue Foundry to researchers and trainees across Canada.

- *Endowed and expendable research funds: $5M*
- *Endowed Master and doctoral level scholarships: $5M*
- *Endowed and Expendable Community, Outreach, Engagement and Knowledge Translation, Innovation Fund: $5M*
- *Endowed Chairs, Junior Chairs, Professorships, and other Faculty support: $5M*

Designing Intelligent Machines for Good

Overview:
U of T Engineering is training the next generation of robotics innovators, leading groundbreaking research, and collaborating with a range of partners to help initiate a future where robots will extend human capabilities, impact the economy, and improve lives. For example, by teaching robots to interpret social cues, U of T researchers are poised to transform elderly care, emergency response, search and rescue, security and surveillance, and manufacturing.

U of T's faculty and students are also enhancing the visual perception of robotic systems, an innovation that could help autonomous vehicles navigate busy streets or enable medical robots to work effectively in crowded hospital hallways. They're designing computer chips that are optimized for machine learning applications and teaching computers to recognize speech and images. And in collaboration with the University Health Network, U of T Engineering is leveraging expertise in fields such as AI, mechanical engineering, rehabilitation science and more to develop practical solutions that improve the lives of older patients and patients with disabilities.

Research, Chairs and Student Support Priorities:

The University of Toronto Robotics Institute
U of T Engineering is home to the Robotics Institute, the largest and most diverse program of its kind in Canada. The Robotics Institute serves to unite, grow and catalyze collaborations among the many exceptional robotics research clusters across U of T and the globe, driving inquiry that is, in some cases, years ahead of its time and blurring the lines across a range of disciplines from engineering to AI to rehabilitation science.

Faculty and students at the Robotics Institute are using machine learning to build self-driving vehicles, creating cost-effective autonomous flying robots and inventing assistive technologies to support elder care. In the process, they are having a positive impact on society, making a difference in our lives and merging engineering and computer science to open worlds once beyond our reach.

- *Infrastructure: $25M*
- *Endowed and Expendable Research Fund: $11M*
- *Entrepreneurship Fund: $5M*
- *Endowed Master and doctoral level scholarships: $5M*
- *Endowed and Expendable Community, Outreach, Engagement and Knowledge Translation, Innovation Fund: $5M*
- *Endowed Chairs, Junior Chairs, Professorships, and other Faculty support: $13.5M*
- *Centre in Rehab Robotics: $12.5M*

Dean's Strategic Chairs
This is a marquee initiative for Engineering. The Faculty is seeking a Dean's Strategic Chair in each Department, and several designated Institutes. A 'strategic chair' provides flexibility for the area of study to change as priorities of the Faculty shift over time. The initial focus for these chairs will be in the area of AI and Data Science. The Faculty expects that AI and Data Sciences will remain a key focus for the Faculty for many years to come. As technology and innovation continue to advance rapidly the focus of the Dean's Strategic Chairs will rotate at the Dean's discretion to new topics over time.

Society is in the midst of what is being called the Fourth Industrial Revolution. Data analytics and AI have tipped the balance, fundamentally changing the way we do business, treat disease, interact with technology and communicate with each other. Our expertise in these areas will help to reshape processes to improve lives and generate value for people around the world.

These chairs complement the Data Science Initiative ISI as it aims to form a community and supports faculty and trainees to expand their data-intensive research activities; develop their computational and data science skills to support their teaching, scholarship, and research.

Currently in the Faculty there are over 100+ researchers who are working in the field of AI and Data Science, whether it is designing the next generation of hardware accelerators that can process the abundance of data required to train deep learning models or applying machine learning software to diagnose rare medical diseases.

- *Endowed Chairs (11): $55M*

Centre for Analytics and Artificial Intelligence Engineering (CARTE)
As the hub for collaborations and partnerships in analytics and artificial intelligence at U of T Engineering, CARTE conducts state-of-the-art research while nurturing the next generation of engineering talent. CARTE seeks to translate and commercialize effective solutions in engineering and be a catalyst for our partners to make a significant and lasting impact in the global marketplace.

By engineering impact through analytics and artificial intelligence CARTE will:

- Facilitate collaborative, cross-disciplinary basic and translational research in Analytics and AI
- Attract, educate and develop expert personnel in Analytics and AI
- Be a catalyst for partners to make a significant and lasting impact in the global marketplace.

- *Endowed and Expendable Research Fund: $5M*
- *Endowed Master and doctoral level scholarships: $3M*
- *Endowed Chairs, Junior Chairs, Professorships and other Faculty support: $5M*

Chair, Quantum Systems
At the intersection of physics and engineering, researchers in Electrical and Computer Engineering (ECE) are creating practical technologies like quantum cryptography by harnessing the properties of quantum mechanics. Other researchers are looking at ways to match the speed and computational capabilities of quantum computing using classical computers. The development of quantum technologies in ECE will transform traditional sectors while forging new domains and holds great promise for commercialization and scientific discovery here in ECE.

