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MEMORANDUM

ATTENTION Senate

DATE August 15, 2022

FROM Wade Parkhouse, Vice-President, Academic and Provost and Chair, SCUP

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RE: SCUP 22-20 External Review Mid-Cycle Report for School of Engineering Sciences

At its July 13th, 2022 meeting, SCUP reviewed the Mid-Cycle Report for the School of Engineering Sciences which resulted from its May 2017 external review.

The following documents are attached for the information of Senate:

- Update on the Action Plan
- Assessment of Educational Goals
- SCUTL's Feedback on the assessment of Educational Goals

C: M. Sjoerdsma; E. Fiume

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MEMORANDUM

Attention: Catherine Dauvergne, Vice-President, Academic and Provost and Chair, SCUP

From: Wade Parkhouse, Vice-Provost and Associate Vice-President, Academic

Re: External Review Mid-Cycle Report for the School of Engineering Science

Date: June 29, 2022

The External Review of the School of Engineering Science was undertaken in May 2017. As per the Senate guidelines, the Unit is required to submit a mid-cycle report describing its progress in implementing the External Review Action Plan and the assessment of its Educational Goals. The update on the Action Plan has been reviewed by the Faculty Dean. The Senate Committee on University Teaching and Learning (SCUTL) has provided feedback to the Unit on the assessment of its Educational Goals. The recommendations from SCUTL will be incorporated into the Unit's self-study report for the next external review.

The following documents are attached for the information of SCUP:

- Update on the Action Plan
- Assessment of Educational Goals
- SCUTL's Feedback on the assessment of Educational Goals

c: Michael Sjoerdsma, Acting Director, School of Engineering Science
Eugene Fiume, Dean, Faculty of Applied Sciences

SFU **School of Engineering Science**

MEMORANDUM

TO:	Bal Basi, Coordinator, Quality Assurance
FROM:	Michael Sjoerdsma, Acting Director, School of Engineering Science
CC:	Eugene Fiume
DATE:	May 1, 2022
SUBJECT:	External Review Mid-Cycle Report for the School of Engineering Science

Please find attached the Mid-Cycle Report for the School of Engineering Science outlining our progress related to the comments raised from our last external review. The document concludes with a brief commentary on educational goals related to our undergraduate and graduate programs.

External Review Mid-Cycle Report for the School of Engineering Science

<table>
<tr><th>Action</th><th>Progress Made</th></tr>
<tr><td>1. Programming</td><td></td></tr>
<tr><td>1.1.1 Undergraduate</td><td></td></tr>
<tr><td>• ER and CEAB note the need to recover lost faculty positions to sufficiently meet the undergraduate teaching needs.</td><td>The number of continuing faculty has shown a modest increase of 0.5 FTE compared to the 2016/2017 academic year. The number of tenure track faculty has decreased from 22.0 to 20.5, whereas the number of lecturers has increased from 5.0 to 7.0. The table below summarizes the number of faculty since 2016/2017, showing that ENSC, for most of the time, has had fewer members since the time of the external review.
Engineering Science – FTE CFL by Rank
<table><tr><th></th><th>2016/17</th><th>2017/18</th><th>2018/19</th><th>2019/20</th><th>2020/21</th><th>2021/22</th></tr><tr><td>Professor</td><td>18.00</td><td>18.75</td><td>18.75</td><td>17.75</td><td>16.50</td><td>16.50</td></tr><tr><td>Associate Prof.</td><td>3.00</td><td>2.00</td><td>2.00</td><td>1.00</td><td>1.00</td><td>1.00</td></tr><tr><td>Assistant Prof.</td><td>1.00</td><td>1.00</td><td>1.00</td><td>2.00</td><td>2.00</td><td>3.00</td></tr><tr><td>Lecturer</td><td>5.00</td><td>5.00</td><td>6.00</td><td>5.00</td><td>5.00</td><td>7.00</td></tr><tr><td>TOTAL</td><td>27.00</td><td>26.75</td><td>27.75</td><td>25.75</td><td>24.50</td><td>27.50</td></tr></table>
Given the ER and CEAB were concerned about meeting undergraduate teaching needs, the increase in lecturers is promising for covering teaching capacity. ENSC is currently in the process of hiring one more lecturer, and the open search for a new director may result in an additional hire if the successful applicant is an external. However, this possible gain will be offset by a faculty member who is retiring at the end of August 2022. Our expectation is that the replacement for retiring faculty members will follow past practice, and that there needs to be a balance between hiring lectures, who support teaching capacity, and tenure track faculty, who support research in ENSC. Note that the number of tenure track faculty in ENSC is the same as the number in 1996. To account for various leaves that members take as well as a desire to increase course offerings, we request additional faculty positions, which should be a combination of lecturers and professors.</td></tr>
<tr><td>• ER recommends reducing the number of students as an alternative to addressing the lack of space and faculty.</td><td>External reviewers are in an enviable position, where various operational constraints need not impair recommendations for addressing lack of space and faculty. While this recommendation may seem feasible for outsiders divorced from the FAM, it is untenable from an internal perspective because a decrease in students will directly affect our budget. While the Dean has some flexibility for distributing funds between the Schools in FAS, there are limitations given all schools require adequate funding.</td></tr>
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	Compared to other provinces, BC does not adequately fund engineering schools, and this deficit is inherited by SFU. Our hope is that internally SFU can adjust its funding model to account for programs that are inherently more expensive to offer and that the senior leadership at the university will lobby the provincial government for proper funding of engineering schools. An overall reduction of students in the program without impacting our budget may be possible if the school can increase student retention. A large intake in first year places strain on our lab space, and first-year students take most of their courses in other departments, which does not help bring in university funds. The next ER suggestion, discussed below, relates to student retention, and it is a more realistic suggestion. The absolute number of students may end up being the same in the program, but the increased retention would allow for a reduced intake of first-year students with more upper division students who remain in the program.
• ER suggests a focus on increasing student retention.	Efforts to increase student retention have occurred at both the faculty level and within ENSC. The FAS-level initiatives are organized through the Student Affairs Unit (SAU), including FAS Start, TechConnect, Indigenous outreach, and a focus on health and wellness. ENSC initiatives include embedding additional support in some courses, investigating our student entry and exit patterns, and changes to curricular requirements. ***FAS-Level Initiatives*** **FAS Start** SAU developed FAS START, a Canvas course designed to prepare students for university life and their start in the Faculty of Applied Sciences. The course provides students an opportunity to get to know each other, an opportunity for students to be advised of the supports available to them as they transition to university, and an opportunity to learn how to enroll in courses and build their first-term schedule. In this course, students envision how they can best contribute to creating a safer environment by identifying their skills, interests, values, and goals in time for the start of their first term, by learning about Equity, Diversity, and Inclusion (EDI) and creating an inclusive community at SFU, and by recognizing changes everyone can make in their lives to reduce stress and stay well both inside and outside the classroom. Across the faculty, 350 students participated in the course. Currently, statistics on student participation are not recorded. Going forward, ENSC will be advocating that more of our first-year students complete this course, and participations rates per school will be kept. **TechConnect**

