LOOKING TO THE FUTURE

SBME STRATEGIC PLAN 2019–2023

DISCOVER
INVENT
TRANSLATE

SBME UBC
SCHOOL OF BIOMEDICAL ENGINEERING

1 MESSAGE FROM THE DIRECTOR

Since the SBME's inception in 2017, we have grown significantly. It was three and a half years ago when we launched UBC's first UG BME program, led by Associate Director Peter Cripton, and in 2021, we have graduated our first BME students. We've built partnerships with the life sciences community through hospitals, universities and industry. We've launched our venture hub and created an ecosystem of people and expertise that allows us to understand problems and advance solutions across biological scales from molecular design through to human physiology and beyond.

The school has also passed through the accredition process with flying colours and we are pleased to announce that we are officially accredited through to 2024.

In 2021, we are continuing to grow our faculty roster, we have finalized the design of our new home, Canada's Living Laboratory, we have launched our new brand and website, and continue to hire passionate, driven people to help propel us forward.

Our graduate programs have expanded with numerous students receiving high-profile awards, including two Killam recipients placing first and third in Canada in 2020. The Engineers in Scrubs (EiS) program celebrated its tenth anniversary by making national and international news through novel collaborations and innovative student projects.

The SBME research portfolio has also expanded to encompass more than 30 Faculty housed at multiple institutions across Vancouver. Our research seminar series hosted over 50 speakers in 2020-2021 alone, we held our first-ever research retreat and our PIs are deeply involved with multiple, large-scale research proposals that will ultimately impact health and healthcare across Canada and beyond.

All of this has set us well on track to meet and exceed our goals as outlined in this refresh of our strategic plan.

Peter Zandstra, PhD, FRSC, FCAHS, PEng
Canada Research Chair in Stem Cell Engineering
Director & Professor, UBC School of Biomedical Engineering
Director & Professor, Michael Smith Laboratories

EXECUTIVE SUMMARY

Technologies developed and improved by biomedical engineers enable transformational advances in medicine that touch every aspect of our lives. From the first glimpse of our children revealed through ultrasound imaging and extended release drug formulations that allow us to sleep through the night, to lifesaving cardiac stents and high performance robotic surgery, our lives have been improved and extended by biomedical engineering (BME) technologies for decades. Now, with the advent of molecular and cellular engineering, biomedical engineers are building a future where cures to degenerative diseases are possible, where devices seamlessly integrate with our bodies to assist and support critical functions, and where data-enabled algorithms help us detect and prevent disease and injury before they occur. The School of Biomedical Engineering (SBME) at The University of British Columbia (UBC) aims to lead Canada in BME research, education, and translation, and be the place to watch, internationally, for the next wave of technologies that will transform medicine. Created in 2017 through a partnership between UBC's Faculties of Applied Science and Medicine, and enabled by the leadership of British Columbia's provincial government, the SBME is unique as UBC's first inter-faculty school and as Canada's living laboratory for new models of convergent research and education.

This 2019-2023 strategic plan is the culmination of ten months of reflection and extensive consultations with internal and external stakeholders. It guides the emergence of a complex and effective organization that is delivering on its mandate even as it becomes established. The SBME envisions a future where fundamental engineering and biological insights are applied seamlessly to the discovery and design of transformative technological solutions that address problems in patient health and quality of life. The SBME's research, education, and translational efforts will yield inventions and innovations that impact society at the individual, population, and system levels—locally, nationally, and internationally. To realize this vision, our mission to be a nexus for education, innovation, and research is underpinned by the recognition that our ambition requires a diversity of inputs, ideas, and people who feel personally and professionally invested in our goals.

Three priorities drive our strategy: education, research and translation, and governance. Our education portfolio is designed to have unique BME courses and a coherent presentation of biology, its engineering and mathematical analysis, its synthesis with engineering design approaches, and its utilization and manipulation in the solution of clinically important biomedical problems.

Our research portfolio positions the SBME to lead in the discovery of new fundamental design principles underlying biological processes, improved techniques for measuring and predicting the behaviour of these systems across biological scales, and in the blurring of the lines between artificial and biological devices. Recognizing our role and responsibility in stewarding our discoveries to impact, we will also build capabilities in responsible translational training and support. In our governance portfolio, we strive to build nimble and effective strategies and structures to enable the SBME to act as a broad umbrella for health biotechnology and translational medicine at UBC and in Canada. Enabling, constructing, and launching an SBME building is undeniably critical to this success. Strategic priorities have been established for each portfolio, and these have been translated into objectives, deliverables, and action plans which will be monitored, reviewed, and adapted in response to progress.

Ultimately, this plan describes a scaffold that will guide the evolution and growth of the SBME from genesis to sustainability. It sets out our vision, priorities and actions, acknowledging our role as a member and key supportive partner in UBC's world-class ecosystem for health technology discovery, education and translation.

We welcome your participation in this journey.

2 SITUATION ASSESSMENT

SETTING THE CONTEXT

BME research and innovation has a broad, historical footprint at UBC and its partner hospitals. UBC was ranked 34th in the 2020 Times Higher Education World University Rankings (2nd in Canada), with over 65,000 students from more than 150 countries, over CAD $600 million in research funding, and an estimated annual economic impact of over CAD $10 billion. A significant proportion of this reputational and economic output can be associated with research and technology development activities in the life sciences; the Vancouver life sciences cluster is ranked as the 7th largest constellation of biopharmaceutical companies in North America. Over 300 companies from biotechnology, pharmaceutical, diagnostic, medical device, medical technology, and digital health sectors call British Columbia (BC) home. With 177,000 employees and CAD $14.4 billion in direct gross domestic product contribution, the life sciences industry is embedded in the larger life sciences ecosystem in the province, which brings together academia, health institutions, hospitals, government, and industry. Further, BC is home to one of the most entrepreneur-rich regions in North America and has more young companies with 10 or more employees than anywhere else in Canada.

Until recently, UBC lacked an independent, comprehensive BME program. The precursor to the present SBME was the Biomedical Engineering Graduate Program, based in the Faculty of Applied Science (APSC), offering Masters of Engineering (MEng), Masters of Applied Science (MASc), and PhD degrees in BME. Undergraduate BME education was presented primarily as options in the Departments of Mechanical Engineering and Electrical & Computer Engineering. This changed with the establishment of the SBME in 2017 through a strategic partnership between APSC and the Faculty of Medicine (FoM), supported through investments and partnerships with the Faculty of Science (FoS), the Provost, and the BC government.

The SBME has already garnered the attention of the Canadian Biomedical Engineering Community as a catalyst for advancement across education, research and translation.

Significant resources have been allocated toward the creation of the SBME. The SBME faculty membership has been seeded through partnerships with departments in APSC and FoM and includes more than 20 faculty members who are leaders in BME-relevant research areas from molecular and cellular engineering, biological imaging, computational biology, organ- and cellular-level biomechanics, and biomedical and rehabilitation devices. UBC, APSC, and FoM have positioned the SBME as a top priority in their strategic planning and, in addition, have committed to providing a large cohort of new faculty hires (including three Canada Research Chairs) with associated start-up funding, space (including the Biomedical Research Centre (BRC)), administrative support, and a priority allocation for a purpose-built building.

2019–2020 SNAPSHOT*

RESEARCH & TRANSLATION

$28 M+
AVERAGE ANNUAL FUNDING
SINCE INCEPTION

$3 M+
ANNUAL FUNDING
FROM THE PROVINCIAL
GOVERNMENT

$350 K+
ANNUAL FUNDING
FOR THREE VPRI
RESEARCH CLUSTERS

340+ Publications
IN THE TOP 10% JOURNALS
(57.2% OF PUBLICATIONS)

680+ Publications
AVERAGE OF 29/FACULTY
OVER FIVE YEARS

14,100+ Citations
TOTAL FROM FACULTY
PUBLICATIONS

2 VENTURES

PER YEAR IN BIOTECHNOLOGY
INCUBATOR LABORATORY SPACE

270+
RESEARCH GRANTS,
CONTRACTS & FELLOWSHIPS HELD

30+ Industry Partners
ENGAGED WITH
THE SCHOOL

GOVERNANCE

8 FACULTY LABS**

15+ ADMINISTRATIVE STAFF

5 CORE FACILITIES**

5-MEMBER LEADERSHIP TEAM

2,596M² FACILITY**

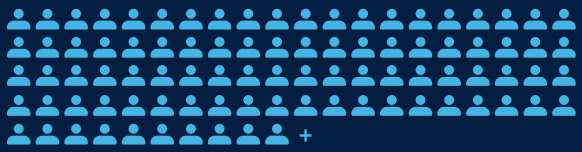
4-MEMBER EXTERNAL
ADVISORY COMMITTEE

*SBME Convergence for 2021 update
**Within the context of the BRC

UNDERGRADUATE

4-YEAR PROGRAM WITH OPTIONAL CO-OP TERMS

90+ UNDERGRADUATE STUDENTS



GENDER DISTRIBUTION

♂ 50% ♀ 50%

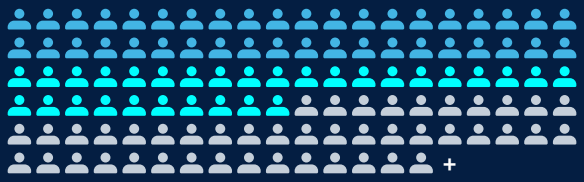
CANADIAN VS. INTERNATIONAL

70% 30%

GRADUATE

ROBUST CLINICAL & COMMERCIALIZATION ENGAGEMENT PROGRAMS

115+ GRADUATE STUDENTS



GENDER DISTRIBUTION

♂ 55% ♀ 45%

CANADIAN VS. INTERNATIONAL

60% 40%

FACULTY

30+

CORE & JOINT RESEARCH & TEACHING FACULTY[1]

26+

ASSOCIATE MEMBER FACULTY

4+

AFFILIATED & ADJUNCT FACULTY

3 UNIVERSITIES

3 HOSPITALS

3 FACULTIES[2]

15 DEPARTMENTS

[1] Data based on SBME core and joint faculty only

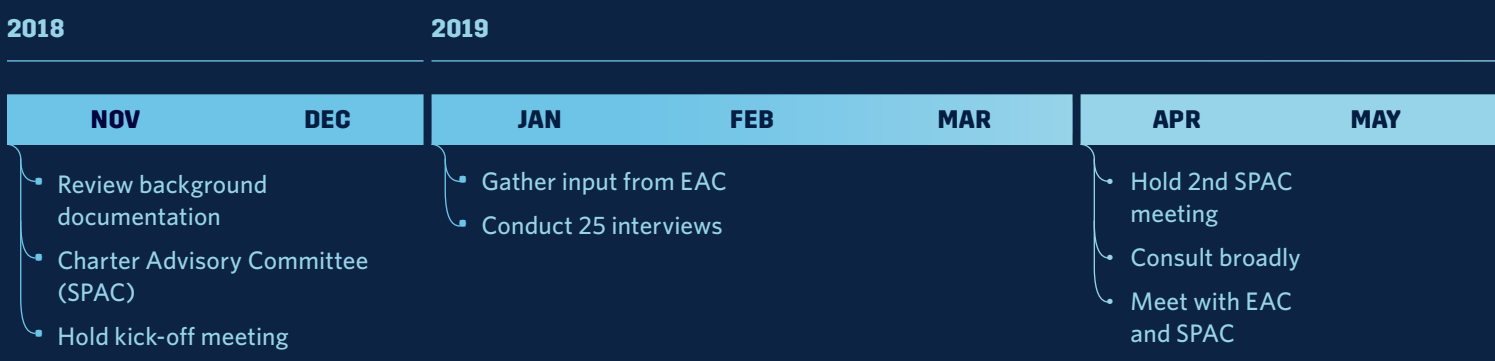
[2] APSC, FoM, FoS

3 PROCESS OVERVIEW

This strategic plan was developed following a rigorous and inclusive process (Figure 1) that built on the extensive business case for the viability of a SBME at UBC.

