Technology for Social Good

Academic Plan 2018-2023
Faculty of Applied Sciences
Simon Fraser University
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Applied Sciences as a Driver of Social Change

Over many millennia, technology has been developed to extend human capabilities. One interesting technological wave likely started at least 50,000 years ago. It involved the use of crushed ochre to draw on cave walls with sticks, and conversely using stone tools to carve on ochre, both thereby extending the human hand to allow the expression of eternal stories. The development of technology to tell stories punctuated their society, and continues to disrupt ours. Technology has mediated social change since the dawn of humanity.

SFU has long seen itself as a conduit of social change. In recent years, social change has been more visibly mediated by technology. The Faculty of Applied Sciences (FAS) has prominently figured in that wave, and over the next five years it plans to be a disruptive, positive force for social change through technology.

The research mission of the “applied sciences” is to make discoveries in science and technology that will have lasting social impact. Our educational mission is tell the story of those discoveries. We have a deep commitment to excellence at the highest level possible. A principal indicator of excellence, against which we measure ourselves, is the disruptive intellectual and positive social impact of our work. While bibliometrics is a key indicator of our rising reputation, our attention is also focused on building our reputation both among external experts reflecting on our science, and in society at large. Along these lines, we have already made many inspiring inroads in areas such as in data mining, visual computing, biomedical engineering and imaging, biomechanics, energy systems, and communication technologies. These achievements are being taken up in industry through technology transfer or start-ups. They are being recognised through numerous awards and media reports. Our research funding is 24% of total SFU research funding, on an expenditure of 11% of the overall SFU budget. We fully expect the next five years will place the disciplines within our faculty among the best in the world. That said, we cannot do everything. Difficult choices will be required: on what to focus, and thereby on what not to focus, and ultimately on where to put resources. Through our academic planning processes, some of these choices have been made. Others will evolve over the next five years as we implement our academic plan. Yet more will emerge from serendipitous opportunities. We also have an
imaginative and unique programme in Sustainable Energy Engineering (SEE) to implement and harmonise with intellectual activities throughout SFU.

A subtitle for this Plan could well be “Everything is Connected”. This is relevant in myriad ways at many scales. As computing, data, and decentralisation propagate through our endeavours, our once-distinct agendas are clearly becoming ever more connected. Research and educational agendas now overlap in surprising ways, requiring broader collaboration within schools, within the faculty, and across SFU. The academic priorities of this Plan will clearly reveal this.

Even as we propel our research mission, we must also attend to an equally important contribution to social change: the educational, intellectual, and environmental experience of our students. Our students must receive the best possible learning experience, and we must broaden our reach to other academic units to expand their horizons. In addition to our two currently accredited engineering programmes in Engineering Science (ENSC) and in Mechatronic Systems Engineering (MSE), through SEE we will be introducing another accredited undergraduate programme. The facilities that will be supported in the new SEE building in Surrey will provide greater access to modern engineering laboratory facilities for our undergraduate and graduate students. The building will support various initiatives beyond FAS, which offers the opportunity for further interleaving of activities and thought.

FAS will be a major player in SFU’s presence in and transformation of the City of Surrey: through the growing presence of MSE, the reinvigoration of Computing Science, and with the implementation of the SEE programme. This is part of a longer-term evolution in which Surrey becomes both a destination campus for key, differentiated programmes, as well as a catchment for SFU for the next generation of a diverse student body. Likewise, our significantly increasing enrolments on the Burnaby campus in Engineering Science and Computing Science, together with an expanding research mission have placed these disciplines in a more central position at SFU-Burnaby. Indeed, our participation in SFU’s Big Data Initiative and the growth of professional programmes in our Faculty is being recognised both within SFU and internationally, which provides an increased range of opportunities for our students upon graduation, and for our professors for research.

Over the past five years, our Faculty has undergone considerable growth in several areas, including:

- 11% growth in our undergraduate AFTEs (excluding co-op).\(^1\)
- 15% growth in graduate enrolments, largely due to a significant increase in graduate professional programme enrolment, particularly our renowned Big Data master’s programme. This trend is accelerating as popularity for existing programmes grows, and as we expand and diversify our offerings.
- 7% increase in research funding.