	The SFU FAS TechConnect program is a supplementary, experiential program for new high school students transitioning to university. Given the success of the program, which was one-term in length, the program expanded in September 2021 to supporting students throughout their entire degree. For the 2021/2022 academic year, 167 incoming students are participating in the program; forty-seven students are from ENSC. First year sessions include Calculus preparation, public-speaking, course planning, wellness, and gingerbread competitions. The facilitated content in each session sets students up for academic success and establishes a solid social network. A theme was developed for each year of the program: *Year One – "Getting Acquainted"*. Assists new students with their transition into SFU by helping TechConnect members to foster connections with other students as well as learn resources for support. *Year Two - "Climbing the Ropes"*. Provides students with a more in-depth understanding of the opportunities within their programs. *Year Three - "Strengthening One's Passion"*. Students will work with a professional and personal development coach to work on their long-term goals. *Year Four - "Helping Others"*. Students will learn of the importance of giving back to the community by helping with first- and second-year sessions. **Indigenous Student Outreach** *Indigenous Preview Day* The Indigenous Recruitment Network organized Indigenous Preview Day which took place on November 23rd, 2021. The all-day virtual event aimed to strengthen SFU's relations with Indigenous communities and to educate audience members on programs at SFU. *Indigenous SRA Network* SAU is part of the University Indigenous Network group. As of January 21, 2022, 12 students applied to the Faculty of Applied Sciences. One Indigenous student was admitted to Applied Sciences through the IUPP Pathway last year https://www.sfu.ca/fass/students/future/iupp/overview.html **Health and Wellness** In collaboration with SFU Health and Counselling, SAU is reinvigorating the FAS's ongoing commitment to student health and wellness. Since fall 2019, SAU has been working to identify opportunities to embed mental health and wellness within policies and programs, enhancing support options for students, and exploring ways to better communicate supports and services available for student

	wellness. Starting in August 2020, SAU brought on a health and wellness coordinator to further work with FAS and each School to identify opportunities and to develop resources to support student health and wellness. The following initiatives were completed: • Developed and maintained the FAS Wellness Resources page with appropriate resources and timely student-focused wellness-related events and initiatives. • Developed and delivered two wellness workshops to first year students across FAS, reaching 400+ undergraduate students as part of Welcome Day, courses, and TechConnect: introduction to wellness and introduction to resilience skills • Developed and delivered an introduction to wellness resources presentation reaching 100+ new graduate students. • Worked with FAS instructors to develop and distribute a draft guide on building health and wellness into courses. • Collected survey and focus group data from 200+ undergraduate students on their self-reported wellness and suggested areas for wellness programming. • In partnership with SFU Health and Counselling, developed a guide on Recognizing & Referring Students in Difficulty • In partnership with SFU Health and Counselling, worked with Faculty and School leadership to develop a wellness training program for all FAS students ***ENSC Initiatives*** To better understand student attrition and retention, ENSC was part of a Big Data study entitled *Factors Affecting Entry, Exit and Re-entry Patterns in the School of Engineering Science* (2019). This study used transcript and demographic data for 1755 students who were active in ENSC between Fall 2010 and Spring 2017. The report culminates in a series of recommendations that the school is investigating. Of particular importance is supporting students who struggle with Math. Ninety-five percent of BC12 students who fail Math in their first term will leave SFU, and only 17 percent of students who pass Math in their first term with a CGPA below 2.5 will complete any degree at SFU. One potential strategy is identifying students in danger of leaving SFU based on their first-term Math mark and providing additional supports. For a few years, ENSC worked with the Centre for English Language Learning, Teaching and Research (CELLTR) to embed additional language support in students' first semester. This work culminated in the creation of a Post-Entry Language Assessment (PELA) related to reading skills to identify students who needed more support. Unfortunately, the support available through CELLTR disappeared with the