FIGURE 1

STRATEGIC PLANNING PROCESS



The formal process to develop this strategic plan was initiated with the chartering of a stakeholder representative Strategic Planning Advisory Committee[3] (SPAC), with a mandate to provide advice to the SBME's Director both on the process and content of the plan, and to guide alignment with UBC's strategic priorities[4] as well as those of our founding Faculties[5]. Input from SBME's External Advisory Committee (EAC)[6] together with 25 stakeholder interviews[7] informed the development of an initial framework which was reviewed by SPAC at an in-person meeting. After incorporating feedback from this in-person meeting, a revised document was presented to internal and external stakeholders over the course of 12 consultation meetings attended by industry and hospital leaders, faculty, students, and the leadership of FoM, APSC, and SBME. Consultation findings shaped the development of a draft strategic plan. In June 2019, meetings were held with the EAC and SPAC to review the draft strategic plan. In July, the SBME leadership team held a one-day off-site to finalize the strategic plan and develop an implementation plan. The plans were reviewed by SPAC at an in-person meeting and shared with the SBME faculty in fall 2019.

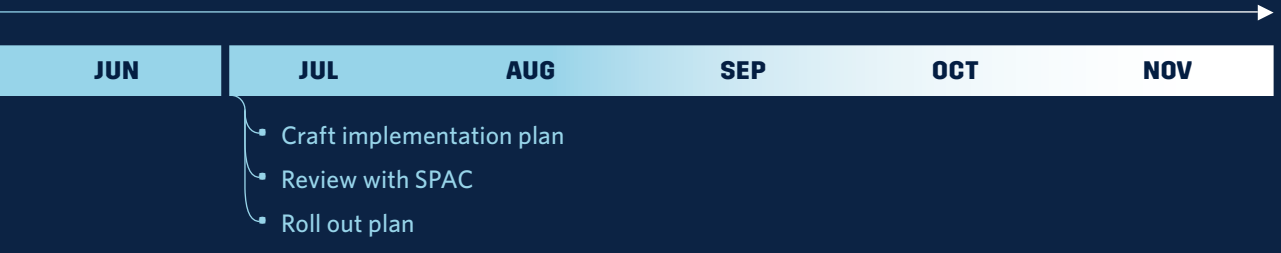
[3] See listing of SPAC members in Appendix

[4] strategicplan.ubc.ca

[5] FoM: stratplan.med.ubc.ca; APSC: strategicplan.apsc.ubc.ca

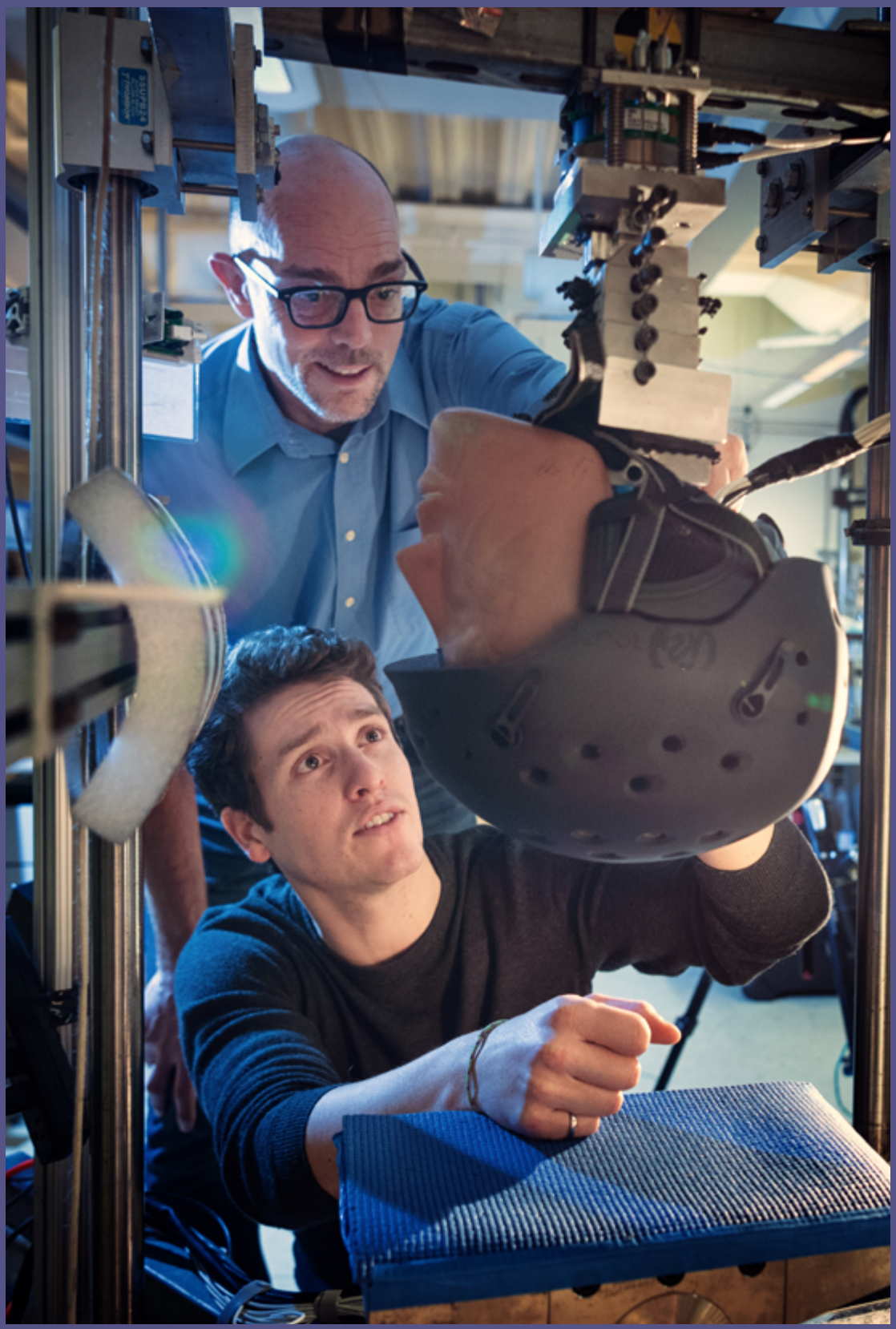
[6] See listing of EAC members in Appendix

[7] See listing of questions and issues in Appendix



4 STRATEGIC FRAMEWORK

The SBME is a hub for transformative education, innovation and research across patient health and healthcare. Our five-year goal is to be recognized as the top BME program in Canada, and among the top 20 internationally.



OUR VISION

A thriving ecosystem that transforms health and healthcare outcomes for all through unconstrained exploration at the convergence of engineering, medicine, and biology.

Over the next 10 years, the following achievements will demonstrate our progress in realizing this vision:

- SBME is a talent and resource magnet;
- SBME-trained biomedical engineers are in leadership roles in the academic, private, public, and non-profit sectors;
- SBME's innovations are transforming the Canadian healthcare delivery and biotechnology ecosystems, and being adopted increasingly on the world stage;
- SBME is an acknowledged leader in fundamental health-related discoveries; and
- Resources committed to the SBME yield significant well-recognized community, societal, and health returns.

OUR MISSION

To be Canada's hub for cutting-edge BME education, innovation and research that catalyzes technological development, collaboration, and societal impact

OUR VALUES

Five values underpin all activities, interactions, and decisions. They act as a compass as well as a lens through which to view the work of the SBME and all its members.

VISIONARY

We strive to look beyond traditional structures and organizing mechanisms and work across boundaries in engineering, medicine, and biology.

EXCELLENT

In pursuit of health as a fundamental human right, we strive to do exceptional, robust and meaningful work individually, collectively across the SBME, and in partnerships at local, national, or global levels.

INCLUSIVE

We are strong allies for diversity and inclusiveness in all aspects of the SBME, embracing different experiences and opinions in pursuit of universally accessible solutions.

COLLABORATIVE

We work together in a spirit of respect knowing that a collective coordinated effort always achieves far more than working alone. We bring unique value to all our partnerships and are a community umbrella for translational medicine.

CREATIVE

Our understanding and appreciation of the wonders of biology and engineering serve as our foundation. Our ingenuity and inventiveness lead us from there to transformative solutions.

OUR FIVE-YEAR STRATEGY

FIVE-YEAR GOAL

Our five-year goal is to be recognized as the top BME program in Canada and among the top 20 internationally. Following the innovative approaches in our research, education, and governance portfolios described below, while remaining open to opportunities that emerge along this path is how we will achieve these goals. The establishment of deep, mutually beneficial and trusting relationships with stakeholders, an entrepreneurial yet socially responsible culture and working environment, and ecosystem-enhancing structures, systems, and processes will provide a sustainable, scalable platform for success, as will the implementation of a monitoring and review process designed to retain agility and responsiveness.

The success measures listed here will drive our strategic framework (Figure 2) and guide the deployment of resources and the execution of priority actions. A strong decision making process will be critical, given the SBME is shifting from 'start up' mode to a more professionally managed and high growth period, where leadership will be faced with multiple strategic choices and opportunities on an ongoing basis.

EDUCATION

The SBME's approach to education is differentiated by its ability to offer both program breadth and depth to each student. Depth is achieved by a unified focus on the integration of biology, engineering design, and mathematics fundamentals delivered by gifted teachers who are committed to the use of new and effective pedagogical methodologies and tools. Breadth comes from the choices provided to each student to customize a learning journey designed for a specific biomedical engineering-enabled professional or career goal. We are committed to providing students with research, skill-building, and health impact-associated educational experiences at each stage of education from first-year undergraduates to post-doctoral fellows.

Education strategic priorities for the next five years:

1 Ensure that SBME's stated values are at the core of our curriculum and program design process;

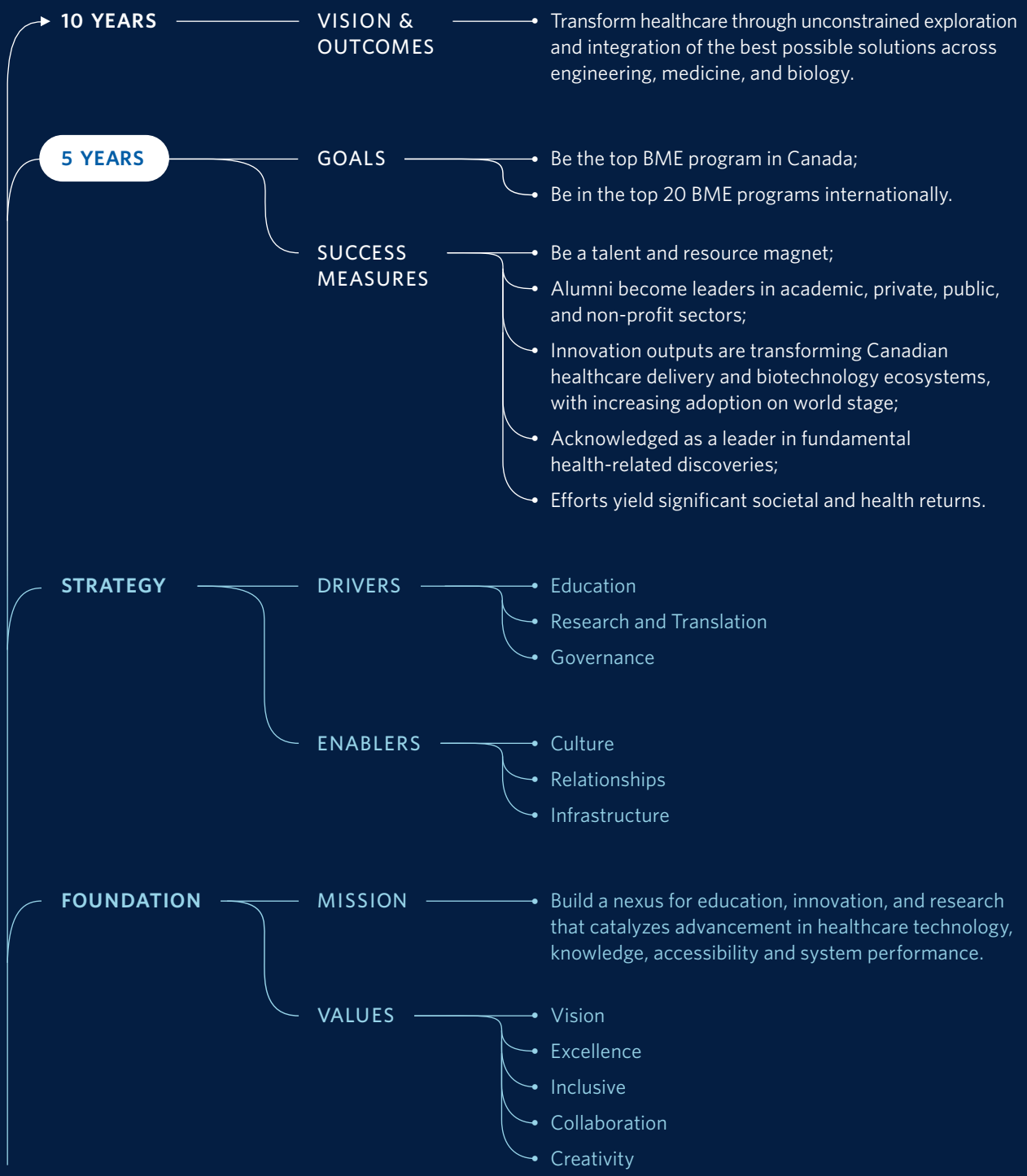
2 Attract the best and brightest students to our programs;

3 Strengthen and expand relationships with industry, community, and clinical partners to provide full and expansive education experiences; and

4 Foster pedagogical and programmatic innovation.

FIGURE 2

STRATEGIC FRAMEWORK FOR SBME PLAN



RESEARCH & TRANSLATION

Our approach to research and translation is rooted in a fundamental understanding of biology as an engineered system, and the use of engineering and other design-based approaches to solve significant health challenges. These efforts tackle problems across biological scales and focus on disease areas where UBC is recognized as an international leader—cancer, brain and mental health, heart and lung health, population health, and chronic diseases (such as diabetes). By fostering convergence, eliminating research barriers, being platform agnostic and technologically enabled, research undertaken by the SBME will be propelled by paradigm-shifting questions that have the potential to transform health outcomes. Recognizing that the breadth of biomedical engineering extends beyond the SBME, the School will act as an enabling nexus, catalyst, and advocate for a broad spectrum of researchers, partners, and stakeholders, and serve as a home for industry engagement and early stage biomedical technology incubation and development at UBC (Figure 3).

Research and Translation strategic priorities for the next five years are to:

1 Recruit and develop a strong cadre of faculty, student and staff research talent;

2 Foster and support an entrepreneurial culture of invention, incubation, interaction, and collaboration;

3 Enable student, faculty and staff access to world-class, priority-enabling research infrastructure;

4 Develop mutually beneficial stakeholder relationships locally, nationally, and internationally; and

5 Play a leadership role in strengthening the translational medicine research ecosystem at UBC, in BC, and across Canada.

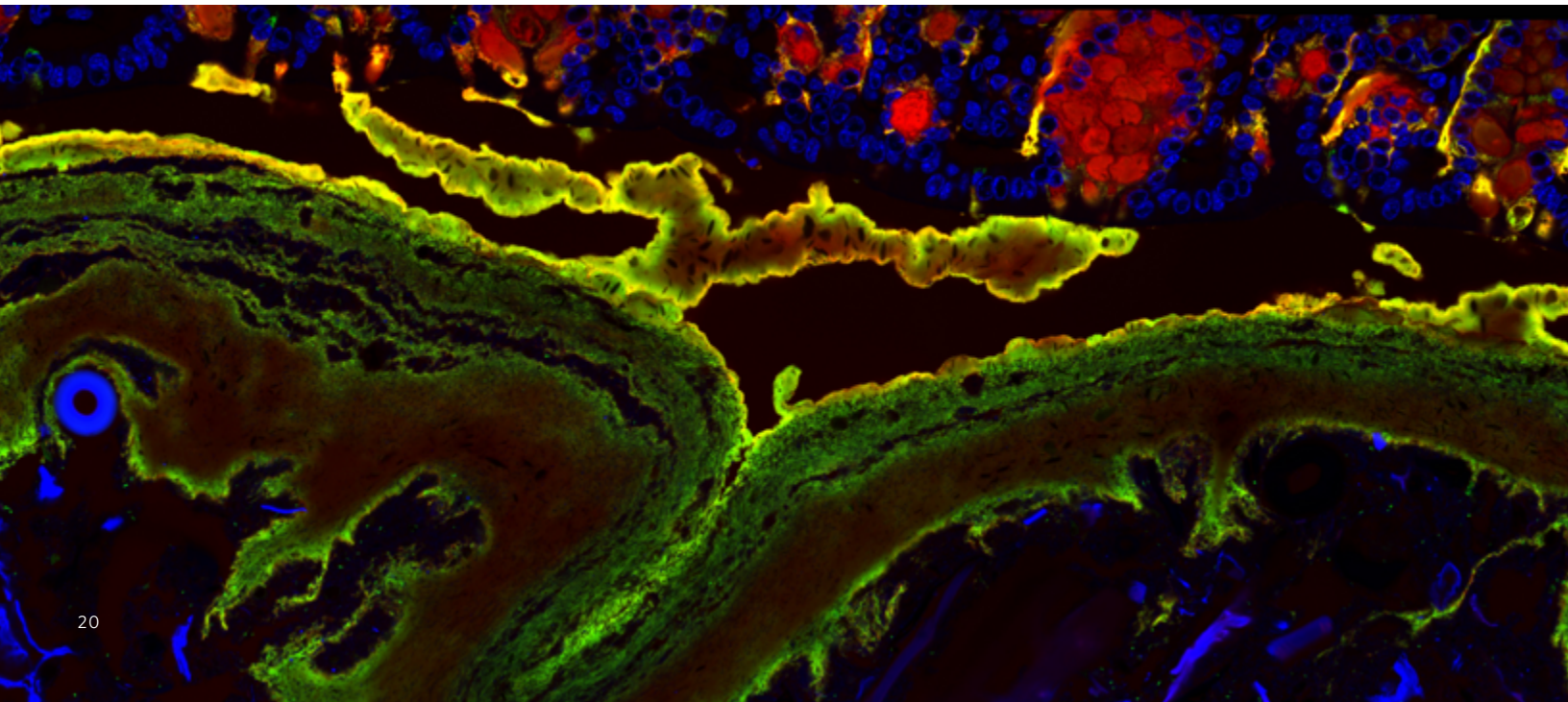
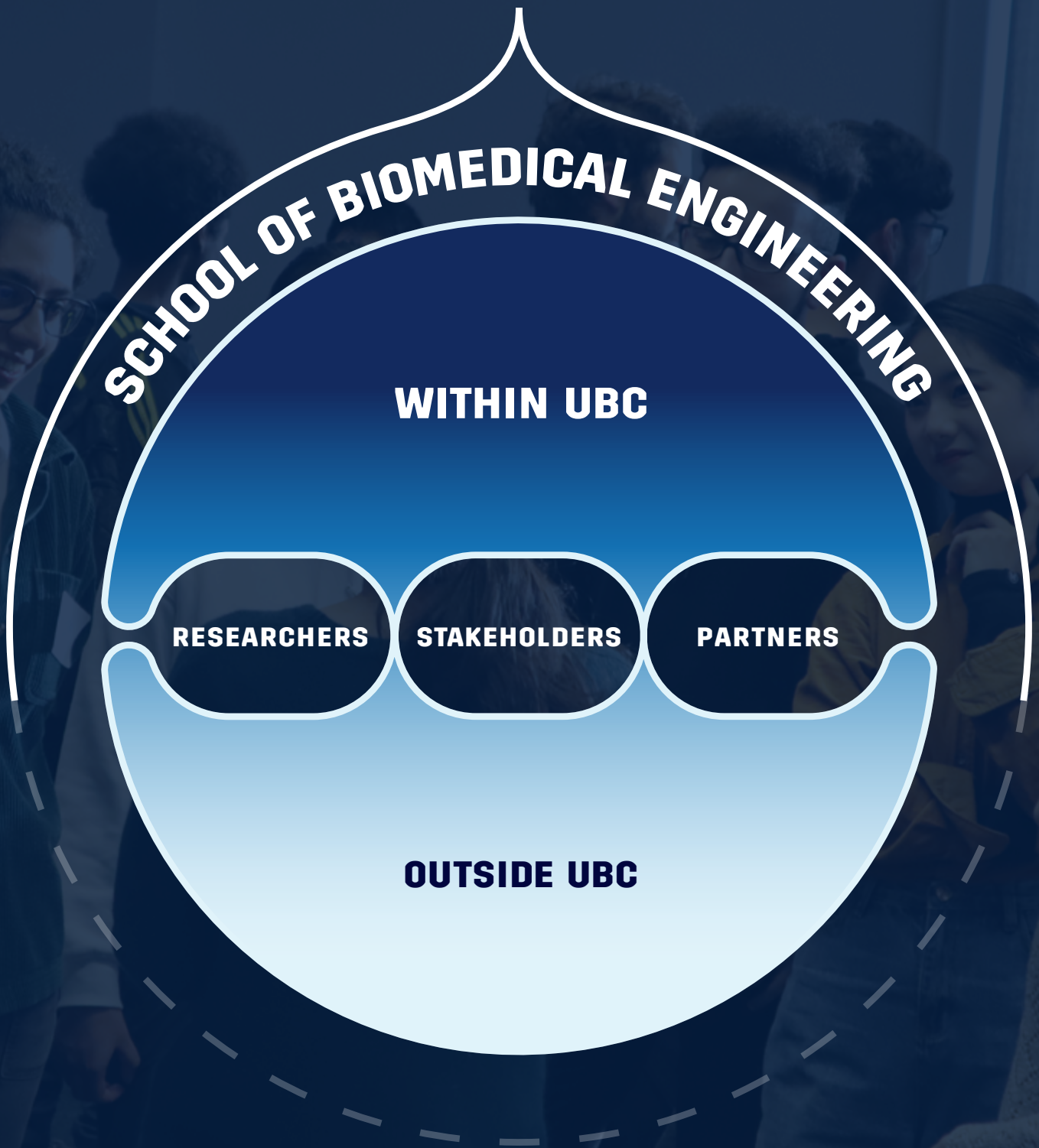


FIGURE 3

SBME IS THE COMMUNITY HOME FOR TRANSLATIONAL MEDICINE ON CAMPUS



GOVERNANCE

The SBME's approach to governance is based on its unique position as a convergent interdisciplinary unit sitting across two Faculties and several departments and organizations at UBC. The SBME honours the founding Faculties' structures and synergistic strengths within UBC, while also expanding beyond the academic environment to become a valuable member of the broader hospital and life sciences ecosystems. Forming relationships, communicating the SBME's strengths, and being diverse and inclusive are crucial inputs to success, as is the ability to be agile and responsive to emergent opportunities. Access to independent funding, starting with the capital for a new building, is a requirement for our success.