This growth far underestimates the actual demand. The Dean’s External Advisory Committee, which includes industry leaders from all sectors relevant to Applied Sciences,

\(^1\) An “activity full time equivalent student” (AFTE) is a measure of one fiscal year of undergraduate activity and is equivalent to 30 course credits.
constantly stresses “quantity, quantity, quantity”. High quality in fact drives quantity through a strengthening reputation. However, we are severely limited by physical constraints that have forced us to become increasingly selective, since our space footprint has remained constant over the past five years despite our expanded enrolment. Further, this growth arose despite a 3% reduction in our continuing faculty line (CFL) complement, which we will be addressing in the next five years through significant faculty hiring.

As our impact in research and education deepens, we must also attend to an often-neglected aspect of our work as scientists and technologists: social engagement and responsibility. Although it is often impossible to predict the ways in which inventions will be exploited, we must engage in social dialogue and socialisation of our work. Everything is connected: we cannot operate in siloes that separate us from society. We must engage, provide context, debate broader issues, continue to build trust, and act responsibly.

The Faculty of Applied Sciences looks forward to the next five years with excitement and optimism. We are in an increasingly healthy financial situation, which will allow us to achieve our goal of increased international prominence while engaging locally within our many communities. We have many challenges to face, of which some particularly difficult ones have persisted for many years. The rest of this document will outline our academic principles, priorities, challenges, and initiatives in which we intend to engage. Our Plan does not make specific resource requests. We will rely on the parallel logistical frameworks in the Faculty Renewal Plan and the evolution of the Faculty Allocation Model to allow us to develop an implementation timeline. Our Plan instead is aspirational. It outlines the goals we expect to be able to achieve assuming a budget allocation model that rewards performance, entrepreneurship, and excellence. The Plans for our four individual academic units are included as appendices.

**Academic Principles and Priorities**

**Planning Process**

At the outset of the planning process, the four academic units within the Faculty of Applied Sciences, Computing Science (CS), Engineering Science (ENSC), Mechatronic Systems Engineering (MSE), and Sustainable Energy Engineering (SEE), were asked to develop individual academic plans. A document outlining some basic principles to guide planning was sent to the schools, as well as the link to the Provost’s planning document. A Faculty-wide town hall meeting was held, in which a wide variety of views was expressed. An Academic Planning Advisory Committee was struck, consisting of both nominees by school directors as well as individuals chosen by the dean to ensure balance and diversity. A refreshing and exciting set of discussions ensued, both within the academic units, and at the advisory committee. The individual plans were reviewed by the committee, with comments sent back to the units for further discussion, revision, and secondary review. The advisory committee then proposed various academic priorities to the dean after broad discussion and debate. This plan is its outcome.
Principles

The planning process was informed by well-documented guiding principles that folded into our priorities, and indeed sometimes disappearing into them.

Student Experience. It is crucial to guide the development of young minds in their education and research. Developing an open, inclusive culture that supports their development and celebrates their achievements is critically important. Substantively addressing this issue will have knock-on effects on many others.

Societal Engagement. The Faculty of Applied Sciences has been insular. If we are serious about having an impact on society, we have to be out in society. We must engage, debate, educate, guide, listen, and participate in the broad discussions beyond our immediate research specialties, since most of those discussions now involve the very technology for which we are in some way responsible.

Excellence. We must aspire to, and develop strategies to achieve, international research prominence and outstanding educational programmes. The development of international academic programmes in achieving this goal is encouraged. Through these aspirations, we will expand the international reputation of SFU and our Faculty.

Excellent people, excellent organisation. Our Faculty will grow considerably in the coming years. We must focus on hiring the best possible people and take advantage of exceptional opportunities. We must also ensure we have the processes and staff organisation in place to serve our students and faculty. This requires that we continually review our workflow, processes, and organisation, making adjustments as needed to improve service and develop our people.