A Chair position in this area of expertise will enable ECE to attract and retain best quantum computing research talent. The Chairholder would be at the frontiers of this research area and acknowledged by their peers as world leaders in their field who would advance the frontiers of knowledge in this field through their research, teaching and supervising students and coordinating the work of other researchers.

- *Endowed Chair: $5M*

Centre for Management of Technology and Entrepreneurship (CMTE)
At the intersection of engineering and business the Centre for Management of Technology and Entrepreneurship (CMTE) was established to provide Canadian industries with leading edge real world applied research opportunities related to financial modelling, data science and machine learning.
The goal of the CMTE is to empower business to take advantage of new and emerging technologies that will have the most immediate impact on their organizations.

With core strengths in financial modelling, data science and machine learning, the CMTE is uniquely positioned to deliver innovative, value-added solutions based upon practical applied research initiatives.

The CMTE provides a rich source of innovative technologies, specialized expertise, recruiting potential and ongoing applied R&D opportunities for undergraduate and graduate students as well as industry partners.

- *Endowed Chair, Data Science and Innovation: $5M*
- *Endowed Collaboration Fund: $5M*
- *Endowed Master and Doctoral-level scholarships: $2M*

Engineering the 21st Century Engineer

Overview:
Today's students arrive at university with more knowledge and skills than ever, U of T Engineering has adapted—giving them a lens through which they can view some of the world's most complex problems differently. Through our course design, the Faculty encourages students to collaborate, work at the nexus of disciplines and open their minds to varied cultures and viewpoints—a must-have in the 21st century.

What's more, the Faculty is empowering students from all walks of life. Programs like Blueprint, MAPS and Prepare are preparing Black students for postsecondary success in engineering and equipping them with the skills and confidence needed to tackle real-world challenges. Girls' Junior DEEP is helping girls in grades 3 to 8 to see themselves as future engineering leaders and innovators, while IDEA (Indigenous Design and Engineering Academy) uses land-based learning to encourage Indigenous students, in grades 3 to 6 as well as high school, to explore an interest in science, technology, engineering and math.

Exposing students to innovation is a critical part of helping them see differently. Through The Hatchery and the mentorship they receive there, students are pursuing their ingenious ideas, founding startups and learning how to better understand the business world.

Research, Chairs and Student Support Priorities:

Dean's Strategic Initiatives Fund
New initiatives and opportunities, esteemed visitors, star faculty retention including:

- Catalyst Funds in global leadership and excellence in strategic areas of research and development of: Sustainable Thriving Global Communities, Healthy Societies, Intelligent Machines and Trans-Disciplinary Education

- Global Talent and Fluency. Recruitment and retention of leading faculty, student, and growing diversity.
- Innovation and Collaboration: Driving entrepreneurship through partnerships and experiential learning including commercialization initiatives and multidisciplinary innovation.

- *Endowed/expendable funds: $25M*

Dean's Internationalization Fund
Supporting international opportunities across strategic themes of sustainability, healthy societies, intelligent machines and enabling technologies, global talent and fluency and diversity, innovation, and collaboration, including R&D collaboration, esteemed international visiting professors, faculty exchange, and student mobility awards for international experience. Fund to include collaboration stimulus and global partnerships through Faculty collaborations, student exchanges, and international projects.

- *Endowed: $10M ($300K annually)*

International Student Support
This is a marquee initiative for Engineering. The Faculty makes available $5.6M in awards to diversify its undergraduate international enrolment. Funding provided over five years would fund $10-15k renewable awards to attract candidates from geographically diverse regions. The goal is to support approximately all international students in each of their degrees at U of T Engineering.

- *Endowed student support of approximately $160M or approx. $12k annual expendable/student*

Doctoral Steam Student Support – PIVOT
This is a marquee initiative for Engineering. PIVOT Scholarships are fully funded first year scholarships for doctoral stream graduate students. This represents an award of approximately $30K tuition support along with a $5K research fund per student. A phase one goal is to fund half of all incoming doctoral stream graduate students confirmed for accepted PhDs. PIVOT Scholarships support students rotating between 2-3 thesis supervisors in their first year before making a commitment to a final research project.

- *Endowed: $82M*

Equity, Diversity and Inclusion Undergraduate and Grad Student Support
Undergraduate and Graduate funding to support Black, Indigenous, or female students (self-identified) who are underrepresented in the programs.

- *Endowed/Expendable support: $10M*

Mental Health Student Support
In response to the growing need for mental health support for our students and in line with the recommendations of the Mental Health Task Force, we created both Faculty-wide and Department specific mental health awards for students who have faced challenges with dignity and perseverance.