Governance strategic priorities for the next five years are to:

1 Build and deploy a robust set of management and governance processes, supported by both FoM and APSC, based on high accountability and transparency, that enable rapid, well-informed decision making;

2 Model and support equity, diversity and inclusion across the SBME, and leverage the resulting creativity, culture, and innovative environment to propel us forward;

3 Develop strategical, collaborative relationships and infrastructure to foster partnership and engagement internally and externally;

4 Grow a strong marketing, branding, and communication capacity that elevates the reputation of the SBME and UBC.

ATTAINING OUR GOALS

These priorities come together to deliver impact and value to the SBME's stakeholders. They are key drivers of our five-year goal to be the top BME School in Canada.

The SBME will measure its progress towards its goals in terms of the commitments to its key stakeholders outlined in the following table.

	SBME'S COMMITMENTS	OUTCOME MEASURES
STUDENTS	SBME prepares students for successful careers in a broad array of life science-related jobs in industry, academia, and beyond. By providing an boundless and unique education at the convergence of biology, medicine and engineering, integrating paradigms and models from multiple disciplines, and illuminating medical needs and opportunities in new ways, we are training the future's leaders.	• Graduate awards won (NSERC, CIHR, Vanier, UBC-wide awards, major foundation awards, Rhodes Scholarships, etc.) • Alumni success and contribution as measured by independent academic success, career placements, community impact, business innovation awards
CANADIANS	The discoveries made will be incubated, developed into health biotechnologies, and applied in inventive ways that make health and healthcare advancements accessible to all.	• Out-licenses secured, companies incubated and launched, and clinical trials initiated • Internal, local, national, and international recognition and awards to the SBME and its community
INDUSTRY & CLINICAL STAKEHOLDERS	Local and multi-national industrial and clinical collaborations will result in partnerships with world class interdisciplinary teams of researchers, supported by high-calibre trainees.	• Industry investment in BME research • Clinical deployment of BME discoveries and technologies • Establishment of meaningful government, industry and hospital partnerships
FACULTY & STAFF	SBME's culture is creative, supportive, inclusive and responsive to individual and collective needs, while providing opportunities for advancement.	• Faculty and staff awards • Career advancement • Faculty and staff retention • Broad engagement from all students, staff and faculty in SBME community endeavours
PHILANTHROPIC VISIONARIES	SBME provides an outstanding investment for those interested in supporting transformative health and interdisciplinary educational impacts.	• Increase funding for new strategic initiatives and program infrastructure • Expansion of our donor network and giving programs to allow for broad participation • Increase our list of high-profile advocates

5 MOVING TO ACTION

The strategic plan will be delivered through the activities and achievements of the portfolio areas of the SBME. This section provides a brief overview of each of these portfolios together with the key actions to be taken in the short and longer term.

UNDERGRADUATE EDUCATION

In September 2018, the new undergraduate program in BME, with funding from the Ministry of Advanced Education, Skills and Training, was launched with the registration of over 60 students. By the 2020–2021 academic year, registration is expected to rise to more than 100 incoming students annually, based on budget modeling and UBC benchmarks of undergraduate engineering cohorts being composed of 20-30% international students. This represents a significant challenge and opportunity, given that the curriculum is still under development, faculty recruitment and appointments are still underway, and BME-allocated educational space is limited.

Engineering students at UBC have a common (generally) first year, where foundational courses are delivered in partnership with the FoS and first exposure to engineering occurs through two specialized 1st year engineering courses (APSC 100 and 101) that are designed and delivered by instructional experts in APSC. Students interested in BME have the opportunity to experience introductory BME content including basic background, context, laboratory, and problem-solving experience through the introduction of two BME-specific first year courses (BMEG 101 and 102). In second year, the program is designed to have unique BME courses and a coherent presentation of biology, its engineering and mathematical analysis, its synthesis with engineering design approaches, and its utilization and manipulation in the solution of clinically important biomedical problems. In third year, students have four specialized streams to choose from: Biomechanics & Biomaterials, Cellular Bioengineering, Biomedical Systems & Signals, and Biomedical Informatics.

To guide decision making over the next five years, in support of the strategic priorities, the following six objectives have been established for the undergraduate program:

1 RECRUIT STRONG & DIVERSE STUDENTS

The intent is to grow the quality and diversity of the student cohort (including the increased participation of indigenous and other underrepresented students) and become the program of choice for engineering undergraduates at UBC as well as a major attraction for top high school students in Canada and internationally. To this end, the SBME will:

ACTIVITIES

- Increase the quality and reputation of the program by providing deep research experiences, continued development of the undergraduate program, and the adoption of proven, innovative pedagogy;
- Lead the advertising and promotion of the SBME in collaboration with UBC and APSC's recruiting activities;
- Establish a high-impact social network and media campaign to promote the undergraduate program;
- Conduct targeted promotion and relationship building activities with local guidance councillors and teachers of indigenous students and other underrepresented groups; and
- Provide instructors with education on unconscious bias, privilege, and more so that they build culturally safe and accessible environments for all prospective students.

2023 DELIVERABLES

- More than 25% of first year UBC engineering students apply to the BME program
- Identification and removal of barriers to participation for all underrepresented groups in tandem with UBC's overarching EDI goals and metrics;
- BME has the highest ratio of entrance award students in APSC.

2 EVOLVE ACCREDITED PROGRAM AROUND A STRONG BME CORE

In Years 3 and 4 of implementing the undergraduate program the emphasis will be on the strengthening integration of math, biology, and engineering content to ensure the curriculum is coherent, consistent, and that gaps are bridged. Opportunities will be cultivated to provide students with research experiences, including a well-articulated capstone project and research thesis offering in their fourth year. The program curriculum, including course content, training opportunities and outcomes, will be mapped to accreditation requirements, while allowing for student creativity in using their learning in applied situations and flexibility to customize their experience with course options in multiple streams. Over the longer term, and based on broad consultation, it is anticipated that the SBME's approach to BME specialization (streaming) will be modified. This requires that the boundaries between the streams be kept as fluid as possible, and that prerequisites and timetables are designed to allow course options. Post-accreditation, the SBME aims to enable individualized specializations and course selection within a strong core curriculum to the greatest extent possible. To achieve this the SBME will:

ACTIVITIES

- Engage faculty regularly (curriculum retreats, faculty meetings, School-wide retreats) to evolve the curriculum continuously and strengthen the core approach and program coherence;
- Establish educational excellence, research experience, and design methodology-based programs as core elements; and
- Establish a strong relationship with accreditation bodies and peer programs in Canada to develop a coherent plan for BME program evolution.

2023 DELIVERABLES

- Program is Accredited by 2021;
- SBME's graduates are enthusiastic ambassadors, and modeling its effectiveness as leaders in academia, industry and medicine;
- At least one faculty member representing each of the three core research themes and one representing each of the four streams is a member of the undergraduate curriculum committee; and
- Over 80% of faculty are deeply involved in one or more educational initiatives.

3 FOSTER PEDAGOGICAL INNOVATION

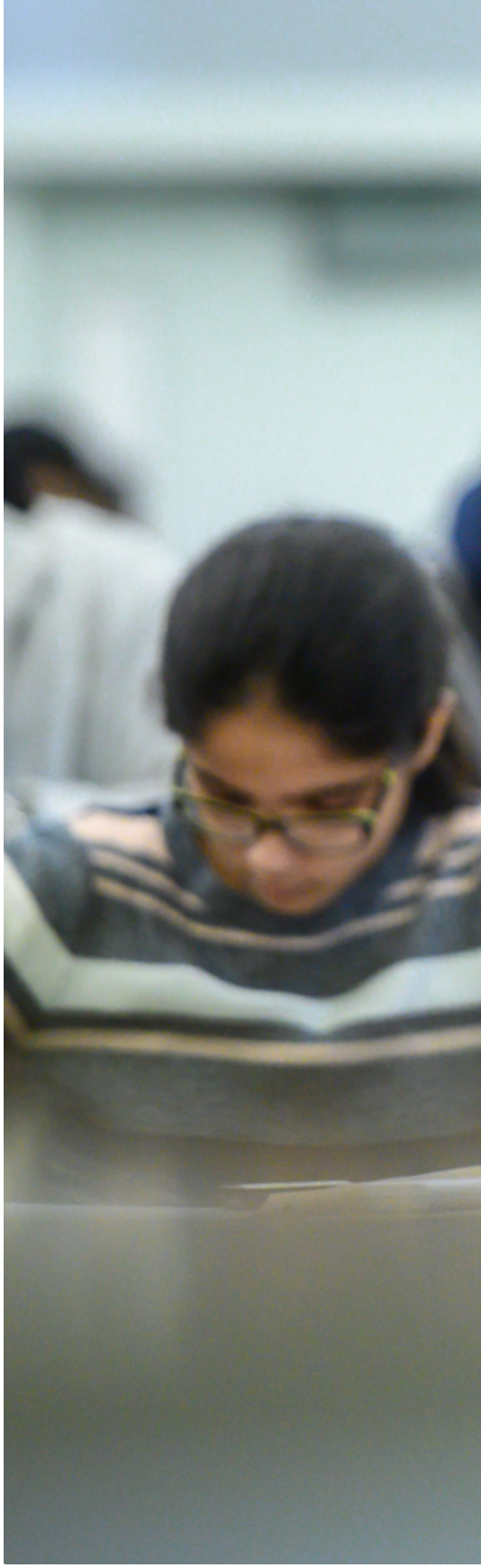
Teaching faculty will be hired and supported as pedagogical leaders who play an increasingly autonomous role in leading the SBME's educational innovation programs for the benefit of all. The SBME will adopt leading teaching modalities such as flipped classrooms, off-site learning (community engagement), and other innovative strategies. These strategies will expose all students in the program to research and experiential learning through a range of mechanisms including: directed studies, summer programs/co-op placements, and the capstone project. To achieve this, the SBME will pursue the activities and deliverables in the following table:

ACTIVITIES

- Foster the application of innovative pedagogy by the faculty by encouraging participation in instructional courses at the UBC Centre for Teaching, Learning and Technology, and by hosting best practices teaching skills workshops for faculty members;
- Support teaching faculty efforts to foster culturally safe learning environments;
- Provide students with experiences that link their BME fundamentals to clinical and community care or industrial implementation; and
- Provide support (e.g. funding, resources, infrastructure) to teaching faculty to develop their pedagogical research programs.

2023 DELIVERABLES

- At least one teaching faculty in senior leadership role in the education portfolio;
- Create learning environments in which all students feel safe to engage and learn at their natural best;
- Students report innovative methods being used in all classes in course reviews;
- All SBME classes use one or more innovative pedagogical techniques (flipped classroom, journal clubs etc.); and
- Clinicians and industry members are regularly engaged in student programs.



4 STRENGTHEN EDUCATION OPPORTUNITIES OUTSIDE OF THE CLASSROOM

The undergraduate program aims to provide all students with access to industrial co-op opportunities, biomedical research, and clinical exposure. This will require expansion of the co-op program with stronger and more diverse linkages to the biomedical industry with engineering design competence and placements at hospitals, community care centres, and in research laboratories and companies in BC and more broadly. In addition, applied clinical learning projects and research training experiences need to be developed for and provided to our undergraduate students. To achieve this, the SBME will:

ACTIVITIES

- Hire a dedicated partnerships staff member;
- Work closely with APSC co-op office;
- Continuously scout for new co-op and design projects with industry, clinical and research partners in Vancouver;
- Build an international network for co-op placements; and
- Communicate the skills and attributes of the students in the BME program to industry partners across the life-sciences ecosystem.

2023 DELIVERABLES

- 50% increase in co-op and employment opportunities for SBME students with prominent industrial, academic, and start-up organizations in the life sciences and related industries (locally, nationally, and internationally);
- Annually increase co-op postings in SBME faculty research labs by two-fold;
- All undergrad students attain research experience via co-op and other means or do a research thesis project in their fourth year;
- Undergraduate student exchanges with Canadian and international institutions are available; and
- Undergraduate research and industrial placement options are in place for students' capstone design project in fourth year.