	creation of the Centre of Educational Excellence (CEE). ENSC's hope is that this partnership can be revitalized for Fall 2022. ENSC's Undergraduate Curriculum Committee is exploring changes to the school's mandatory co-op work term requirement. Currently, all students must complete at least one year of co-op with the first, four-month term in second year. The supermajority of students does not complete their co-op in the recommended semester, which often causes severe scheduling problems because completing their first co-op semester is a prerequisite for upper-division courses. ENSC is working with Work Integrated Learning (WIL) to determine various options of incorporating experiential learning within our curriculum while removing as many constraints as possible. In the external review, ENSC mentioned creating a help desk, similar to the ones at MIT, staffed by a sessional instructor and four TAs. Because of COVID restrictions and ongoing renovations to the Applied Sciences Building, this initiative did not occur. However, the Engineering Science Student Society (ESSS) has started a student-led initiative to help students. ENSC is formally reaching out to the ESSS to discuss how their efforts may be supplemented. ENSC is still interested in broad-based admissions to attract diverse students. Currently, Sustainable Energy Engineering (SEE) supplements their admission process of transcripts with a series of focused questions to gauge student interest in the SEE program and their community engagement. This process requires additional resources for readers. SEE's admission process is considered a pilot, and ENSC is waiting for the pilot phase to conclude for SEE before considering our own broad-based admission.
• ER suggests examining the teaching load.	Ensuring equitable teaching loads are not unique to ENSC, and the Dean initiated a FAS-level committee with representatives from each school. This committee met in 2019; it analyzed historical teaching assignments within FAS; it investigated policies at other universities, and it identified a long list of factors that could be used to account for teaching load. There was no resolution to which factors should be used nor any appropriate thresholds and weightings. Now that teaching loads have been examined, the next step is implementing a system for accounting for various factors that affect teaching load. The Dean will be reconvening this committee in the near future. ENSC has recently started a process of auditing teaching history of each faculty member and is moving to a FAS-supported eTRACs system for better bookkeeping. Independently of the Dean's office, we are reviewing language in the collective agreement related to teaching workload to see how we can account for differences in courses.

• ER recommends external service courses be considered only if sufficient funding is not available from the FAM model.	ENSC has created the first of the TEKX (Technical Experience) series of courses. TEKX 101, *Introduction to 3D Printing and Laser Scanning*, is a cooperative project between ENSC and the SFU Library. It targets training non-engineering students in a QB course on the concepts and hands-on experience of 3D printing, so they can use the Library's Media and Maker Commons. This course has greatly exceeded our original plan, which was to offer TEKX 101 once a year and, if demand was sufficient, to expand to twice per year. TEKX 101's first offering in Fall 2019 taught 24 students, but the course had a waitlist of over 25 students. The interaction with the library makerspace went very smoothly with ENSC supplying the TAs to train the students in their 3D printing projects. A second offering was given in spring 2020, again with a 100% oversubscribed waitlist. We had planned a larger offering in summer 2020 and had 40 student applications when COVID 19 restrictions on the library forced us to cancel. In Spring 2021, jointly with the library, we created a reduced size offering to maintain COVID safety protocols to 14 students. This reduced offering was repeated in Fall 2021. The current Spring 2022 offering has expanded to 30 students The sustained student enrollment in the course has proved the TEKX concept: there is a demand for technical training among non-engineering students – a concept that was uncertain before we tried it. Using a non-Engineering course name helps remove any trepidation that the course is focused on engineering students. This permits engineering to reach out to the rest of the university and offer not only training, but an understanding of what engineering is all about. The courses must be designed to meet the needs of non-engineers by avoiding equations and instead presenting that information in graphs and tables. Topics for TEKX need a strong hands-on component that should be related to a useful topic for those outside of engineering. This cooperation with the library has benefited both: 130 students at this point have received detailed training in using their makerspace, which has expanded the demand for that area. To our knowledge, this is the only engineering course taught for non-engineers in Canada, and it is the only engineering/library combination. Our current plans are to expand the class to 40-50 students per term (COVID permitting) with three offerings per year. TEKX has has been successful enough that the instructor (a 3D printing expert) has been hired as a limited term lecturer starting this year. We are also examining concepts for other TEKX courses in a different technical area. Additional TEKX offerings will establish collaboration with other units at the university. ER's recommendation related to external courses and the FAM misses a fundamental motivation of the course: it is about outreach and service to the university by engaging students in other departments.