Career Development. Our faculty and staff should receive the mentoring support and resources required to develop their careers to enhance and enrich their lives.

Synergy and Harmony. While it is important to develop discipline-specific intellectual cultures, our schools have often operated entirely independently of one another. For example, we have no joint programmes between our schools but have many between other faculties. This level of isolation is functionally inefficient, and it is an obstacle to enhancing student experience and faculty/staff career growth. This requires resolution and consolidation.

Diversity and Inclusion. We must become more creative in developing ways to include, foster, recruit, and retain a more diverse range of students, staff, and faculty.

Equity. Our processes must both be, and be seen to be, fair, consistent, and reasonable. This applies to all aspects of our operation as a Faculty.

Multiple Campuses. We are a multi-campus Faculty, which introduces opportunities and challenges. We encourage the development or refinement of initiatives that on the one hand may harmonise our Faculty across our Burnaby and Surrey campuses, take advantage of opportunities, and overcome challenges; on the other hand, we would welcome proposals to
establish distinguished initiatives on our two campuses, particularly on the Surrey campus, that push beyond our current academic offerings.

**Infrastructure.** Although we are in the midst of constructing a new building to house our Sustainable Energy Engineering programme, we recognise the pressures faced in maintaining, developing, and expanding our educational and research infrastructure. We will use the academic plan to set infrastructure priorities, which will allow us to work collaboratively on them.

**Faculty Allocation Model (FAM).** The FAM stops at the Dean’s Office. This means that budget flow to Schools is not directly tied to their enrolments. A creative, ambitious plan may attract more resources.

**Academic Priorities**

Of the many important initiatives that have been proposed in the individual school unit plans, some particularly noteworthy initiatives came to the front. The unit plans are available as an appendix.

**New Resources**

This document is aspirational and thus is largely silent on quantitative resource requests. It is, however, worth reflecting briefly on our resources and expected revenues. Over the next five years, we anticipate significant revenue growth through the rollout of the SEE programme, continuing growth in undergraduate and graduate enrolments, and a broader range of graduate professional initiatives. Advancement resources will also be attached to our academic priorities. Lastly, faculty renewal will also afford the opportunity to apply resources to new or existing initiatives. All told, we anticipate on the order of 60 new faculty positions as well as additional supporting staff over the next five years to sustain our growth. This inevitably will require the construction of a new building on the Burnaby campus and expansion of facilities at Surrey to house new educational and research facilities. We believe this construction is best achieved through the creation of a new building to bring together multiple faculties, just as the Academic Quadrangle was once conceived.

**Academic Initiatives**

**Communication**

Our faculty has had an effective external communication strategy to audiences outside SFU, but we have done less well both within the faculty and across SFU. To this end, we propose the following initiatives:

1. Propose a “Technology for Social Good” President's Colloquium series.
2. Develop a faculty wide colloquium series on topics of interest to all units.
3. Hold inter-faculty colloquia and panels on common topics such as “The Future of Quantum Computing”, “AI for All”, “Technology for Good”, and “Diversity in STEM”.
4. Hold regular town halls involving students, staff, and faculty to discuss issues within FAS.
5. Better advertise all seminars and events throughout FAS and beyond.

Students and Academic Programmes

1. **Expansion of graduate professional programmes and certificates.** The problems in society are becoming increasingly complex and interdisciplinary. The constraints of undergraduate programmes, whether due to accreditation or course prerequisites, often leave little room to explore these problems in greater depth and breadth. In expanding and diversifying the graduate experience, we can begin to address this issue. We currently support several successful graduate initiatives beyond the regular research-intensive master’s and doctoral programmes. These include the professional master’s programmes (PMP) in Big Data (in CS), the PMP in Mechatronic Product Realization (in MSE), and the M.Eng. programme (in ENSC). MSE also offers a certificate programme called the “Siemens Mechatronic Systems Certification Program” (SMSCP). All of these programmes have demonstrated robust interest and enrolment. We plan to expand our offering of PMPs to include visual computing in 2018, and several other differentiated programmes in all of our units including SEE. The flexibility of new graduate initiatives will also allow us to develop joint programmes with other faculties. Our immediate focus will be with Business, Science, and Environment, but the model is flexible enough to involve all faculties. As a start, we plan to lever the existing MSE initiatives with the Business School, particularly the “Certificate in Innovation and Entrepreneurship”, and the “Graduate Certificate in Science and Technology Commercialization” into a broader cross-faculty initiative. The growth in these initiatives is not intended to compromise the regular graduate pathways; indeed they are created to provide a broad spectrum of opportunities amid a larger and growing appetite for graduate studies in our disciplines.