5 GROW AN INCLUSIVE, VIBRANT, & ENGAGED STUDENT COMMUNITY

While the undergraduate program is still in the formative stage, the SBME will facilitate open and inclusive student engagement in the design of the curriculum and co-curricular activities as well as in launching student clubs and grass-roots initiatives aligned with the SBME's mission and values. In addition, student access to information is critical to gaining widespread student input on the multiple options being developed in course and specialization choices. To this end, the SBME will:

ACTIVITIES

- Define the attributes that are conducive to success in the SBME graduate program to better inform course and co-op choices;
- Create narratives and case studies that provide insight into different BME career options and paths;
- Ensure the co-op activities and programs available to students mirror their interests, backgrounds, and experiences; and
- Continue to foster the community by empowering and expanding the SBME student club, student teams, and committee participation
- Create integration opportunities for undergraduate students in faculty research groups as co-op/work-learn, etc.

2023 DELIVERABLES

- Student experience and culture within SBME are consistently rated as excellent by all current students and alumni;
- 90%+ SBME undergraduate participation in all student and social initiatives;
- Active student profile series that recruits passionate graduates to share their stories (at least ten stories per year); and
- SBME Alumni are active participants in career pathing workshops, conferences, seminars, etc.

6 ADVOCATE FOR THE ACCREDITATION OF ALL UNDERGRADUATE BME PROGRAMS IN CANADA

Current accreditation standards may not reflect the evolution of national and international BME curricula to include quantitative biology, systems physiology, molecular and cellular engineering, and systems biology. To advocate for accreditation standards that align with best practices, the SBME will:

ACTIVITIES

- Work with UBC-based members of the Canadian Engineering Accreditation Board (CEAB) to identify appropriate individuals to contact and lobby with respect to BME industry and matching educational priorities;
- Lead discussions around program development and accreditation with the councils of other Canadian BME schools/departments; and
- Work with SBME faculty to conduct peer-reviewed research on core BME content, best practices in instruction of this content, and appropriate metrics to evaluate content. This research will support the lobbying efforts at CEAB and with other Canadian universities.

2023 DELIVERABLES

- Ensure that BME-specific evaluation criteria at CEAB is properly representative of the quantitative biology, physiology, clinical implementation, and other hallmarks of modern BME programs; and
- Formation of a Canada-wide BME Heads Council that overees standardization and regulation of BME programming and pedagogy.

PRIORITY ACTIONS

In summary, the Undergraduate Program will undertake the following actions:

NEXT 36 MONTHS

2019 2020 2021 2022

- Finalize and implement curriculum design to achieve accreditation.
- Determine approach to specialization.
- Strengthen research exposure, industry engagement and co-op options for students.
- Recruit a diverse and academically strong student body.

LONGER TERM

2023+

- Develop a strong and inclusive student culture.
- Work with CEAB and other Canadian BME programs to shift accreditation to reflect best practices in BME education and practice.

GRADUATE EDUCATION

UBC has a rich history of graduate education in BME starting in 1970, with the establishment of an MEng program in Clinical Engineering. In 2006, a UBC Biomedical Engineering Program, closely aligned with the Electrical & Computer Engineering and Mechanical Engineering departments, was launched to focus on graduate student education, research, and development, specifically as related to medical equipment, biomedical devices, and diagnostic tools, as well as injury prevention and rehabilitation. In 2012, the Engineers in Scrubs (EiS) program, funded by NSERC's Collaborative Research and Training Experience (CREATE), was created to expose biomedical engineers to design problems in the clinical environment with the goal of fostering innovation in medical technologies.

The SBME's graduate program recognizes that the field of BME is rapidly growing and evolving. New medical discoveries, innovations, and technologies appear at an accelerating pace. The program offers MEng, MASc, and PhD degrees designed to give graduate students broad exposure to subject matter aligned with their research interests, and a solid foundation in BME through formal coursework and development of research leadership skills. Graduate students are selected for admission based on demonstrated excellence, their working knowledge in both the life and applied sciences (in addition to depth in their specific research areas), and their fit with the research projects of the thesis supervisors. In 2018, a successful pilot rotation program for PhD students was launched. This program serves several key goals by providing access to the best students for new faculty members, attracting the best students from the US and other jurisdictions, and providing all students with a broader understanding of BME activities across the SBME. The curriculum allows students to gain more extensive knowledge of different fields by taking courses from departments across APSC, FoM, and FoS, in addition to our core BME flagship courses. To this end, in 2019 a mandatory flagship modular course was launched for all BME graduate students covering cutting edge topics across biological scales, taught by an integrated team of engineering and biomedical faculty. Recently, funding from the Praxis Spinal Cord Institute (formerly the Rick Hansen Institute) from 2018 to 2021 has enabled more MEng and MASc projects. These serve to raise students' clinical exposure, provide more educational opportunities on the venture creation process (in partnership with the Sauder School of Business), and increase maker-space resources.

To guide decision making over the next five years, in support of the strategic priorities, the following three objectives have been established:

1 INCREASE TOP APPLICANTS & EXPAND ENROLMENT

The intent is to increase the diversity of the student body, to draw excellent students from new countries and new institutions, as well as to shift the mix of students, expanding the research-oriented PhD cohort both in number and percentage. To achieve this the SBME will:

ACTIVITIES

- Implement strategies to increase the diversity of the pool of outstanding applicants by identifying and removing barriers;
- Provide opportunities to increase the visibility of role models at different career stages, and with different lived experiences;
- Provide additional research opportunities (e.g., research projects/ internships/directed studies in summer) for undergraduate students to gain additional experience, setting them up for direct entry to the PhD program;
- Develop a sponsored partnership program to provide more research experience opportunities to undergrads from other universities (including students supported by Undergraduate Student Research Awards);
- Develop international exchange programs with other academic institutions; and
- Communicate the strengths and merits of the SBME graduate program and its ecosystem to a growing global audience.

2023 DELIVERABLES

- 20% increase in top-ranked international applicants joining our graduate program;
- Two-fold increase in top-ranked domestic applicants;
- 20% of students receive external entrance awards;
- PhD students are the majority of graduate students;
- Half of the PhD students are direct entry from a bachelor's degree;
- Students are supervised at equal numbers by jointly appointed members of the FoM and APSC;
- New SBME faculty have success recruiting the award-bearing students, and are regular users of our rotation program; and
- Broaden the pool of application and acceptance to the program by removing all social and economic barriers to participation.

2 STRENGTHEN THE ACADEMIC EXPERIENCE

BME graduate education is becoming increasingly competitive, including in the Asia Pacific region. Hence, in the spirit of continuous improvement, three key areas for change have been identified covering changes to the curriculum, expanding the rotation program, and finally, preparing students for careers that may not be in an academic environment. The intent is to provide students with more exposure to the clinical environment and working with clinical partners. One opportunity rests with aligning the applied components of the EiS program more closely with the vision and mission of the SBME, in preparation for the introduction of additional flagship programs possibly through success with other CREATE opportunities. To achieve this, the SBME will pursue the activities and deliverables in the following table.

ACTIVITIES

- Expand the graduate course offering by introducing a number of changes including: smaller, more modular courses that address critical areas of emerging knowledge, showcasing the expertise of new faculty, and expanding partnerships to provide opportunities for students to develop industry-ready skills;
- Expand the rotation program through a combination of determining funding mechanisms that encourage faculty participation, promoting widely to students and making necessary changes to internal systems and processes;
- Prepare pre-doctoral and postdoctoral trainees for alternative career paths, leveraging existing materials available across UBC and supplementing as necessary to fill unique needs related to specific BME career options;
- Strengthen the academic experience by creating safe, inclusive learning environments, and enhance retention of underrepresented groups, leading to more representation;
- Expand the clinical and industry partner network, involving a larger and broader group of potential clinical and industry partners in graduate student related activities;
- Evolve and expand the EiS program, completing the program enhancements funded by the Praxis Spinal Cord Institute; and
- Examine how clinical and industry partnerships can be strengthened for other SBME activities (e.g., capstone, MEng internship co-funded awards).

2023 DELIVERABLES

- Increased number of students accepting rotation program offers (25% of all students);
- All industry-targeting graduate students are selected by one of their top three preferred companies for jobs;
- Trainees continuing in academia are being given research or teaching opportunities at top 50 internationally ranked BME schools;
- Five new specialized BME-coded graduate courses run each year;
- 95%+ satisfaction and employability ratings from industry on the skills and work of graduate students;
- 15% increase in BME-appointed joint faculty with clinical roles involved in graduate teaching and EiS;
- Commensurate (15%) increase in BME graduate students performing some of their research in a hospital, or hospital research institute setting; and
- Develop a graduate student-oriented fund program for activities and awards.

3 FOSTER TRAINEE ENGAGEMENT WITH SBME-WIDE ACTIVITIES

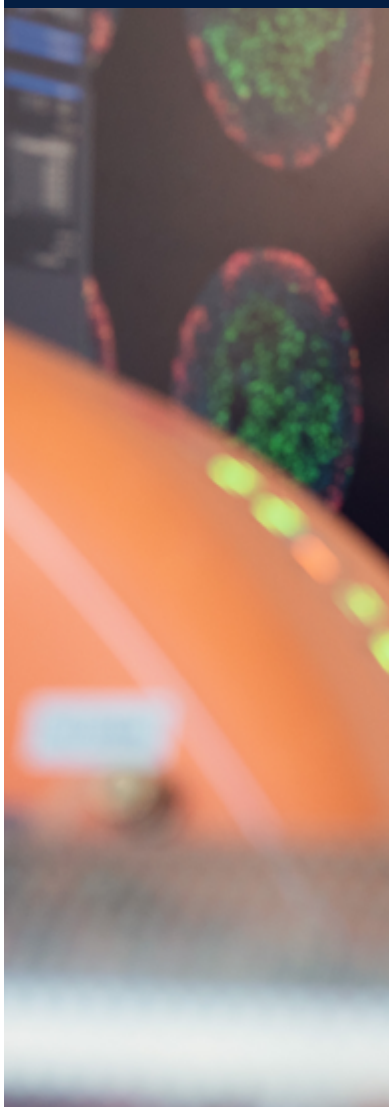
The SBME aims to revolutionize graduate education by creating an environment where talented individuals feel unconstrained, think differently, and are inspired by each other to create and learn. Developing a program with the minimum boundary conditions will maximize flexibility and opportunities for inventive outcomes. To achieve this the SBME will:

ACTIVITIES

- Offer trainees the opportunity to develop a seminar series designed to strengthen the dialogue among and across students and faculty, provide a forum for trainees to present their work, receive constructive feedback, and learn how to build a professional network;
- Launch topic-specific BME discussion groups to spark bottom-up collaborations between labs
- Foster a strong social media presence where students promote each other's successes and research activities;
- Launch multiple communications streams, story series and social media channels to foster student recruitment and participation;
- Build engagement activities whenever there are opportunities to bring the students together around value-add activities; and
- Support student advocacy in entrepreneurial, social impact, or equity and diversity initiatives.

2023 DELIVERABLES

- At least three graduate student led events per year;
- Establishment of multiple graduate student profile series and a student seminar series, where graduate students and their work are the focus;
- Triple online student audience and engagement in the program; and
- Increase trainee-initiated multi-lab research collaborations, and publications by 25%.



PRIORITY ACTIONS

In summary, the Graduate Program will undertake the following actions:

NEXT 36 MONTHS

2019 2020 2021 2022

- Expand available research experiences for UBC and other undergraduates to develop more students ready for direct entrance into the PhD stream.
- Expand the rotation program.
- Create mechanisms that enhance trainee engagement with School-wide activities, including seminar series.
- Expand Engineers in Scrubs program and other mechanisms to provide students with increased clinical exposure.