• ER and CEAB both require that all faculty obtain Professional Engineering status.	The requirement for Professional Engineering (P.Eng.) status has been addressed. Of the faculty members in ENSC, 26 have their P.Eng., and the remaining four are in progress. Two of the people in progress are new hires, who will have to obtain their P.Eng. within the next two years. One of the in-progress people is a term practitioner faculty. The final person was recently interviewed by Engineers and Geoscientist BC (EGBC). The interviewers' recommendation will proceed to EGBC's Credentials Committee in early May. By the time of the next external review, all faculty members in ENSC will have their P.Eng. status. ENSC will continue with the practice of stipulating in hiring letters that new hires must obtain their P.Eng. within a certain time frame. This practice has proven to be the best mechanism for ensuring timely compliance.
• ER recommends ensuring sufficient technical staff.	The technical and IT staff for ENSC has gone through a fundamental change, where ENSC is finally receiving adequate support after a few years of being understaffed. The model in FAS has moved to a centralized management of technical staff, where staff are hired within the Dean's office and then deployed in Schools when needed. Supporting ENSC as technical support staff through the Dean's office are an Electrical Lab Engineer, Mechanical Lab Engineer, Fabrication and Wetlab Specialist, and a Machinist who is shared between Burnaby and Surrey campuses. Currently, ENSC also has two embedded technical staff within the school: a Lab Tech and a Computer Systems Technologist. Determining priorities and workflow is the responsibility of the Director Technical and Facilities, who, in addition to the technical staff, manages IT, Facilities, and Safety within FAS. This current arrangement has been successful in addressing the needs of the school. The Director Technical and Facilities meets regularly with the Director of ENSC. The ability to work through COVID restrictions and shifting spaces regularly because of renovations is testament to the effectiveness of this new model.
1.1.2 Graduate	
• The ER suggested that funding for graduate students be increased by increasing TAships and reducing number of grad students.	ENSC currently has 141 graduate students: 45 M.Eng., 37 M.A.Sc., and 59 Ph.D. students. Incoming graduate students are now promised a minimum of $20,000 in financial support for the duration of their degree as a combination of TA units and RA funding. The table below summarizes the financial support for graduate students since 2016/2017 based on admit term of matriculated students. Note that actual funding for a graduate student may exceed the $20,000 if the student receives additional TA units or graduate scholarships.

Engineering Science – Promised Financial Support (Duration of Degree) on Admission

		2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
M.A.Sc.	$ promised	$465,000	$677,168	$645,000	$791,100	$459,500	$512,000
	# of students	15	16	14	14	12	14
	Avg/student	$31,000	$45,145	$43,000	$52,700	$30,633	$34,133
Ph.D.	$ promised	$990,000	$1,298,500	$694,000	$1,283,250	$772,800	$679,000
	# of students	14	16	10	17	8	7
	Avg/student	$70,714	81,156	$69,400	$75,485	$96,600	$97,000

The funding for M.A.Sc. students is close to funding available in 2016/2017. Funding for Ph.D. students has increased considerably. Note funding for M.Eng. students is not guaranteed, and students applying into this program are aware they have no priority of TAships.

Given that TAships form part of the funding for many graduate students, one potential option is to increase student funding by increasing the TA budget to provide additional base units for courses or to create new opportunities to help students, such as the help desk. Increasing funding in this way needs to consider ENSC's budget and student enrollment in the undergraduate program, which would bring additional money to the school. However, any increase in the undergraduate program has its own constraints and would be contrary to ER's recommendation of reducing the student population.

ER suggests reducing the number of graduate students. To reiterate our previous objection to this recommendation, our ability to supply adequate numbers of TAs to our undergraduate courses is dependent on thesis-based graduate students (M.A.Sc. and Ph.D.). The interrelationship between our undergraduate and graduate programs cannot be ignored, and simply coordinating a reduction in both student populations is unrealistic given the FAM at SFU. Additionally, ENSC does not have a central ENSC graduate intake model anyways, so the school cannot increase or decrease the number of graduate students. Our faculty recruit graduate students directly when they have funding to offer and can find a qualified graduate student. As with other diminishing trends, decreasing grant funding per head in our faculty will ultimately reduce the number of graduate students organically. There are no special incentives for faculty to really go after increasing their grant funding as grant applications are a lot of work, success rate is 10%, and the downside of success is more research work.

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- ER is concerned about the duration of masters degrees and suggests higher mentorship.

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Time to completion is a concern that ENSC is still addressing. The target for M.A.Sc. degrees and M.Eng. degrees is 2 years (6 semesters), and the target for PhD degrees is 5 years (15 semesters). The table below summarizes the average semesters to graduate based on graduation year.

Engineering Science – Average Semesters to Graduate Degree Completion

	2016/17	2017/18	2018/19	2019/20	2020/21
M.A.Sc.	9.0	7.8	8.2	10.4	6.6
M.Eng.	7.9	8.9	7.1	7.1	5.2
Ph.D.	17.7	18.5	22.6	23.0	18.7

For 2020/21, the time to completion for Master's degrees are meeting the target. PhD completion rates are still above our target, and we will need a couple more years of data given the time needed to complete a PhD. ENSC did ensure that PhD students are meeting earlier with their supervisory committee and that progress reports are completed. Complicating matters is COVID, which restricted access to laboratories and resulted in fewer graduate courses being offered. It is highly probable that COVID coupled with disruptions caused by renovations will impact time to completion.

ER's coupling of time to completion and recommending higher mentorship may be missing factors that go beyond mentorship. As faculty members in ENSC note, they are providing guidance to students, so it should not be inferred from time to completion that students are left stranded to find their path. Faculty members have commented that quality applicants are often international students, who need to adapt to a different educational environment as well as deal with acclimating to a new country. Determining where to enhance mentorship is certainly welcome, but other factors may be influencing students' time to completion. Future work for ENSC will be investigating time to completion for students based on a variety of demographics.

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- ER recommends bringing back the PhD comprehensive examinations.