2. **Expansion of regular graduate programmes.** Our existing research-intensive graduate programmes and cohorts will also need to expand. Since we are expecting to hire at least 60 net new faculty over the next five years, this naturally leads to at least 300 additional graduate students. Currently, 120 of those graduate students are newly available seats under the SEE programme. The considerable growth in the graduate cohorts will lead to a much more vibrant intellectual atmosphere in our faculty, although we will need to attend to challenges such as time-to-completion and space. Direct-entry to the doctoral programme should be strongly considered for ambitious students who have a clear desire to advance quickly to Ph.D. studies.

3. **Diversification of our graduate programmes.** Our offerings at the graduate level have been diversifying, as evidenced in the previous sections. These initiatives provide broader accessibility to graduate studies, and they increase diversity and opportunity, while maintaining a high bar for excellence. This diversification will continue over the next five years with the addition of the SEE graduate programme, the development of new professional programmes in each of our schools, as well as cross-faculty graduate initiatives with, for example:
   a. Business, on technical entrepreneurship.
   b. Science, on the physical chemistry of energy storage, electrolysis, and catalysis.
c. Environment, on sustainability.
d. FCAT, on design, information visualisation, and visual computing.
e. Health Sciences, on biomedical devices and engineering.
f. Social Sciences, on social policy and the applied sciences.
g. Arts, on digital humanities.
h. Education, on education analytics.

We also plan to explore a greater range of experiential research opportunities for our thesis-based students who desire applied-research internship experiences to complement their academic studies.

4. **Expansion and diversification of undergraduate programmes.** The undergraduate experience will be expanded to broaden the reach of the applied sciences, to harmonise with other strengths within the university, to accommodate an increased demand for literacy in our fields, and to increase diversity. We currently offer various inter-faculty joint initiatives such as:

   a. Biomedical Engineering option (ENSC-BPK).
   b. Engineering Physics option (ENSC-PHYS).
   c. Data Science option (CS-STAT-MATH-BUS).
   d. Majors with CS in:
      i. Data Science (CS-STAT-MATH-BUS).
      iii. Geographic Information Systems.
   e. Joint majors with CS in:
      i. Mathematics (as well as honours).
      ii. Molecular Biology and Biochemistry (as well as honours).
      iii. Information Systems in Business Administration and CS.
      iv. Linguistics.
   f. Dual degree programmes:
      i. MSE with BUS.
      ii. CS with Zhejiang University.
   g. Entrepreneurial capstone projects (BUS, MSE).

This includes relationships with three other faculties. While these are all highly valuable programmes, many of them combine already-onerous programmes, making the result even more challenging for students; this appeals to a select group of highly ambitious students, which is very desirable. However, we also need to extend our reach to a broader audience. Our new initiatives will include:

- The introduction of new minor programmes or clusters of courses. Such an expansion is important for many reasons. Three key reasons are that: it will allow more students from other faculties to participate in the applied sciences; it will increase the participation of under-represented groups in the applied sciences; and it will allow those disciplines in FAS that primarily mount accredited programmes the latitude to develop strong non-accredited programmes.
The development of purpose-built service courses that will have broad appeal outside our disciplines. This would include 3D maker/fabrication courses, and specific interest courses and workshops in, for example, AI, visual computing, robotic systems, and biomedical engineering.

A broader array of interdisciplinary senior capstone courses, particularly as the SEE programme rolls out. We anticipate involving all faculties in these initiatives.