- *Endowed/Expendable support: $500K*

Internship Fund for the Engineering Science Research Opportunities (ESROP)
The Division of Engineering Science provides unique opportunities for outstanding Engineering Science students to experience hands-on research early in their academic careers. Over a four-month summer term, ESROP students gain first-hand experience in cutting-edge research across fields as diverse as computer vision, smart power integration and subatomic physics.

- *Endowed Internship support: $5M*

Undergraduate Awards
To attract the very best students from across Canada and around the world, the Faculty is seeking private support for student aid. Merit-based scholarships can be awarded based on academic excellence, outstanding leadership skills or to students from groups that are under-represented in the Faculty. Scholarships can also be directed within any of the Faculty's nine undergraduate programs. Emphasis placed on Undergraduate Admission Awards, preferably renewable.

- *Endowed student support: $10M*

Graduate Awards
Top quality of graduate students is critical to the success of the research enterprise within the Faculty. Recruiting and retaining outstanding graduate students is challenging, especially when competing with top engineering schools around the world. These scholarships will provide the funding packages required to attract the best and the brightest graduate students to the Faculty.

- *Endowed: $10M*

Summer Research Fellowships
Each summer, hundreds of U of T Engineering students gain research experience working in labs on campus and across the world. Funding will support Research Fellowships located both in Canada, and globally.

- *Endowed Fellowship support: $30M (approximately $1M annually)*

Institute for the Studies in Transdisciplinary Engineering Education and Practice (ISTEP)
In recognition of President Gertler's three priorities, and the emphasis placed on reinventing the learning experience for students at U of T, the Faculty seeks three new limited term chairs, Chair in Engineering Education, Engineering Communications and Chair, Engineering Ethics and Equity in the Institute of Transdisciplinary Engineering Education and Practice (ISTEP).

ISTEP is evaluating the benefits of innovative instructional strategies and spaces to enable richer and deeper student learning. For example, ISTEP is deploying active and technology-enhanced learning, designing assessment tools to provide more meaningful feedback, and using data analytics to better understand student experience.

ISTEP's research ranges from examining theories and paradigms in engineering education, to applied studies of instructional interventions to support course delivery and program development.
We are exploring how engineering students develop as leaders, how they work effectively in teams -both in person and virtually- and how best to nurture their professional and scientific communication abilities. This area also includes research around access, equity, diversity, and

inclusivity, and is helping to shape the nature of competencies such as communication, leadership, teamwork, and entrepreneurship in engineering contexts.

- *Chair in Engineering Education: $5M*
- *Chair in Engineering Communications: $5M*
- *Chair in Engineering Ethics and Equity: $5M*
- *Endowed Chair, Engineering Leadership (Troost ILEAD): $5M*

Early Career Professorships
Awarded to researchers in the Faculty of Applied Science & Engineering who are within the first 10 years of their careers, the professorships provide increased research funding for a period of three years and are awarded to professors with a high level of research excellence and graduate student mentorship. These professorships will boost U of T Engineering research across the range of strategic themes – sustainability, healthy societies, intelligent machines and engineering education.

- *Endowed, $6M (Each professorship is endowed at a minimum of $1.5M)*

Entrepreneurship Mentors
Increasingly, students are passionately pursuing a new path: that of the entrepreneur. Engineering will be able to support our talented student-entrepreneurs as they prepare to change the world. The Entrepreneurship Mentor will educate students and assist in turning their transformative ideas into viable and sustainable businesses. With this bold vision in mind, the Faculty aims to hire accomplished and successful entrepreneurs who can leverage their wide breadth of industry knowledge, expertise, and network. This role will strengthen already existing resources of the Faculty and provide hands-on teaching and coaching to connect the dots between theoretical knowledge and real-world business experience.

- *Expendable: $1M*

Entrepreneurship Hatchery
The Entrepreneurship Hatchery is the launch pad for the next generation of global engineering leaders, innovators, and entrepreneurs.

At U of T, Canada's largest university and a powerhouse of talent and innovation, we believe that one of the biggest determinants to entrepreneurial success is the people behind the ideas. When you develop strong entrepreneurial human capital, great start-up companies are the collateral damage. This is the unique value proposition of The Entrepreneurship Hatchery, an accelerator and incubator for engineering-inspired innovations at the heart of U of T's thriving campus-wide entrepreneurial ecosystem.

- *Endowed Connectors Fund: $5M*
- *Fellowships: $1.5M expendable*
- *Endowed and Expendable Seed Funding: $2.5M*
- *Endowed Directorship: $5M*
- *Experiential Learning Opportunities: $1M expendable*

The Engineering Student Outreach Office (ESOO)
The ESOO develops and implements the core outreach programs offered by the Faculty. We act as the central unit for outreach activities promoting Science, Technology, Engineering and Math

(STEM) education to a wide audience. Our programming serves both future engineers and current undergraduate and graduate students.

- *Expendable: $3M*