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Bringing back the PhD comprehensive exam has been raised in ENSC's visioning committee and during our faculty meetings. This idea is divisive and is still being discussed. As mentioned in the external review, instead of a comprehensive exam, PhD students in ENSC present to their supervisory committee regarding their proposed research. ENSC has been vigilant in ensuring this presentation does not happen too late in the program so that any issues can be identified early. A creative way forward may be to create PhD comprehensive exams that are customized to each of our research directions.

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• Increase the number of graduate courses.	Given the various requirements to ensure we meet our undergraduate accreditation requirements, ensuring adequate offerings of undergraduate courses takes priority. The additional effort to offer undergraduate courses, many of which have hands-on laboratories, through the pandemic and through renovations has increased faculty workload. However, with new hires, ENSC is increasing its capacity to offer graduate courses, as shown in the table below. **Engineering Science – Graduate Course Offered** **2016/17 2017/18 2018/19 2019/20 2020/21 2021/2022 2022/2023** **# Courses** 9 13 12 7 11 9 15 For the 2022/2023 academic year, we will offer 15 graduate courses, five of which that have not been offered in two years or more. ENSC's intent is to continue to offer 15 courses per academic year and to address the limited availability of courses for certain research areas. The only way to significantly increase graduate courses is to hire more faculty members with active funding-based research programs.
2. Research	
• ER notes that the greatest restriction on research is the very limited space available.	Restriction on research space continues to be a major limitation on research within the school. As discussed in Section 4, *Working Environment*, research space after renovations are complete will be reduced from 1326.57 m^2 to 1303.05 m^2. Because of a reduction in the number of research spaces (31 to 28) the average area per research space will increase from 42.79 m^2 to 46.54 m^2; however, this number is still below the NASM standard for engineering. ENSC is currently establishing a procedure for reviewing the use of research space that considers equipment needed for research, the number of graduate students, and future plans for expansion with the aim of using our limited space more effectively. In the long term, however, the limited space for research in the Applied Sciences Building will constrain any future growth. The Dean along with SFU needs a plan for supporting research with in ENSC and FAS.
• The ER calls for increased cooperation with other departments and universities.	ENSC has worked with MSE to allow their students who are on their five-year flex plan to fulfill MSE degree requirements with ENSC courses. TEKX 101 has also been a success in teaching students from other departments. Additionally, some research by our faculty is conducted with colleagues in other units, such as 4D Labs. As noted in our self-study, MOUs have been signed with Japanese

	universities/institutes (National Institute of Informatics (NII), Yamagata University, and Totorri University) and The Indian Institute of Technology (IIT).
• ER calls for the department to create a long-term plan.	ENSC submitted a long-term plan to the Dean on May 13, 2018, which considered many facets of the school. The plan was motivated based on the External Review, and it addressed many of the action items from the ER. Some initiatives include establishing new areas within ENSC, such as quantum engineering and AI Engineering, Professional Masters Programs, graduate certificates that relate to local industrial companies, attracting students from the USA, and increasing student retention. In addition to the ER, the long-term plan was informed by two school retreats, where faculty members discussed a variety of issues. The conversation continued through a visioning committee that has met 41 times since June 2020. Topics have ranged from considering the schools vision and values, branding and marketing of the school (including branding, taglines, and the potential renaming of the school), addressing inclusion and reconciliation, improving retention, attracting quality students, renewing ENSC's websites, considering PhD qualifying exams, and establishing research centres. The visioning committee allows faculty members to discuss and debate how to implement many of the items discussed in the long-term plan. Ideally, we would have liked to be further into implementing many aspects of this plan, but the impact of COVID has meant our collective efforts had to focus on delivery courses and maintaining research agendas, all of which required substantially more time during the pandemic.
3. Administration	
• ER note that with the new Dean and VPA there is the opportunity to rebuild trust between the school and the higher administration.	Since the time of the ER, SFU has appointed a new VPA, and the Dean of FAS has recently been ratified for another 5-year term. To strengthen our relationship with our Dean's office, we have increased the frequency of meetings. The Director of ENSC meets once per week with Associate Director, Academic Affairs FAS and the Director Technology and Facilities FAS as well as biweekly meetings with the Dean and FAS's Senior Director. These meetings help build trust by ensuring regular communication about various issues. In order to strengthen the relationship with the Dean and faculty members in ENSC, it would be useful if the Dean can attend faculty meetings once per semester.

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- ER recommends increasing the number of departmental support staff.

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Overall, the support staff for ENSC, including technical support through the Dean's office, is one FTE lower than in 2016/17. The number of FTE support is summarized below. Note that positions held within the Dean's office are prorated to account for the support that is provided to ENSC.

Engineering Science – FTE Support Staff

	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22
APSA	4	5	5	3	3	3
CUPE	10	9	8	9	9	10
TOTAL	14	14	13	12	12	13

As the table indicates, from 2019 to 2021, the FTE support staff was lower than historical levels. Moreover, ENSC has seen significant vacancies with several key staff leaving for other positions. Since December 2022 to Feb 2022, staff have left the following positions: Manager, Academic and Administrative; Coordinator, Administrative; Confidential Assistant to the Director; and Graduate Program Assistant. ENSC has relied on staff from the Dean's office to help bridge core duties, and we have a temporary employee in the Graduate Program Assistant role. As of March 14, 2022, we have filled the Manager, Academic and Administrative position, who will start the process of filling the vacant positions. Note that at the time of external review, the Academic and Administrative, Coordinator position was temporary. This position is now a continuing position. While the position is vacant, the roles and responsibilities are being evaluated to determine if they should be modified to better support the school.

