External Review Report

for

Faculty of Applied Science, University of British Columbia

October 24, 2022

An external review was conducted on October 17-19, 2022 at the Faculty of Applied Science (APSC), University of British Columbia (UBC). The objectives of the review are to assess the strength and balance of the Faculty's teaching and research activities, academic programs, and service, to evaluate the Faculty's leadership and administration, to assess the Faculty's standing nationally and internationally, and to advise on the future development of the Faculty.

The review committee consists of the following members:
Cristina Amon, *University Professor and Dean Emerita, Department of Mechanical & Industrial Engineering, University of Toronto, Canada*
Ishwar Puri, *Vice President of Research, University of Southern California, USA*
Jean Zu, *Dean, School of Engineering and Science, Stevens Institute of Technology, USA*

This review report follows the guidelines of the 2022 Terms of Reference of the Review Committee, attached in the appendix.

1. Undergraduate Education and Student Learning

The Faculty of Applied Science (APSC) at UBC is a global leader and powerhouse for education, innovation, and research. The reputation of the Faculty has grown substantially with the recognition that the School of Architecture and Landscape Architecture (SALA) is Canada's #1 ranked architecture school and is ranked 35th globally (QS Rankings); the School of Nursing is tied for the first position in Canada and ranked 23rd globally; the School of Community and Regional Planning (SCARP) is Canada's #1 ranked planning school and is ranked 14th globally; the Faculty's Engineering Program is tied for the first place in *Maclean's* ranking and ranked 36th globally.

The Faculty comprises outstanding and dedicated faculty members and staff, and high-quality students. APSC provides a wide range of top-notch undergraduate programs and robust experiential learning environments. It has one of the largest co-op programs in Canada with an 80% placement rate for engineering students. The School of Engineering at the UBC Okanagan campus has gone through an impressive exponential growth since its establishment in 2005.

A strong focus and significant efforts have been made to increase collaboration between the UBC Vancouver campus (UBCV) and UBC Okanagan campus (UBCO) as well as across different Faculties and departments. A successful new program, manufacturing engineering, has set an exemplary model for joint programs between the two campuses. The School of Biomedical Engineering created in 2016 is a successful collaboration between the APSC and the Faculty of Medicine. The recently introduced environmental engineering program is a collaboration between two engineering departments: Civil Engineering and Chemical and Biological Engineering. These joint programs have helped tremendously in increasing collaboration, connection, and engagement across different academic units among faculty and students. We understand that such joint programs have their challenges, in part due to the complexity of the administrative governance structure and processes at UBC. However, the Faculty has been working untiringly to overcome the challenges and has made significant progress.

The demands for the engineering programs are extremely high, posing a very high admission bar with a minimum high-school GPA of 95%, which is extraordinarily high. Many bright high-school students are unfortunately excluded from entering the programs. The total number of engineering students per capita in BC is much lower than that of other provinces while the demand for such graduates in BC has been increasing steadily. Therefore, we strongly recommend considering a significant increase in the number of seats given to the engineering programs at UBC.

Despite the brightest students being admitted to the engineering programs, the attrition of first year engineering students to second year is high. About ten percent drop from the program and another ten percent repeat some of their first-year studies. Over ten percent of students in the common first year are unable to enroll in their first, second or third choice of specific engineering disciplines.

The teaching responsibility for research-active faculty appears to be higher than at peer institutions while fewer mechanisms for reduced teaching are available. This issue is exacerbated at UBCO where research active faculty members typically teach three undergraduate courses in a year and two undergraduate and one graduate course in a subsequent year. This leads to faculty members teaching different courses year to year, which may negatively influence their classroom effectiveness, their research output, and their work-life balance.

Undergraduate students feel empowered to work with academic advisors, faculty members, and the Faculty leadership. They report feelings of mutual respect and the existence of many channels of communication. The School of Engineering has a very strong undergraduate research culture. Engineering students on the Okanagan campus typically enroll in various minors, including arts and computer science.

The School of Nursing is unable to make effective use of some of the Faculty resources, such as in undergraduate advising, grant management (since these resources seem not to be as familiar with SSHRC and CIHR grant programs), and clinical placements instead of co-op placements, which are different from those provided to architecture or engineering students. Nursing does not typically enroll

international students. Hence, it is limited in its ability to fund activities to support its undergraduate students.