LONGER TERM

2023+

- Evolve to a more flexible curriculum with smaller, more modular courses.
- Provide supports to prepare students for alternative career paths.
- Develop a graduate student oriented fund and program to support awards and activities.

RESEARCH & TRANSLATION

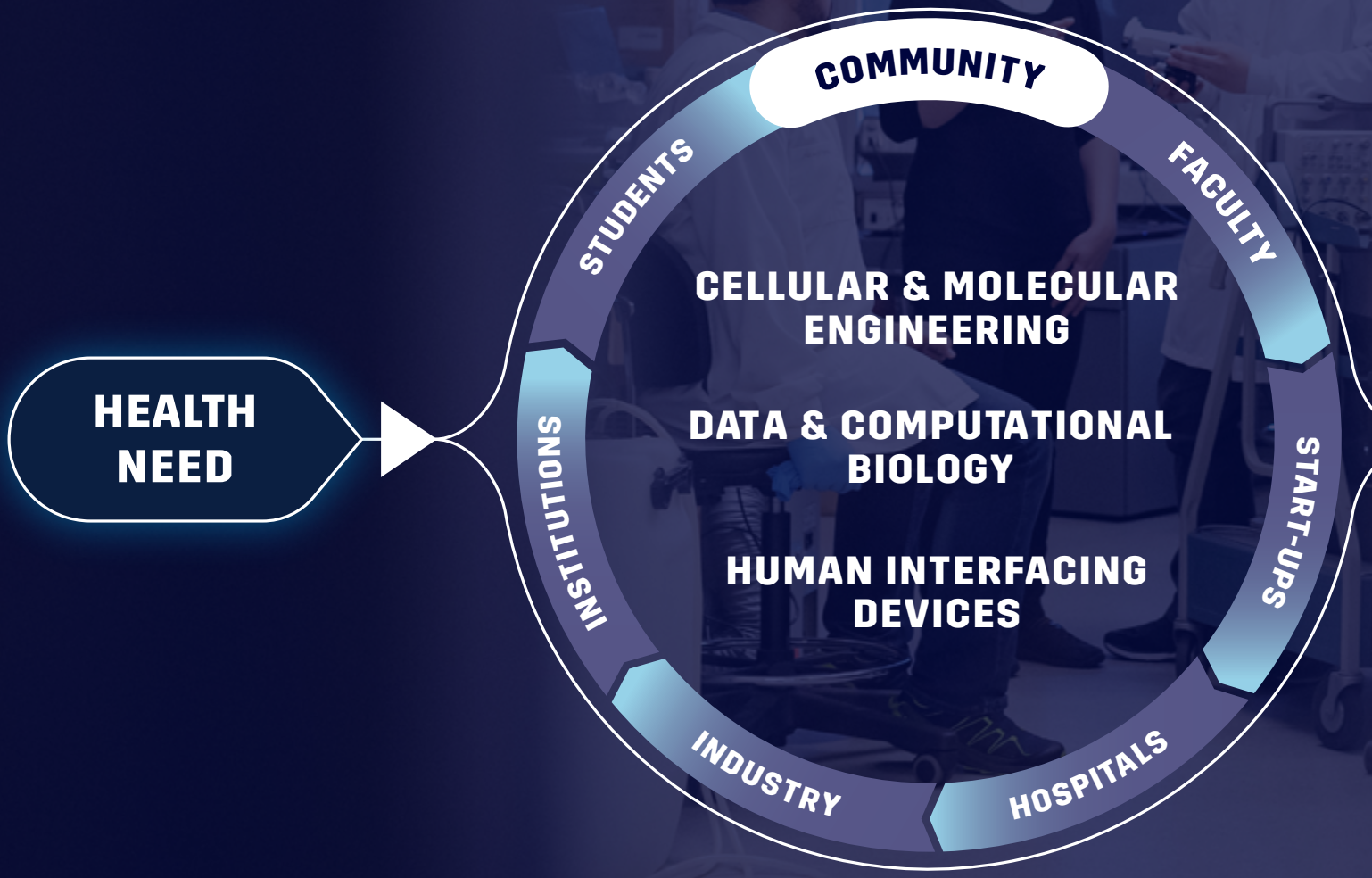
The time has come for BME to articulate a new vision for healthcare—a future where engineering design and innovation, as currently applied to materials and devices, is extended to biological systems (Figure 4). This will require leadership in the discovery of new fundamental design principles underlying biological processes, improved techniques for measuring and predicting the behaviour of these systems across biological scales, and a blurring of the lines between artificial and biological devices.

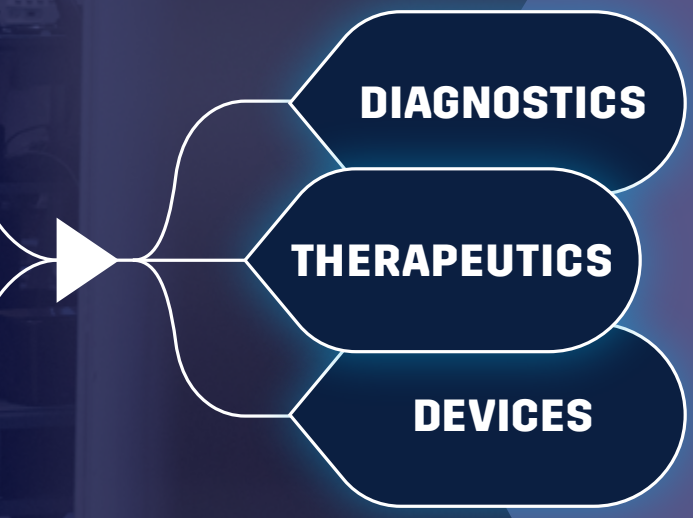
Evolution resulted in complex but very robust design solutions to enable life. SBME researchers strive to understand the complexity of existing biology to the point that they will be able to predict its behaviour in response to specific inputs. They will use this knowledge to engineer new solutions to health problems by replacing damaged or lost biological function, or designing new biological capabilities. This understand-predict-engineer cycle will be deployed across biological scales, from molecular to whole organism problems, with the understanding that the power of engineering and controlling biological systems comes with responsibility. Respectful of this tenet, the SBME will work with partners to integrate societal, legal, and ethical discussions into all activities and strive to serve as a source of expert advice and reflection on health biotechnologies.

Three broad themes (Cellular and Molecular Engineering; Imaging, Computational and Data-Systems Biology; and Human Interfacing Devices) have been identified, grounded in existing strengths at UBC as well as the multiple achievements of SBME faculty to date. These themes are connected to each other by sharing a common focus on the integrated biological processes that underlie normal physiology and injury or disease. Inflammation, trauma, degeneration, and metabolism are non-exhaustive examples, as they play key roles in modulating many of the health challenges afflicting society today. These processes, when altered, can affect human health in a large range of diseases. To provide guidance on hiring priorities, platform and research investments and partner formation, the SBME will focus on these biological processes as they relate to the strengths and priorities of the FoM, specifically in cancer, brain health, heart and lung, population health, and chronic diseases. Major transformative questions will be tackled by actively seeding internal interdisciplinary collaborations and by supporting BME leadership of national and international initiatives. Furthermore, by working closely with clinical partners, the SBME will continue to move innovation and invention rapidly from the lab into the clinic. A key asset in this effort is the SBME's student- and partner-led new venture incubation facility, which provides health biotechnology companies with space and support otherwise unavailable in Vancouver.

FIGURE 4

SBME RESEARCH & TRANSLATION IS TRANSFORMING HEALTH IMPACTS





HEALTH IMPACTS

RESEARCH THEMES

The SBME's research will contribute to areas with the broadest health impacts: from devices that modify organismal behaviours, to sensors that read biological changes while they are still reversible, to machine-brain interfaces that support and slow or reverse declining cognition. This research competency is organized into three broad themes.

THEME 1: CELLULAR & MOLECULAR ENGINEERING

This theme is focused on understanding how biological complexity results in complex emergent properties. This knowledge can be used to reveal links between biological processes across organs and to human pathology, establish design principles used to engineer new properties within molecules, cells or systems (synthetic biology), or to restore functions lost to pathologies.

THEME 2: IMAGING, COMPUTATIONAL & DATA-SYSTEMS BIOLOGY

This theme aims to accelerate data gathering and predictive power across biological scale and spatial dynamics and relate these to developmental progression in normal and diseased tissue function. Key areas of focus will include time-resolved dynamical modeling; the deployment of artificial intelligence (AI) to access, manage, and holistically interpret data gathered from multi-modal, multi-scale systems; and new data-driven strategies to individualize heath decline prevention or treatment. Integration of spatially coded molecular and cellular information into diagnostics and devices will enable the real-time interpretation of biological data collected through wearable and implantable sensors, and a deeper understanding of how the dynamics of individual molecular measurements connects to emergent biological functions.

THEME 3: HUMAN INTERFACING DEVICES

This theme aims to meld the electro-mechanical and biological worlds through biocompatible interfacing technologies. The barrier between technology and biology is omnipresent, whether in medical implants, prosthetics, biomaterials, drug delivery systems, novel safety systems or mobility devices. Human Interfacing Devices will use novel materials, sensors, and actuators to develop increasingly seamless transitions between humans and the next generation of devices in prevention-focused, restorative, and assistive healthcare.

These research themes build on a rich history of success since faculty associated with the BME program, as leaders in their fields, have produced innovations that have led to numerous companies and technology licencing outcomes. Moving forward, collaboration between BME faculty working in these thematic areas will be supported and grown through a variety of mechanisms designed to bring people together, such as: new collaborative seed grants, graduate and post-doctoral awards, training programs (such as the NSERC CREATE programs), university-recognized research clusters, and seamless access to core research platforms and facilities.

1 FOSTER AN IMPACT-FOCUSED ENVIRONMENT OF EMERGENCE & COLLABORATION

As the School expands through new hires, it is important that incoming faculty find a cultural environment that promotes pride in belonging and leads to enhanced interactions among all members of the SBME. To this end, regular interactions between basic researchers, clinicians, engineers, and trainees will be fostered and valued. Behaviour that enables collaborative and creative problem solving, going beyond and outside of institutional silos and boundaries will be rewarded, and mechanisms for sharing ideas and opportunities will continue to be created. To achieve this the SBME will:

ACTIVITIES

- Initiate internal funding programs supporting postdoctoral fellows and collaborations between cross-disciplinary faculty;
- Host annual faculty retreats to develop a collaborative research culture;
- Implement an annual "Distinguished Speaker" seminar series that features national and international leaders;
- Schedule regular school-level trainee development opportunities around new technologies and cutting edge research methods; and
- Introduce trainee-directed SBME awards aligned with strategic priorities.

2023 DELIVERABLES

- 50% increased research output and impact over 2019 levels: number of publications, impact factor of publications, funding received;
- Increased level of activity over time of internally seeded collaborations involving co-supervision by a BME member and a clinician;
- Regular research lab exchanges for graduate students to learn new technologies;
- Strong (>80%) student attendance and participation in SBME research seminars, faculty visits;
- Integration of faculty performance reviews with awards; and
- Securing three faculty awards per year.

2 EXPAND PARTNERSHIPS WITHIN UBC & BEYOND

The intent is to position the SBME as the hub through which connections are created both within UBC as well as across the local ecosystem, nationally, and internationally. To achieve this the SBME will:

ACTIVITIES

- Coordinate and synergize activities with other UBC Faculties (Science), Departments and Schools;
- Expand partnerships with non-academic organizations within UBC;
- Develop and coordinate research partnerships with other institutions, focusing on BC, Cascadia and the Pacific Rim;
- Develop a portfolio of mutually beneficial industry relationships;
- Strengthen existing linkages with the clinical community in alignment with the FoM's strengths; and
- Participate in heath technology advancement, regulatory, and reimbursement forums to provide expert input.