Constant turnover of staff is a concern because it places additional burdens on the remaining staff, Dean's office staff, and faculty members. Now that the new Manger has been hired, part of her early duties will be to audit the workload of each position and determine any changes that need to be made to ensure equitable workloads.

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- ER notes concerns of some faculty about the makeup of the TPC.

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The TPC is comprised of faculty members as per Article 29.8.1 of the collective agreement. As noted in the external review action plan, no TPC that reviews promotions contains either the faculty member, or their spouses, under promotion consideration. Biennial reviews become more problematic because of the requirement for assistant and associate professors. However, any potential COI is managed by the TPC Chair who ensures that no discussions of cases that might impact a member or their spouse takes place when they are present. ER notes that the concern about TPC composition is originating from some faculty, so potentially these members may be unaware of the processes the TPC is using. ENSC is currently updating its tenure and promotion requirements, and this updated document, to increase

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	transparency, will contain a section outlining how the TPC is constituted and the processes used to avoid COI.
4. Working Environment	
• ER notes insufficient space for both undergraduate teaching, and research/graduate work.	Space continues to be an ongoing issue for ENSC for both teaching and research. As mentioned, the Applied Sciences Building is currently under renovations. The table below summarizes the space available to ENSC pre-renovations (2018/19) and after renovations (Fall 2022).

Space Allocated to ENSC Pre-renovations and Post-Renovations

	TOTAL AREA (m^2)			QUANTITY		AVERAGE AREA (m^2)	
Room Type	*Pre Reno*	*Post Reno*	*ΔArea (m^2)*	*Pre Reno*	*Post Reno*	*Pre Reno*	*Post Reno*
Office	895.64	893.20	-2.44	69	70	12.98	12.76
Teaching Lab	1130.73	1271.12	140.39	20	22	56.54	57.78
Research Lab	1326.57	1303.05	-23.52	31	28	42.79	46.54
Other	863.38	644.33	-219.05	42	43	20.56	14.98
TOTAL	4216.32	4111.70	-104.62				

After renovations, ENSC's space for teaching laboratories will increase by ~140 m^2. The new teaching space is more contiguous than our previous teaching space, and the space has more efficient layouts to support students. While the renovations will be positive for the undergraduate spaces, unfortunately, the research laboratories will be reduced in size. The impact of this reduction is discussed in section 2 in this report. As mentioned, ENSC will have to optimize space amongst faculty members, but there are limits on our ability to function with limited space that is below NASM standards for engineering.

• Regenerating the team spirit within the department.	The last several years for ENSC have been difficult. An expanding student body with a decrease in faculty members in limited space has been arduous at times. The school is at a pivotal moment of having to contemplate its vision and adapt from an elite, boutique program that it was in the mid-80s. Any momentum of reconsidering the vision was waylaid by COVID and the need to focus hours on supporting students through the pandemic. The university's willful avoidance of acknowledging this workload in meaningful ways has not helped. Compounding matters are the renovations that have displaced many faculty members from their offices and caused additional work in the continual shifting and adapting of teaching and research labs. The turnover in staff with the many vacant positions has also resulted in limited support for some functions.

	Perhaps the adage of “its darkest before the dawn” is pertinent here. Regenerating spirit is a process, and despite being at a low point in many ways, faculty members have continued to support students and maintain high research productivity. With the imminent completion of renovations and the presumed end to COVID restrictions, faculty members in ENSC are ready to come back and engage in person. We are currently in an open search for a new director who is anticipated to start sometime after the Fall 2022 semester. The desire to improve ENSC is evident based on the visioning meetings that continued throughout the pandemic. The upcoming new space and a new director coupled with a renewal of staff and our new faculty hires place us in an excellent position to invigorate our spirit and envision a bright future for ENSC.

Midcycle Report on Educational Goals and Assessment
School of Engineering Science

Undergraduate Program

As an accredited engineering program, ENSC must meet the requirements set forth by the Canadian Engineering Accreditation Board (CEAB) for its undergraduate program. Around 2012, CEAB started the process of requiring engineering schools to demonstrate 12 mandated graduate attributes:

- **Attribute 1: Knowledge Base for Engineering** - Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
- **Attribute 2: Problem Analysis** - An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.
- **Attribute 3: Investigation** - An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
- **Attribute 4: Design** - An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
- **Attribute 5: Use of Engineering Tools** - An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
- **Attribute 6: Individual and Teamwork** - An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
- **Attribute 7: Communication Skills** - An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
- **Attribute 8: Professionalism** - An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
- **Attribute 9: Impact of Engineering on Society and the Environment** - An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
- **Attribute 10: Ethics and Equity** - An ability to apply professional ethics, accountability, and equity.
- **Attribute 11: Economics and Project Management** - An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
- **Attribute 12: Life-long Learning** - An ability to identify and to address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

Using the attributes provided by CEAB, each engineering school creates indicators (a.k.a. learning outcomes) that are associated with each graduate attribute and are distributed throughout the curriculum. For each indicator in a course, instructors determine the most appropriate assessment method, and then they report back aggregated student performance into four categories: Exceeds Expectations (Excellent Performance), Meets Expectations (Good Performance), Marginal (Satisfactory Performance), Below Expectations (Unsatisfactory Performance). Instructors decide the breakpoints for these categories, but they often correspond to A+ to A-, B+ to B-, C+ to C, and C- to F, respectively.