Enhanced experiential opportunities for our students. The SEE programme advocates field-oriented work terms, which will migrate to our other units. Our participation in the “Tech-e” programme, in which students take an additional co-op term in a start-up or in technology transfer, will be expanded.

The expansion of infrastructure support for team projects, clubs, seminars, boot camps, and hackathons. An effective way to increase diversity and social interest in our faculty is to develop broadly based team projects and clubs that have attractive, ambitious goals. We will expand initiatives in, for example:

- The FAS Robotics Competition.
- Workshops in AI, fabrication and maker spaces, augmented and virtual reality, printed circuit board (PCB) and microfabrication.

We will expand these activities. We will provide space and infrastructure to support team based, non-credit engagement with our faculty. We have begun by creating a central (FAS) resource and dedicated effort to bring together representatives from all FAS student societies and teams at least annually to make them aware of the timing and process to request support, allowing for a co-ordinated approach and increasing overall awareness. The FAS resource will also provide coaching to teams regarding preparation of their requests and management of their expectations given the overall landscape of teams and available resources.

We will provide enhanced working space in conjunction with SEE building. This will include working space in the SEE building capstone lab (interspersed with capstone courses), access with technical support to a “project lab cluster” including a machine shop, printed circuit board and microfabrication lab, and 3D printer/laser cutter lab, and ideally one or more team-rooms dedicated to use by student teams, with sign-up and access actively managed by FAS.

The further diversification and development of joint major degrees with key disciplines. For example, we do not have a chemical engineering department within our faculty and we are unlikely to create one. However, the Faculty of Science has a strong Chemistry department with which we can collaborate to create a joint major in Chemistry and SEE in particular, although this will be open to other units.

**New Scholarly Priorities**

The individual school unit plans have proposed many worthy initiatives. Some are intended to reinforce various existing areas of endeavour, while others propose new directions. We have
coalesced some particularly compelling priorities that we believe will be of considerable strategic importance. Such initiatives are intended to contribute to undergraduate, graduate, and research agendas as well as foster links across SFU. These initiatives include the following.

1. **AI and AI Engineering.** While the scientific outcome of “artificial intelligence” may not lead to the full simulation or modelling of the human brain, the questions it asks about the ability to model specific aspects of intellectual activity as “intelligent agents” are profound and important. AI techniques have emerged from the laboratory and have been deployed in a bewildering array of applications. However, the current understanding barely scratches the surface of the science and engineering that must be done. We propose the following initiatives:

   a. Increased focus in AI across our schools, particularly in CS. The massive investments made by various levels of government in AI in Ontario, Quebec, and Alberta adds urgency to this initiative.

   b. A multi-institutional centre for AI spanning (at least), SFU and UBC. Strength in numbers will be needed. This is easier to do now that we have progressed to the point that we are colleagues and collaborators, not competitors, with UBC.

   c. The development of an AI Engineering initiative. The integration of AI technologies into orthodox engineering practice leaves open some significant gaps. Some particularly difficult problems include:

      i. To understand the nature of uncertainty and how that can be modelled in engineering practices that require tight and predictable tolerances. Such guarantees do not currently exist in AI algorithms.

      ii. To develop sound software development and engineering practices that integrate AI technologies.

      iii. The development of new AI technologies suitable for austere engineering applications.

      iv. To harmonise the use of AI with Engineering Ethics and professional responsibility.

   This is largely an ENSC initiative that overlaps with CS.

   d. Reaching out to the Social Sciences and Humanities to reflect on political and ethical implications of the deployment of AI technologies.

2. **Digital Health Technology.** Researchers in areas inspired by biology and medicine are located in all of our schools. They have made significant contributions to biomedicine, biomedical visualization, medical devices, wearable technology, computational biology, and biomechanical engineering. We will increase our presence in these areas through further hiring as well as additional support to create shared laboratories to facilitate collaborative research. We will further strengthen our links to the faculties of Science, Health Sciences, and Business as part of this initiative. We will develop supporting undergraduate and graduate initiatives to foster career growth in these areas.