The Faculty has been examining first-year student wellbeing and stressors on a weekly basis through Terms 1 and 2 for several years. This has helped to inform the supports the Faculty provides and its messaging to students. As a result, several resources have been developed on transitioning to university learning and assisting first-year students.

2. Research

APSC has very strong research activities and culture of innovation. It has experienced a tremendous growth in research which has doubled its research funding from 2017 to 2021. This is a remarkable achievement unparalleled in other Canadian higher educational institutions. UBCO has been playing a key role in the research growth with its young, highly motivated, and dynamic faculty members. The research centres in APSC have been the drivers in leading large, interdisciplinary research programs and team grant applications with significant success: for example, the BioProducts Institute that has excellent connections to industry and government; the School of Biomedical Engineering with applications that include stem cells to cure diseases; the School's aspiration to build a GMP facility and its expertise in nanomedicine. The Clean Energy Research Centre was mentioned with foci in hydrogen and the use of the campus as a living lab. The Centre has fostered long-term robust partnerships with national research centres, government, and industry, particularly regional and local industry. Despite all these successes, there seem to be untapped opportunities for additional collaborative multi- / trans-disciplinary research initiatives.

APSC has significantly increased its research support by hiring several staff to support research proposals and industrial partnerships. Eight workshops are offered to develop research leadership on important topics such as developing and protecting intellectual property, writing large research grants, team building and project management. UBCO has its own team of 1.5 staff in supporting research partnerships. We believe that this support has tremendously enhanced the success rate of research proposals and partnerships, as evidenced by the doubling of the research funding since 2017.

Although many researchers would like to participate in large proposals, it is challenging to "motivate faculty to lead" these proposals. Concern was also relayed about the performance of the University-Industry Liaison Office, where invention disclosures and patent applications apparently languish for periods beyond faculty expectations.

Major challenges and inequities remain between the Vancouver and Okanagan campuses. Unlike Vancouver, the School of Engineering at Okanagan does not have internal resources to move big projects forward, although it reportedly accounts for two thirds of that campus' research expenditures. Challenges arise due to the distance separating the two campuses, which require deliberate efforts for collaborations to succeed. Reportedly, there are no joint or courtesy appointments across the two campuses. Although funds are available for mobility and collaboration, these are typically utilized by Okanagan faculty. There is recognition of the importance that Engineering places on its footprint at

Okanagan. For instance, UBC has submitted a new CERC application in disaster management (in civil engineering) and supports a clean tech hub at Okanagan.

3. Graduate Education and Post-Doctoral Training

APSC has seen a healthy growth in Master of Engineering students in the past several years with an approximately 30% increase in the Vancouver and 400% in the Okanagan campuses. Furthermore, the Faculty introduced two very successful leadership programs, Master of Engineering Leadership (MEL) and Master of Health Leadership and Policy (MHLP) programs, both of which have gone through a significant growth of over 120% increase in enrollment. We learned that the School of Engineering in Okanagan is working with the Faculty of Arts and Social Science on campus to create a new master's degree related to design to be offered in 2024. Overall, the professional Master's programs are on good track and have potential for further growth.

While the overall growth in research master's and PhD students has been moderate, the School of Engineering at Okanagan has gone through a major growth as a result of expansion and hiring of highly driven and high-quality junior faculty. A mandatory four-year funding guarantee has been implemented for PhD students. The minimum funding requirement is $24,000/year for UBCV and $20,000 for UBCO. Furthermore, most students receive top-up funding from TAs and scholarships. The COVID pandemic has posted a challenge to the programs in that fewer faculty come to campus on a regular basis and thus have reduced face-to-face meetings and supervisions and discussions in the research labs. As a result, the effectiveness and wellbeing of the research students have become a concern. Every possible effort should be made to address this concern.

Postdoctoral stipends were reported by a Department Chair to be a "bit of a wild west", where, unlike in peer universities, a minimum is not stipulated. The general annual remuneration was reported to be in the $40,000 to $60,000 range.

4. Collaboration and Outreach to the Community

APSC is widely viewed as a leader in collaboration with and outreach to the community as well as industry. According to central leadership, APSC is a role model for UBC for research of relevance to society such as in climate-related topics, clean technologies, biomedical engineering, and forestry and agriculture products.

The Faculty has an office and staff supporting EDI and Indigeneity, for instance with notable support for Orange Shirt Day. The partnership of the School of Nursing with Indigenous communities has been widely recognized and has served well the local communities. The Geering UP program is another

illustration of the deep commitment to the community and reports an impressive annual outreach to 25,000 K-12 students, including programming for 2,700 Indigenous and 2,000 girls.