2023 DELIVERABLES

- Improved quality of industry relationships as measured by a minimum of five industry-partnered research grants, 20% of SBME students taking part in a work experience in a local industry, and 20% of faculty members involved in funded interactions with industry;
- Regular (twice per year) engagement of faculty with policy makers to provide input and counsel on health system related issues;
- SBME trainees and faculty involved in commercialization activities, spin-offs, and start-ups;
- Sister organizations (Schools and Departments) at UBC have entered into synergistic partnerships with the SBME;
- SBME is a key participant in at least one new UBC cluster of excellence per year;
- Five licences from BME-developed discoveries and technologies to local and international commercial partners; and
- Two BME discoveries and technologies implemented in community heath scenarios.

3 CREATE INFRASTRUCTURE TO DELIVER WORLD CLASS INNOVATION & TRANSLATION

In biomedical research and technology development, an effective mechanism to attract research funding and bring different communities of researchers together are common infrastructure cores that enable cutting edge research and translation by allowing access to the latest technologies. These cores also act as social hubs, efficiently connecting researchers sharing common interests and leading to novel collaborations. To achieve this the SBME will:

ACTIVITIES

- Identify, prioritize and develop a plan to meet the infrastructure needs of the SBME community;
- Play a leadership role in a multi-institutional effort to bring clinical translation facilities to BC;
- Evaluate, adopt, and support a lab and data management system for the SBME;
- Use the opportunity provided by the new building to establish joint working spaces in which biomedical engineering approaches can be tested in human volunteers;
- Promote SBME incubator hub as a key asset for health biotechnology translation at UBC; and
- Connect with the leadership of the Life Sciences Institute to align efforts towards the creation of sustainable infrastructure cores.

2023 DELIVERABLES

- Identification and establishment of core facilities unique to BME and cooperation with those where access is required via partnerships;
- Process for enabling access and renewal of core research facilities;
- Plan for computing and IT support to BME faculty;
- First-in-class data management, electronic-lab-notebook and sharing capabilities for BME faculty;
- Plan for support and renewal of animal facilities needed by BME faculty; and
- SBME biotechnology incubator facility is fully subscribed and an integral part of the new SBME building.

PRIORITY ACTIONS

In summary, the Research Program will undertake the following actions:

NEXT 36 MONTHS

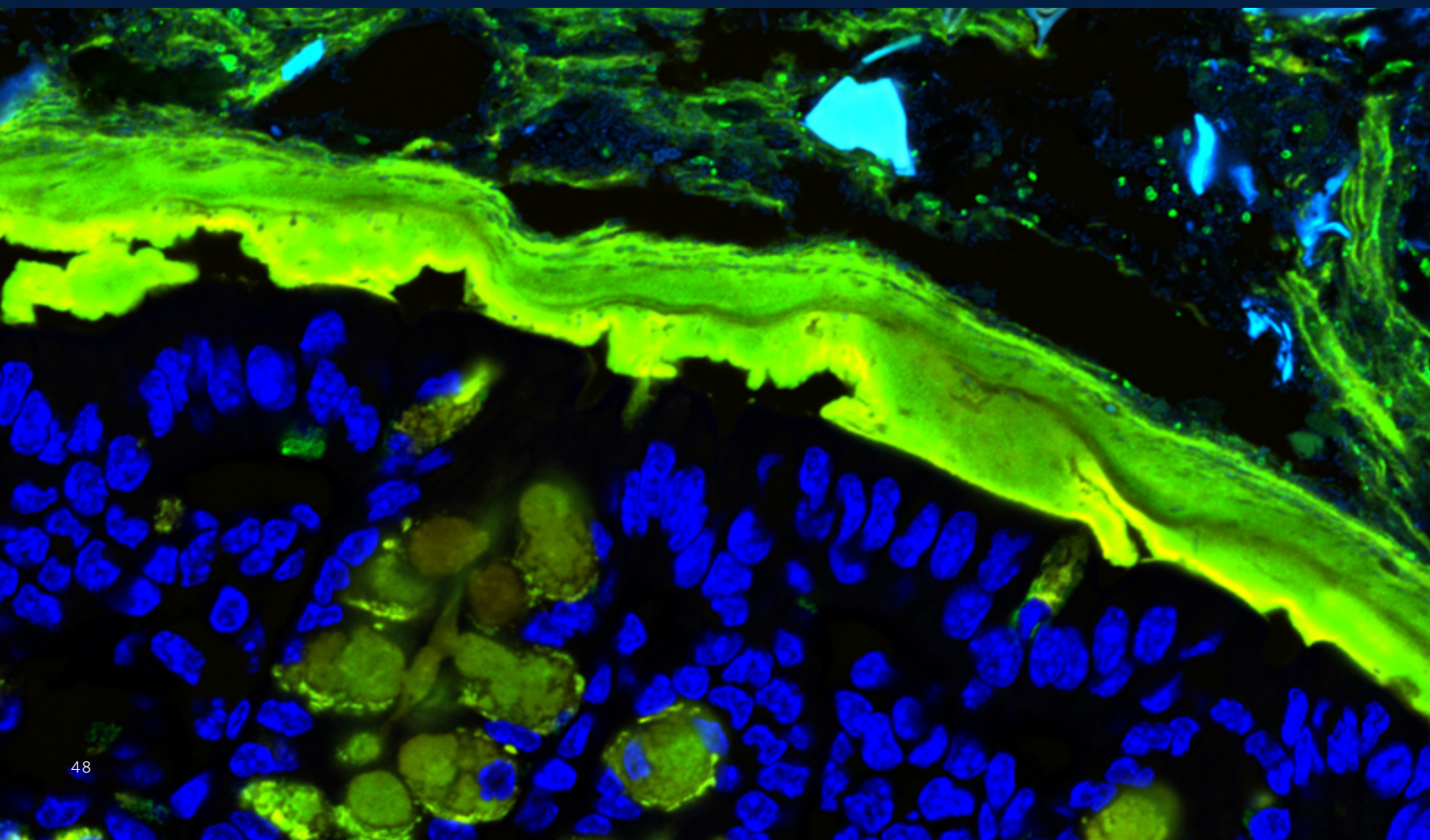
2019 2020 2021 2022

- Increase the number of large collaborative grants applied for and secured by SBME faculty.
- Expand industry relationships and support and develop the SBME health biotechnology incubator facility.
- Establish regular cycle of student and faculty research retreats and seminar series.
- Integrate research opportunities across educational programs.
- Identify and enable SBME community infrastructure and data management needs.
- Develop and implement a successful faculty awards program.

LONGER TERM

2023+

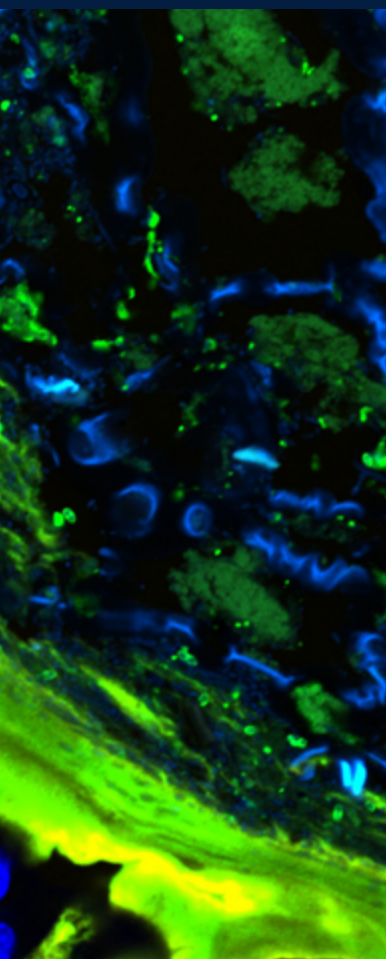
- Introduce additional mechanisms to foster connectivity with clinicians.
- Acquire/build common infrastructure cores.
- Establish the SBME as a thought leader with government, community, industry, and clinical partners.



GOVERNANCE

As a leading, comprehensive BME investment, the SBME—UBC's first inter-faculty school—is emerging as a flagship national program. The SBME position as a key strategic partnership between the FoM and APSC brings together significant interdisciplinary capabilities, a diverse range of resources, and the fundamental expertise and relationships needed for success. With these resources come operational and philosophical complexity related to budget, infrastructure, research, and education that render the governance strategy critical to the success of the SBME, especially at this early stage in its development. More holistically, the governance structures supporting the SBME must: allow program design and implementation simultaneously; serve to establish and monitor the SBME's strategic direction and priorities while honouring and building upon valued established partnerships and a broad faculty base; support the design of innovative educational programs while working within engineering accreditation constraints; and identify research and education priorities across a wide range of academic cultures. Ultimately, nimble and effective governance strategies and structures are needed to enable the SBME to act as a broad umbrella for health biotechnology and translational medicine at UBC and in Canada.

Beyond organizational aspects, securing space for teaching, research, faculty, student learning, and technology innovation is a top priority. As of 2019, 25 faculty members have been drawn from the FoM, APSC, and FoS, with four to eight additional faculty members joining by the end of 2020. Mobilization of another ~15 faculty positions is anticipated, creating a cohort of over 40 faculty members over the next five years. The SBME's near-term hiring and education goals require the development and refurbishment of current space allocations, and designation of new (interim) BME space while a custom-designed building is constructed and populated. The new building will provide a nexus for faculty, infrastructure, and equipment, and for the coordinated delivery of education, research, and innovation (clinical and commercialization) programs.



Over the next five years, in support of our strategic priorities, the following five objectives with associated activities and deliverables items have been established:

1 BUILD DEDICATED LEADERSHIP CAPACITY

The SBME is actively expanding the number of full-time faculty and staff, while adhering to its commitment for diversity and inclusion. As the organization increases in complexity, additional opportunities for leadership and contribution emerge. Furthering the robustness of the organization and its ability to leverage its talent and resources (as well as those of its partner communities) to deliver on its mission requires a strong commitment from established or recruited faculty in filling leadership roles in identified and emerging areas of responsibility. To this end, the SBME will:

ACTIVITIES

- Continue with faculty recruitment, focusing on key research, education and leadership priority areas;
- Prioritize hiring of SBME core faculty;
- Strengthen the leadership cadre by complementing our hiring strategy with more senior hires, and by building new leadership portfolios into the SBME governance structure;
- Ensure joint appointments and partnerships with departments across UBC are both aligned with the SBME's strategic priorities and deliver mutual benefits;
- Recruit and retain high performing staff members to partner with faculty leaders in achieving strategic goals;
- Create and award staff performance using internal and external awards;
- Design and implement an onboarding and mentoring process for faculty and staff; and
- Develop and implement the structures, processes, and supports to enable an inclusive and diverse culture.

2023 DELIVERABLES

- A fully subscribed and committed faculty that reflects a representative, inclusive culture of impact;
- SBME faculty lead and take ownership of established and new (e.g., clinical translation, faculty development, etc.) portfolios;
- Staff and Faculty recognition and awards programs are in place for outstanding contributions to the SBME community;
- Faculty and staff in leadership positions modeling behaviour that fosters an equitable learning and research environment; and
- Newly recruited faculty members are achieving success and characterize their start-up phase as "smooth."

2 DEVELOP EFFECTIVE SYSTEMS, POLICIES & PROCESSES THAT GUIDE SBME CULTURE & DECISION MAKING

The intent is to harness the strengths of the founding Faculties while recognizing that the SBME's success requires the introduction of a new framework that harmonizes the existing policies of the SBMEs founding faculties with a hybrid culture and environment to achieve a cohesive governance approach specific to SBME. This requires the SBME to:

ACTIVITIES

- Forge new policies, where needed, that align with existing policies, processes, and practices of the founding Faculties;
- Adopt and utilize UBC infrastructure, or external resources, as appropriate, for efficient document tracking, approvals governance, and data sharing; and
- Review, identify, and adopt from UBC or peer BME organizations best practices, policies, and activities for interdisciplinary organizational success.