3. **Quantum Engineering and Computing.** Over the past century, a deeper understanding of quantum theory has led to significant inroads in quantum technology. Scientists and engineers are now developing techniques to harness the subtle properties of quantum
theory, such as entanglement, superposition, and tunneling. An exciting new field of quantum technology is emerging, of which quantum computing (QC) is the best known. QC is an ambitious attempt to revolutionise the models of computation that underlie traditional computer systems. There are other practical applications of quantum technology in the development of purpose-built devices such as sensors, imagine, radar, etc., that are being considered. This is an agenda in which we must participate. We would thus like develop deeper expertise in quantum engineering, with an eye to establishing stronger connections to Physics through joint and cross appointments, and the development of shared initiatives in QC and quantum technology more generally.

4. **Advanced Manufacturing.** Our faculty, MSE in particular, is at the forefront of the development of new technologies to improve the design and development of new manufacturing processes. This is a rich enterprise that requires the engagement of many parties: engineering to develop the science and technology of next-generation manufacturing systems, design to facilitate new workflows and for product design, business to connect design and manufacture to a business model, and industry to give direction to application areas. Underlying advanced manufacturing is “Industry 4.0”, a worldwide movement that advocates smart, energy efficient, cyber-physical approaches in the development of new industrial processes. Big data, sensor fusion, and “Internet of Things” will become fundamental to monitoring and adapting manufacturing processes. In addition to connections to industry, to SIAT, and to the Business School, this initiative will afford our faculty the opportunity to forge stronger links, under the leadership of MSE, with SEE, ENSC, and CS.

5. **Information and Communication Technology.** The term “ICT” was once thought of as “big iron and fat wires” that preferred centralised hub-and-spoke access patterns. Modern ICT is decentralized, and access patterns form webs rather than channels. It involves the deployment of a diverse range of communication devices, distributed and cloud computing, sensors, internet of things, and networking mechanisms to create an adaptable, responsive, robust computing fabric to help humans in their endeavours. We plan to devote resources to the science and development of new ICT. This will involve fundamental research in:
   a. Telecommunications, including fundamental work in fields and waves, which is the subject of new interdisciplinary CFI funding.
   b. Communications hardware.
   c. Computer engineering and software. A significantly stronger link will be developed between computer engineering, which lies within ENSC, and computing science. This will be accomplished through joint faculty positions and associate memberships across schools.
   d. Cybersecurity. Developing secure systems that enforce privacy policies, and that inoculate against malware, while still remaining highly responsive, has chronically been a deep challenge in computer systems and software research. An advantage of a centralised access model, while not particularly suitable to today’s accessibility needs, made the security problem slightly easier. The complex access patterns of today’s deeply compound the problem. An interdisciplinary cybersecurity initiative at SFU is highly desirable.
6. **Ongoing growth in Computing Science.** The momentum built by CS through its recent hires is creating a singular opportunity for it to be counted among the best CS schools in the world. Bolstered by the demand for its undergraduate, graduate, and professional programmes, it is important to capitalise on the growing momentum and fame of the school.

7. **Data driven applied science.** We should strengthen our faculty complement in machine learning (ML) as part of the regular growth in CS and Statistics. That said, while ML can be seen as a complementary discipline to classic inference/model based AI, there is much more to do in developing techniques to exploring data that is independent of ML. We thus must grow in the areas of data management and exploration, including data modelling and mining, imaging science, data and information visualisation, data/visual analytics, and data compression and communication. These areas of study will interleave with agendas being pursued in Data Science (STAT-SCI), and SIAT-FCAT.

8. **Sustainable Energy Engineering Programme.** The recently approved SEE programme provides the university with a unique opportunity to leap into worldwide leadership in the cleantech and sustainable energy areas. In steady state, it will house 320 full-time undergraduates and 120 graduate students. The undergraduate full programme proposal was developed last year and went through SFU governance and subsequently to BC’s Degree Quality Assessment Board. With approval recently announced, we are now able to mobilise a full implementation team to start the programme in September 2019. We are “priming the pump” for 2018 by admitting additional undergraduates and graduate students into existing Applied Sciences programmes, with the hope that many students will wish to transfer formally into the programme in 2019 upon opening the new SEE building in Surrey.