5. People

The strongest asset of APSC is its people, from top-notch and dedicated faculty and staff to bright and enthusiastic students, to proud and committed alumni. Everyone we met has praised the leadership and tireless efforts of Dean James Olson, who is both highly respected and liked by faculty, staff, and students. We note that the Dean has an inordinately large number of direct reports and could benefit from delegating some reports to a Chief of Staff.

The reviewers learned that engagement and workplace culture must be rebuilt and strengthened post-pandemic. Faculty engagement within the campus has declined during the pandemic and some staff are still demotivated to be on campus. Consequently, students, both graduate and undergraduate, do not see clear value in coming to campus due to fewer opportunities to engage with faculty and staff.

Reflecting this disengagement, the preparation of this review report was challenging due to numerous no shows, since some of those invited to meet with the review team did not participate to provide their opinions, or send written comments. In particular, the reviewers did not hear separately from Vancouver faculty members or Okanagan students.

Although this level of disengagement varies by school and department, we learned that "the number of voices" required for a robust program has deceased in several units, and there are some concerns about the mentoring of graduate students.

The review recognizes this important issue since it experienced this diminished level of engagement. During a few sessions, none of those scheduled attended, even over Zoom. During other sessions, only a minority of those who were scheduled attended.

On the other hand, there is a strong sense of belonging among the diverse members of the Faculty who, although in different areas, consider themselves to be in related professional programs. The Dean is recognized as building upon this approach to bring the community together, strengthening the sense of identity in the Faculty and building community.

6. Diversity, Inclusion, and Indigenization

The review team learned that EDI.I is considered a core value of the Faculty, which has made significant progress with the creation of an Associate Dean of EDI.I and allocation of resources -- all of which is highly commendable. The School of Nursing is recognized for its notable EDI.I work, particularly the relationship with Indigenous communities, as are SALA and SCARP. With social science orientations, these schools in the Faculty consider themselves to be leaders in EDI.I.

The gender diversity of the engineering student population is still challenging, particularly in the Okanagan campus. The Faculty is encouraged to consider factors other than mark cutoff in evaluating

student profiles for admission, as is done in other peer universities in Canada through written and video responses to relevant questions. We learned that the admission is done at the central level, and it is not clear for the reviewers what input the Faculty provides. It is, therefore, important for the Faculty to have more involvement in the admission process in order to achieve better diversity of all sorts, including gender diversity. Attracting Indigenous students is especially challenging for engineering due to the small pool of candidates; outreach efforts need to continue at earlier grades to enlarge the pool in the pipeline.

The gender representation in master's (35% women) and Ph.D. (40% women) programs at Okanagan is well above those in other engineering schools nationwide, which is admirable.

7. Physical Infrastructure

With the rapid growth of APSC in both research and education in the past several years, and the concern about aging research infrastructure, facilities are in urgent need of both upgrading and expansion, even though there have been some renovation investments over the past 15 years.

The plan for the new Applied One Building, a $280M project, is encouraging. The new building is crucial and imperative for APSC to sustain its position as a global leader. The fundraising target is $75-100M. Likewise, the BME Building is a $140M project, with $25M from the provincial government, and the balance from the central capital fund supplemented with donor fundraising.

Cybersecurity is reported to be a concerning issue. While the Dean's Office is noted by the central leadership as being very supportive, cybersecurity compliance with researchers remains a challenge. Decision making and investments are currently maintained through relationships rather than a governance structure. Therefore, there is an opportunity to establish an IT governance committee in APSC like those in other Faculties.

8. Financial Resources

The budget model of APSC at UBCV follows the principles of the university budget model for flowing funds to schools and departments. UBCO has its own budget model following the Okanagan campus budget allocation. Over and again, the review team learned that the current decentralized budget model does not provide sufficient funds for the Faculty to invest in new initiatives in areas of strategic importance. Due to perceived uncertainties, departments hoard cash for rainy days rather than investing it, even though most departments have considerable cash reserves. Units maintain carry-forward surpluses which do not enable significant capital infrastructure investment or other investments such as seeding and increasing research activities.

Non-engineering schools, due to the nature of their disciplines, do not benefit as much as the engineering departments from the Faculty's services such as for co-op programs or research grant support. The schools need to have their own staff and support for their programs to flourish, yet they contribute the same 'tax' as the engineering departments. The review team observed that the Faculty

has been working closely with the schools on their budgets, and there are already plans in place to revise the budget allocation model.