In 2015, CEAB formally incorporated graduate attributes as part of its official accreditation requirements, which corresponded to our last visit. Therefore, ENSC has already gone through one cycle of review where we demonstrated that we were collecting data and analyzing it for continual improvement. COVID has disrupted the accreditation cycle and delayed our next visit, We expect that our next visit will occur in either the summer or fall semester of 2023. We are starting the year-long process of preparing our documentation, which will include a detailed analysis of our indicator data. Our work with graduate attributes has shown that the first few cycles of collecting data needs to consider program-level improvement simultaneously with improving the model used for collecting data. For example, except for two cases, ENSC has four indicators associated with each attribute. In total, we currently collect data for 48 indicators. Each indicator is being collected multiple times throughout the curriculum. While, admittedly, the number of data points may seem excessive, it is a reduction from the original curriculum mapping we had created in 2012.

In terms of improving data collection, ENSC is now at the point where data management is becoming an issue. Part of continual improvement is being able to run a variety of reports that can be used by individual instructors as well as committees, such as our Undergraduate Curriculum Committee. Currently, ENSC uses Excel spreadsheets, which is not efficient. We have recently met with a company who creates software specifically tailored for managing CEAB graduate attributes. One area we want to investigate is whether the number of indicators per attribute can be further reduced. Another potential area of improvement is to reduce the number of courses that report out indicator data. Collecting specific indicator data is time consuming, so determining the most appropriate courses for data collection is worth exploring. Because CEAB is concerned with graduate attributes, all we need to demonstrate is that students meet these requirements by the time they graduate. It may make sense to only evaluate in culminating courses. For example, instead of collecting data in all three digital circuit classes, only the third class may need to report data.

In terms of curricular change, ENSC has concentrated on areas of our curriculum where there was insufficient teaching and evaluation of concepts. Since our last accreditation visits, ENSC has modified its curriculum to better address teamwork, reading comprehension, and occupational health and safety. Each of these areas is discussed below.

Teamwork: In ENSC, students have many opportunities to work in groups; however, teamwork was never officially taught or evaluated. Based on attribute 6, ENSC enhanced the curriculum of ENSC 100, *Engineering, Science, and Society*, to formally incorporate topics related to group formation and dynamics. The course project has a rubric outlining participation and group expectations, which require students to evaluate themselves and peers. The TAs who facilitate design labs also evaluate student performance in terms of teamwork. The two-semester capstone project course (ENSC 405 and ENSC 440) have also enhanced its rubrics for how group work is evaluated.

Reading comprehension: CEAB's Attribute 7 references reading, writing, speaking, and listening. ENSC has always had a strong, embedded, technical communications program; however, the curriculum has focused on output: writing and speaking. The inputs of reading and listening have not been assessed. We were able to derive some data related to listening from supervisor evaluations from our mandatory co-op program; however, listening as a skill is not officially taught before students go out on their first co-op term. Reading was an area that was totally neglected from our program. With the office formerly known as CELLTR, ENSC developed a post-entry language assessment (PELA) to evaluate reading comprehension that was administered in an offering of ENSC 105, *Process, Form, and Convention in Professional Genres*. The intent was to identify students in need and offer them more support. The restructuring of CELLTR under CEE and pandemic restrictions resulted in a suspension of the PELA. The instructor of ENSC 105 will resume the PELA in Fall 2022. The initial PELA was able to identify students in need of additional resources; however, the best way to support these students has yet to be determined.

Occupational Health and Safety: One of ENSC's indicators for demonstrating Attribute 9: *Impact of Engineering on Society and the Environment* is Indicator 9.3*: Health and Safety (Occupational Safety)*. Before graduate attributes were introduced, ENSC only covered OHS by requiring students to complete WHMIS training in ENSC 105. Upon noticing the lack of content related to OHS, we introduced content in ENSC 120*, Introduction to Electronics Laboratory Instruments Operation and Measurement Techniques,* where students learn about lab safety and proper soldering techniques. ENSC 405, the first course of the capstone project course, now incorporates machine shop training. ENSC was also part of a working group with WorkSafeBC, which included representatives from Engineers and Geoscientists BC (EGBC) and the other research universities to create material that can be used by engineering schools to address OHS in engineering curricula. Again, COIVD has delayed this project, but we expect this project to resume in the fall semester.

ENSC has identified other areas of improvement that can be addressed over the next two years: listening, design content in the common core, standardization of fourth-year elective courses.

Listening: Listening is a skill that needs to be taught and evaluated in our curriculum. Although supervisor evaluations are being used to assess this skill, students first exposure to the concept of (active) listening is not until ENSC 405. This skill could be incorporated into ENSC 105.

Design Content: ENSC has conceptualized design using the Double Diamond Model of Design as proposed by the British Design Council. CEAB's attribute 4 relates to design, and we have created four indicators to collect the data. Although students are exposed to design in various courses, most do not cover the entire design process. The exception is our capstone project course. One potential solution is to introduce a corner stone design course that occurs at the end of second year or at the beginning of third year. Such courses are common in other engineering programs.