As we roll out the implementation strategy of the undergraduate component, we are hard at work on the graduate component. A full programme proposal for M.A.Sc. and doctoral degrees is being formulated and will be submitted to the Senate Graduate Studies Committee, following the recent approval of the Memorandum of Understanding for our graduate programme. Both the undergraduate and graduate agendas will contain various areas of endeavour that will reinforce academic priorities that were indicated earlier. Some important examples include the following.

- The “Smart Cities” pillar of SEE will include topics in cyber-physical systems, low-power computing and communications devices, distributed sensing, and big data, among others. It will invite participation across all of our existing units.
- Sustainable Manufacturing pillar engages MSE in particular. Indeed, the “sustainable manufacturing” sub-agenda within SEE will be delivered by MSE in conjunction with the Advanced Manufacturing/“Industry 4.0” thrust (see above).
- The capstone courses and experiential learning/co-op engagements will promote exciting, non-traditional activities embracing the Environment, First Nations, and policy issues.
- The emerging graduate curriculum will interleave with, and be open to, our existing
graduate students. Conversely, various relevant graduate courses within the faculty already exist that will provide cross-pollination.

A strategic research committee has been struck to plan the research component of SEE. Our goal is to create a compelling research agenda that will attract top internationally prominent scholars that will establish the sustainable energy research at SFU as among the best in the world.

Our plan at this stage is to charter SEE as a programme rather than as a school. This decision will be reviewed in future, likely just after the undergraduate programme is accredited. At present, we believe this offers the right level of nimbleness and flexibility to respond to possibly changing situations in sustainable energy.

What an exciting initiative!

**Challenges**

In the final section of our plan, we indicate the things the keep the dean up at night. All of these issues have been discussed and grouped as ongoing challenges. Fortunately, we believe we have practical and possibly even effective responses. As such, we indicate our planned response by indicating specific actions where possible. These challenges include the following.

- **Diversity.** A chronic challenge in the Applied Sciences is the under-representation of various groups, especially participation by women, First Nations people, and African Canadians. Indeed, the participation of women in computing and engineering is only slowly rising, and progress on the participation of other under-represented groups is worse still.

  **Actions:**
  
  - Improve student experience. We feel that increased diversity will be attracted by better student experience and engagement.
  - Broad-based admissions. The use of indicators beyond GPA will increase the size and diversity of the applicants to our programmes.
  - Address student retention and attrition. The data indicates that under-represented groups in applied sciences are also more likely to discontinue their studies. We must thus develop better processes for identifying at-risk students and improving their chances of success through mentoring and tutoring.
  - Embrace First Nations Engineering. The Western Faculties of Applied Sciences are organising a nascent initiative focusing on First Nations Engineers. We are enthusiastic participants in this initiative.
  - Engineers Canada has put out a “30 by 30” initiative, in which the goal is to sustain 30% participation rate of women licensed engineering by 2030. We support this initiative but believe this is ambitious for licensed engineers, since only about 25% of all engineering graduates acquire their P.Eng. status, and the take-up rate among women graduates is much lower: currently only about 17%. However, we
believe the bar is readily achievable for engineering and computing as a whole, outside of the licensing process.

- Participation in Canada-wide engineering and computing diversity initiatives, such as the Canadian network for coding, and Technovation.
- Striking a faculty level diversity committee that also levers the presence of our NSERC’s Chair for Women in Science and Engineering.

- **Mental Health.** Increased awareness of mental health issues among our students, staff, and faculty has become extremely important. Anecdotal studies appear to suggest that students, staff, and faculty within the applied sciences may be even more susceptible. **Action:** Strike a working group to gather literature on the subject and liaise with SFU mental health services to provide better support mechanisms in our faculty.