In view of this situation, we strongly concur that the current budget allocation is not equitable across all units, as articulated in the self-study document and during the visit. The Faculty should therefore modify the current budget allocation model to enable future strategic investments with a budget model that is flexible and promotes strategic growth. It is encouraging that a budget taskforce has been appointed to discuss the matter of budget allocation models.

The School of Engineering at the Okanagan campus has its own budget and there is the so-called budget firewall between UBCV and UBCO. As a result, it is difficult for the two places to complement and support each other financially due to the barriers induced by the budgetary processes.

9. Leadership and Administration

UBC Applied Science has an excellent reputation within and outside the university, particularly under the outstanding leadership of James Olson as Dean. His collegial and collaborative leadership style is highly recognized and praised by all constituencies across the board. He has built a very strong leadership team with a transformational vision since he became the dean. He appointed almost all the current department heads who are strong and dedicated leaders, as evidenced by many metrics including the rise of the UBC engineering ranking to the top position in Canada. He also established a strong and dedicated team in the dean's office with several important new director positions such as the EDI.I director. The team has effectively supported all the units in APSC and has been working closely with the School of Engineering at Okanagan. The new director of the School of Engineering at UBC Okanagan, who joined three months ago, is an excellent hire. He is a thoughtful leader who can lead the School to the next level of excellence.

Differences arise from the governance and structures of the educational programs in engineering on the two campuses. The accredited undergraduate degree programs in the two schools are also different. Thus, a collaboration between the schools is more natural and organic in research and at the graduate level.

The review team learned that the Schools of Nursing on both campuses have had different histories and trajectories that necessitate different administrative structures and governance, but it appears that the two Schools collaborate effectively. External reviews of the School of Nursing have, however, noted that there are some challenges related to being included in the Faculty of Applied Science. A key example provided was the allocation of Canada Research Chairs, but successful negotiations have allowed four CRCs to be allocate to the School of Nursing. Only relatively recently have engineering and nursing begun to collaborate with the strong encouragement of the current Dean.

Strategic planning is uneven across schools and departments. While some have these plans in place and have processes to review them periodically, others are just beginning to develop them. The review

team learned that department heads are aware of the need for adequate project management while implementing their strategic plans.

The Dean's Advisory Council is composed of distinguished alumni and leaders in the Vancouver and Okanagan regions. The Council is actively engaged and genuinely interested in APSC. They also speak very highly of the Dean and show strong enthusiasm for supporting the Faculty.

10. Future Development

The future of the Faculty is extremely bright and there is ubiquitous confidence in its vision and leadership. Building on its current excellence and upward trajectory, we make the following suggestions for future development.

a. Since the Province would like UBC to grow in STEM disciplines, particularly in engineering and technology, this provincial interest should be nurtured and strengthened to receive new funded seats.

b. We agree with the Dean that, as it exists within the Faculty of Applied Science, the current budget allocation model is not equitable, particularly across units that focus on graduate education, are small or contain large international undergraduate programs, and among non-engineering programs.
    i. The current budget model of the Faculty does not reflect its strategic plan and does not support its aspirations. The budget allocation model should be revisited to enable strategic investments and be modified accordingly.
    ii. Special consideration should be given to schools that have unique needs and characteristics different from engineering units.
    iii. The Faculty, school and department strategic plans should be linked to anticipated future resources so that these plans do not simply languish as aspirations that remain unimplemented.

c. The relatively high level of faculty disengagement and reduced on-campus presence should be understood and pro-actively addressed.

d. The attrition of first-year engineering students to second year is high. About ten percent drop from the program and another ten percent repeat some of their first-year studies. These fractions are larger than at peer Canadian universities. There is a need to consider altering the first-year curricula and pedagogy, e.g., by reducing the total number of courses, introducing more project-based or experiential learning, and/or providing enhanced support such as through embedded counsellors or academic advisors.

e. Several matters require attention to further integrate the engineering units at Vancouver and the Okanagan.