Standardization of fourth-year elective courses: The first two-years of the engineering program are common for all students. At the end of second year, students declare an engineering option. In their fourth-year students have choice in selecting fourth-year courses. These courses are ideal places for capturing indicator data. Unfortunately, because the courses vary, reporting out program-level data becomes difficult. One of ENSC's initiatives is standardizing indicators for these courses so that data can be aggregated. Instructors would still have freedom to teach topics the way they want; standardization would just ensure that global themes, particularly those related to design, are consistent. Such standardization would also help with our other accreditation requirements.

ENSC started delivering its current curriculum in Fall 2013. It is now time that the School starts envisioning a new curriculum. The 12 attributes with the corresponding indicators are a useful framing for considering the topics and themes that should be incorporated. The data we have collected and the enhancements we have added are the first step for continual improvement. As mentioned, our continual improvement up to this point has concentrated on content that was lacking in our program in terms of teaching and assessment. Future improvements will need more significant curricular changes that are ideally implemented when we renew our curriculum.

Graduate Program:

Unlike ENSC's undergraduate program, there is no accreditation requirements that need to be met. The longstanding accreditation of ENSC's undergraduate program meant that the school was always meeting implied educational goals. CEAB's recent mandate of graduate attributes, for the most part, just meant providing additional data to demonstrate what the program has been teaching for many years. In comparison, ENSC's graduate program has always been more open in terms of course selection. Currently, there are no required courses for our M.A.Sc and Ph.D. programs.

As outlined in the self-study report, ENSC created three educational goals for its M.Eng. program and four educational goals for both the M.A.Sc. and Ph.D. A series of courses, theses, or publication history are mapped to each educational goal.

Currently, ENSC is evaluating the grades associated with the courses that students have taken. There is discussion whether some courses ought to be mandatory. In addition, ENSC is creating a rubric for theses in order to extract some data from committee members and the external reviewers. The need to publish is also being discussed, and ENSC is in the early stages of determining whether students in a certain degree need to publish a minimum number of conference and journal papers. And, as the ER recommended, ENSC is currently considering whether PhD candidates need to pass a qualifying exam.

The marked difference between the undergraduate program and the graduate program is that the former has a well-defined structure, and implementing educational goals through graduate attributes was a matter of mapping indicators to courses. For the latter, contemplating educational goals has spurred many philosophical discussions of what a graduate program should be. Clearly, the undergraduate program is more advanced in terms of educational goals; however, the changes being made are incremental. Although ENSC does not have as much data or structure for its graduate programs, the changes being considered are more foundational.

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MEMORANDUM

ATTENTION:	Michael Sjoerdsma, Acting Director, Engineering Sciences
FROM:	Elizabeth Elle, Vice-Provost, Learning & Teaching (for SCUTL)
RE:	ENSC Mid-cycle Educational Goals Assessment
DATE:	June 17, 2022

The Senate Committee for University Teaching and Learning has recently been charged with providing feedback to units in their mid-cycle assessment of Educational Goals. Here we note a number of positive things your department is doing, along with some suggestions for how you might leverage this process to support your departmental goals without the work becoming burdensome to faculty.

As an accredited program, Engineering Science must meet the requirements of CEAB, the Canadian Engineering Accreditation Board, which requires assessment of 12 graduate attributes. ENSC has defined 4 indicators for each of these attributes that they are choosing to measure. It is very understandable that ENSC is finding this level of data collection burdensome, as it is difficult to connect the mountain of required data to ways to improve the program. ENSC has already demonstrated that the cycle of assessment is improving their knowledge of their program and has made a number of improvements, specifically to areas where they have identified gaps. For instance, they have introduced an activity in first year to improve teamwork, noting that there wasn't a clear development of this skill from introduction through mastery. They are also considering changes to lower-division courses to improve performance on skills like reading, listening, and design. All of this work is to be commended.

There are some areas where SCUTL recommends improving your process, to the extent it aligns with CEAB expectations.

- Definitely move to performing assessment on fewer indicators, and focus on upper division courses. To be useful, assessment must be sustainable in the most important resource—your time. It's also considered best practice to focus on capstone or late-degree experiences—and to circle back to the lower division (and specifically to pre-requisite courses) only when a problem is identified in the upper division.
- Co-op is potentially a rich source of information for you; if there is a way to design data collection from the co-op supervisor evaluations that is sustainable you will potentially learn quite a lot about student performance in an authentic engineering environment.
- Given the numerous changes you have made within courses to improve student learning, focussing on the impact of those changes would be more useful to you than continuing to collect data on all 48 graduate attributes. Should you go ahead with your great idea of standardizing the learning outcomes of your 4th year courses, there would be an opportunity to focus on them as well.

- At the graduate level, it sounds like you are doing great work here, and one that may be especially impactful will be your idea to develop a rubric for theses. Doing so will likely provide great support for students writing theses as well. Consider, when deciding how to proceed with the grad program, sustainability/feasibility of data collection and analysis (a simple rubric for all theses may be just the thing).

Finally, if you could use any additional support, please reach out to the Learning Experiences Assessment and Planning group in my portfolio (email them at: leap@sfu.ca). I've added people to the team with expertise in assessment and survey analysis, and they are here to help you. And of course I'm more than happy to discuss this memo and your future endeavors with you.