- **Course/programme accessibility, and over-crowding.** We have the highest AFTE/CFL ratio (33) outside of Education, and the highest undergraduate average class size (80) at SFU. The good news underlying this is that our permanent faculty teach about 80% of our courses. In other words, the use of only 20% sessional instruction, which is only a touch above the ambient study-leave replacement rate of about 15%, suggests a commitment to permanent, high-quality instruction. Part of this is also due to the requirement that instructors have a P.Eng., which considerably reduces the pool of qualified sessionals, and considerably increases the cost of course delivery. **Action:** commit to significant faculty growth, with careful attention to finding a Lecturer/Tenure-stream faculty balance that lowers section size for those courses that are compromised by over-enrolment. Note that many high-enrolment courses can be very successfully delivered.

- **Substandard teaching and research infrastructure on both campuses.** The Burnaby campus enterprise is compromised by poor laboratory infrastructure, and MSE on the Surrey campus is currently housed in space that was not designed for engineering laboratories. **Action:** At Surrey, house crucial MSE laboratories in shared space in the new SEE building and retrofit existing space as necessary; at Burnaby, the enrolment expansion and pressure on lab, class, and office space will require nothing short of a new building. We feel this is an addressable issue if a new building is constructed with an eye to combining cognate disciplines, such as Science, Health Sciences, and Applied Sciences.

- **Faculty retention and career development.** With the increase in our reputation, our faculty are becoming extremely attractive to other institutions both in industry and academia. Further, the wave of retirements will hit our shores in the next few years. **Action:** Recognise that some churn will happen, but also put much greater focus on increasing salaries, renewing infrastructure, and mitigating high workloads. We must hire with a primary focus on excellence.

- **Staff development and retention.** Staff are not properly levelled or compensated, and the functional staffing organisation is inefficient, brittle, and does not provide career development opportunities. **Action:** develop a new organisational structure that addresses these concerns, and hire more excellent staff.
• **Campus Inequity.** The services (residence, gym, culture) available to faculty, staff, and students vary considerably across the two campuses. **Action:** strike a working group to identify and address some of these problems. Many of these problems pertain to SFU as a whole.

• **Lack of “Brand Recognition”**. The “Faculty of Applied Sciences” casts a wide net. At some universities, and in the past at SFU, this faculty housed a wider set of disciplines. Now it houses Computing and Engineering. **Action:** Change the name of the faculty.

• **Re-imagine the experiential/co-op student experience.** The undergraduate and professional master’s co-op appear to be working adequately, but are in need of review. The SEE programme among others wishes to introduce other kinds of experiential learning. Further, the increasing demand for research-based internships will require a new approach. **Action:** develop a working group to review and assess the experiential learning elements of our programmes.

• **Teaching Practice.** It is important to provide career development for teaching practice for all faculty. 
  
  **Action:**
  
  o Provide peer-partnering support to exchange experience in the classroom.
  o Extend the role of our Faculty Teaching Fellows to support and develop practical in-class advice.
  o Encourage and support for faculty to lever university resources such as TLC workshops, and promote a culture that recognizes and values pro-actively seeking their support.

• **Digital Supercluster.** It is our intention to participate in the BC’s Digital Supercluster initiative. Indeed, initiatives in digital health and visual computing are entirely consonant with this agenda. We have made some progress in early initial meetings, but the there is some concern that the industry-led projects are of too short a duration to be effective research vehicles. **Action:** continue engagement.

**Concluding Remarks**

Applied Sciences is embarking on a new adventure. It is setting its sights high to achieve international attention and prominence over the next five years, for the pursuit of excellence at that level becomes the only option open once we discover we are capable of it. Doing so will require a prolonged commitment to recruiting outstanding faculty, staff, and students. We must work together internally by harmonizing where we can, and differentiating where it makes sense to focus. We will need to collaborate with our fellow faculties, because everything is connected. Students must be more carefully attended to, and our aims for excellence must be communicated to them, for it will help them to set their own bar for excellence. An exciting new chapter has begun, and our opportunity to effect social change for good is immense.