i. The Okanagan Director does not have the status of Dean at UBCO, which leads to perceived inequity with peers on that campus. We applaud the new leadership model, one director leading both academics and operations, which is a big improvement from the previous two-person leadership model. However, it will be beneficial to have a clear status and mandate of the director position and further strengthen the responsibilities of that position.
ii. Continue strengthening the partnership and collaborations between the two campuses. The review team learned that while faculty may avail themselves of a fund to enhance collaboration between the two campuses, Vancouver faculty do not typically travel to the Okanagan campus to explore partnerships and foster collaborations, i.e., mobility is mostly from the Okanagan to Vancouver. We point to the development of the new manufacturing engineering program as an exemplary model to nurture two-campus collaboration. Here, each campus is developing its own synergistic niche that complements the other's capabilities, i.e., process and controls at Vancouver and industrial management at Okanagan. The development of this program has deepened the linkages and partnership between the two campuses. The Clean Tech Centre has also implemented successful approaches in developing two-campus synergies.
iii. Explore implementing different mechanisms to overcome silos within and between units. For example, biomedical engineering is a program in the Vancouver campus, whereas at the Okanagan campus it is an option, but the two curricula exist independently with limited collaboration. The review team recommends greater curricular alignment between the two campuses despite the challenges with the two independent governance models.
iv. Consider courtesy appointments between the Vancouver and Okanagan campuses which currently are non-existing. Although there may be procedural difficulties, we recommend that this matter be quickly addressed and resolved. While joint appointments may take longer to resolve due to the different governance structures and policies, this is also advisable to consider in upcoming years.

f. The Dean's Advisory Council (DAC), composed of distinguished alumni and leaders in the public and private sector, provides strategic advice and exceptional support to APSC. The DAC can also play an important role in future fundraising, particularly for the Applied One capital infrastructure project, as well as advocacy with the government and UBC leadership.

APPENDIX

Terms of Reference of the Review Committee, 2022

Context:

The Faculty of Applied Science is globally unique in terms of the composition of disciplines that make up the Faculty. In 2018 the Faculty began an extensive consultation process to build a new strategic plan that articulates the opportunity and potential for transformative change. The plan was completed in early 2020, and the Faculty began to align resources and introduce new leadership structures in support of implementing the plan. This review provides an opportunity to evaluate the Faculty as a whole, and provide critical insight into what internal and external factors may impact the Faculty's ability to realize the bold vision outlined in its strategic plan.

Purpose of the Review:

To review the strength and balance of the Faculty's teaching and research activities, academic programs, and service; to evaluate the Faculty's leadership and administration; to assess the Faculty's standing nationally and internationally; and to advise on the future development of the Faculty.

Terms of reference

Without limiting its overall mandate, the Review Panel should consider the following:

1. ***Leadership and administration:*** Review and evaluate the governance, organizational structure, faculty and staff composition, leadership team, and administration of the Faculty. Are there appropriate opportunities for diversity in leadership, and appropriate levels of transparency, consistency, and accessibility in the Faculty's affairs?

2. ***Education and Student Learning***: Review and evaluate the overall range of the undergraduate and graduate programs offered by the Faculty, and consider its reputation compared to the accomplishments of comparable national and international Faculties.

3. ***Research***: Review and evaluate the quality, extent, range, and balance of the scholarly activities of the Faculty, with particular attention to its interactions inside and outside the university and its reputation nationally and internationally. The review should address the range and quality of the research facilities at the Faculty's disposal.

4. ***Financial Resources:*** Review and evaluate the Faculty's financial position and processes including its success in obtaining funding by external agencies and in identifying potential revenue opportunities.

5. ***Physical Infrastructure***: Assess the quality and quantity of the Faculty's educational facilities, including physical and digital facilities, and the suitability of these facilities to deliver on the mission of playing a leading role in the university of the future.

6. ***People:*** Consider and assess the working environment, morale, and institutional culture of the Faculty.

7. ***Experiential Learning Programing*****:** Consider and assess the overall suite of programming to support experiential and community learning, and evaluate the success of such programs.

8. ***Collaboration and Outreach to the Community***: Examine the extent to which the Faculty has built a network of connections with other institutions and outside agencies as a means of developing its teaching and research programs.

9. ***Diversity, Inclusion, and Indigenization:*** Review the Faculty's diversity, equity, and inclusion processes, actions, and programs, including how the Faculty is addressing the recommendations of the Inclusion Action Plan (IAP), the Indigenous Strategic Plan (ISP) and the Anti-Racism and Inclusive Excellence Task Force.

10. ***Future development*****:** Identify the challenges and opportunities facing the Faculty, and make recommendations about possible directions for its future growth and development, taking into account the Faculty's priorities as outlined in its strategic plan.