2023 DELIVERABLES

- SBME is recognized for operational effectiveness by UBC and external organizations; and
- SBME is recognized as a model inter-Faculty academic unit and its policies and strategy are adopted by other similar initiatives at UBC and across Canada.

3 CREATE A CHALLENGING YET SUPPORTIVE CULTURE, REFLECTIVE OF THE VALUES OF THE SBME

The importance of an intentional approach to developing the culture has been recognized. The desired culture must celebrate the legacies and strengths of the founding Faculties while also enabling the behaviour and values required for future success and broadly based impacts. To that end, the SBME will:

ACTIVITIES

- Develop robust mentoring programs to support students, staff, and faculty and link them to relevent supportive networks;
- Support the development of a strong sense of social responsibility in BME faculty, staff, and students;
- Create opportunities for different BME community members to share knowledge, lived experiences, and perspectives;
- Include student participation and engagement in key SBME committees or processes in an appropriate manner; and
- Create mechanisms to acknowledge major achievements of students, faculty and staff.

2023 DELIVERABLES

- 95%+ satisfaction scores among faculty, students, staff, and alumni indicate professional and personal growth, a sense of being valued for individual and collective contribution, and trust in the inclusive working environment;
- A work environment that is notable for the ease with which the BME community connects with each other and others across the ecosystem.
- A culture that espouses and represents our five founding values in all of its initiatives, decisions and planning.

4 DEVELOP A CUSTOMIZABLE PARTNERSHIP APPROACH

The SBME works in a number of different stakeholder ecosystems (education, health, innovation, communities, etc.) and with diverse set of partners and communities. Cultivating each priority partnership based on the nature of the stakeholder group, and on alignment for mutual benefit, will increase the probability of significant impacts. Success is to be found in working with and through others. To support this objective, the SBME will:

ACTIVITIES

- Establish criteria for partnerships with different stakeholder groups based on achieving mutual benefits;
- Identify and establish partnerships with key local communities;
- Foster the continued growth of an inter-connected biomedical academic and clinical community;
- Develop a partnership approach for UBC stakeholders in the context of the SBME's role as a hub for translational medicine and health biotechnology at UBC;
- Establish partnerships that provide space to support BME hiring during the building construction phase; and
- Define an SBME approach to strengthening industry relationships that will guide the efforts of the Research and Translation and the Education portfolios.

2023 DELIVERABLES

- Strong mutually beneficial relationships are in place with multiple stakeholders across industry, hospitals, academia and clinics;
- Partners feel at home in the SBME, utilizing our flex space for interactions with SBME faculty, and actively participate in SBME activities;
- SBME staff, faculty, and students feel at home in partner environments;
- Increased awareness among academic community of the problems facing health and healthcare, and of the role the SBME can play in finding and building solutions;
- New SBME building is designed with partnerships in mind, enabling opportunities for scale and adaptive collaboration in the future;
- Partners participate in, and collaborate on SBME's programs, identifying SBME as their "home" on UBC campus; and
- The life sciences community sees SBME and its students as the place from which to launch impactful health-related projects.

5 EXPAND SPACE & BUILD RESOURCES

The SBME is growing rapidly on all fronts with new faculty, new undergraduate student cohorts, an expanded graduate program, and an enhanced administrative team to help deliver our mission, programs and activities. If the SBME is to achieve its bold vision, its rapid growth requires new space and funding resources to be identified, acquired and mobilised. To secure these resources the SBME will:

ACTIVITIES

- Accelerate the development of a cohesive strategy for an aligned case for support and associated priorities with respect to the development teams in the FoM, APSC, and the Office of the President;
- Nurture and develop funder and partner relationships;
- Catalyze the approval, design, and construction of a new building, with a new innovation/incubator site;
- Develop and launch a marketing and communications strategy and plan to maximize presence and knowledge among key audiences;
- Provide oversight and resources to our core infrastructure, ensuring the appropriate relationships are in place and risk is managed; and
- Leverage SBME's budget to support strategic priorities.

2023 DELIVERABLES

- A "Circle of Friends" philanthropy group is providing connections and development guidance to the SBME;
- A fully and sustainably funded building is welcoming its first occupants;
- At least one externally funded endowed research chair is established;
- Leveraged philanthropic support is in place for research and educational priority initiatives; and
- Communication and social network metrics indicate that SBME is well regarded among key stakeholder audiences.

If the SBME is to achieve its bold vision, its rapid growth requires new space and funding resources to be identified, acquired and mobilised.

PRIORITY ACTIONS

In summary, Governance will undertake the following actions:

NEXT 36 MONTHS

2019 2020 2021 2022

- Continue with hiring of both junior and mid-level faculty.
- Communicate the key role for the SBME building as a UBC and community nexus for translational medicine and education.
- Implement priority advisory and governance structures.
- Actively develop the School's culture through engagement of stakeholders.
- Embed diversity and inclusion practices in all School policies and practices.

LONGER TERM

2023+

- Grow partnerships across all stakeholder groups.
- Expand leadership complement and provide further support to each portfolio.
- Attract investment (external sources) and strategically invest in internal initiatives (SBME funds).

6 MONITORING PROCESS

Mechanisms to monitor progress against objectives, and adapt action plans accordingly, are essential to achieving the deliverables outlined in this plan.

YEAR ONE

The implementation of the plan commenced in the fall of 2019. SBME leaders have created individual portfolio action plans, aligned with the strategic direction and established objectives and will implement and report against these on an ongoing basis as part of monthly check-in meetings with the School Director. These plans will also form the basis of regular meetings with portfolio staff support partners. Monthly Leadership Team meetings will serve as the forum for discussion of areas of linkage, overlap, or interdependence. The Director of Strategy and Operations will be responsible for benchmarking, tracking, and reporting on the success metrics for the School.

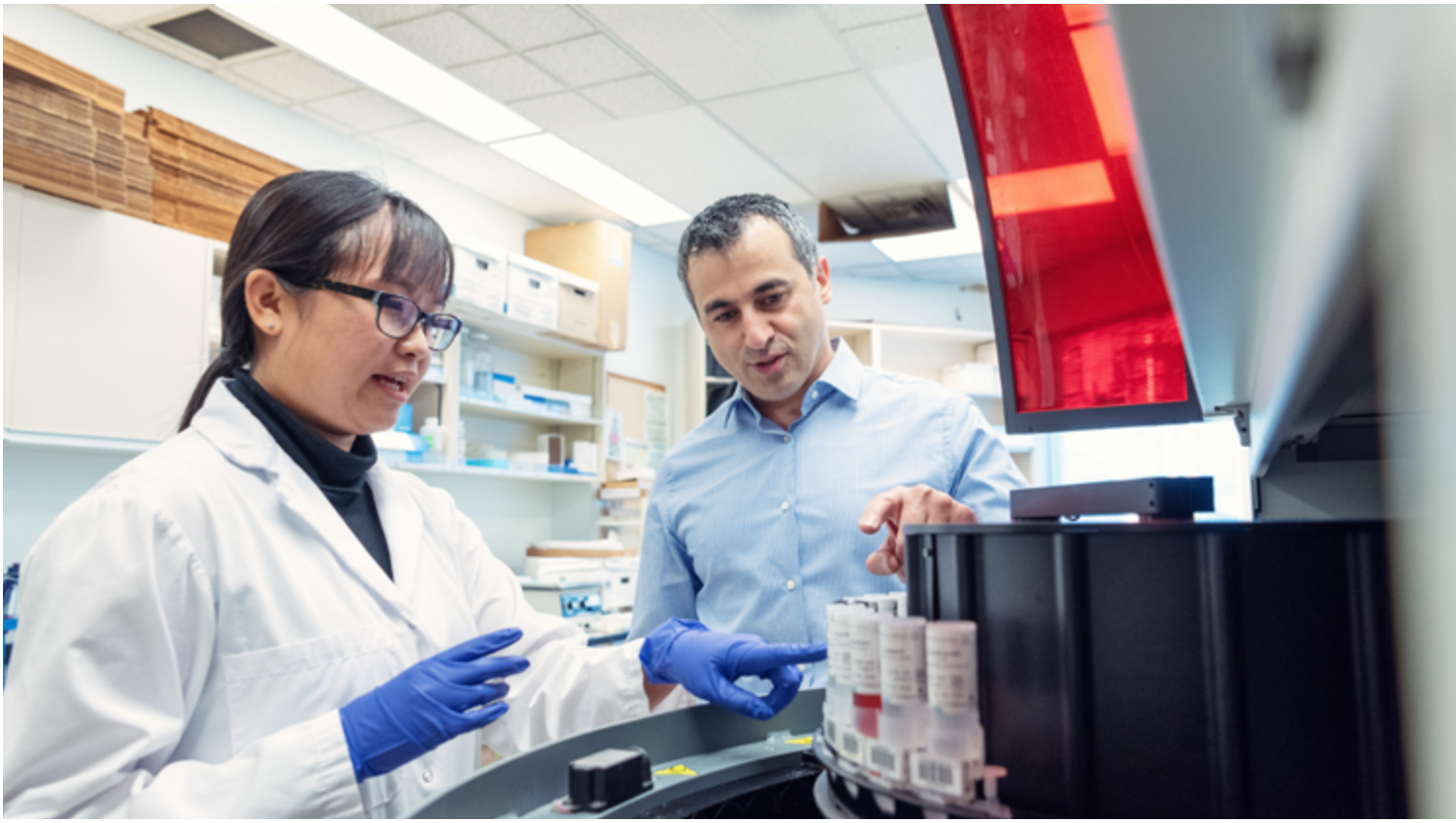
REPORTING & COURSE CORRECTION

With the understanding that change is the only constant, course corrections may be made over the life of this plan with the appropriate input from and consultation with stakeholders, faculty, students, and committees. Monthly faculty meetings present an opportunity for discussion about opportunities and issues, including new initiatives. The Deans of the FoM and APSC receive progress reports on a regular basis and are important information sources with respect to external environmental changes. Stakeholder advisory groups (industry, clinical leaders, and the philanthropic community) provide a forum for discussing new initiatives, developing support for implementation, and gathering critical external viewpoints. Students and staff are key partners in implementing the plan and providing feedback. The EAC is the School's most senior advisory group, providing the opportunity twice a year for serious reflection and informed external input. Annually, at the leadership team off-site, the status of implementation, lessons learned over the previous 12 months, external forces and trends, and new developments will be discussed and priorities established for the upcoming year.

APPENDIX

LIST OF STRATEGIC PLANNING ADVISORY COMMITTEE MEMBERS

DR. PETER ZANDSTRA	Director & Professor, SBME; Director & Professor, Michael Smith Laboratories
DR. PETER CRIPTON	Director, Undergraduate Program; Professor, SBME
DR. KAREN CHEUNG	Director, Graduate Program; Professor, SBME & Electrical and Computer Engineering
DR. FABIO ROSSI	Director, Research; Director, BRC; Professor, SBME & Department of Medical Genetics
DR. PAYAM ZAHEDI	Director, Strategic Planning & Operations SBME
DR. ALY KARSAN	Medical Director, Centre for Clinical Genomics, Michael Smith Genome Sciences Centre, BC Cancer Agency; Professor, Department of Pathology and Laboratory Medicine; Associate Member, SBME
DR. CHERYL WELLINGTON	Professor, Department of Pathology and Laboratory Medicine & Associate Member SBME
DR. CHRISTIAN KASTRUP	Associate Professor, Michael Smith Laboratories & Biochemistry and Molecular Biology; Associate Member, SBME
CAROLINE BARNHART	HR Manager SBME (2018-2019)

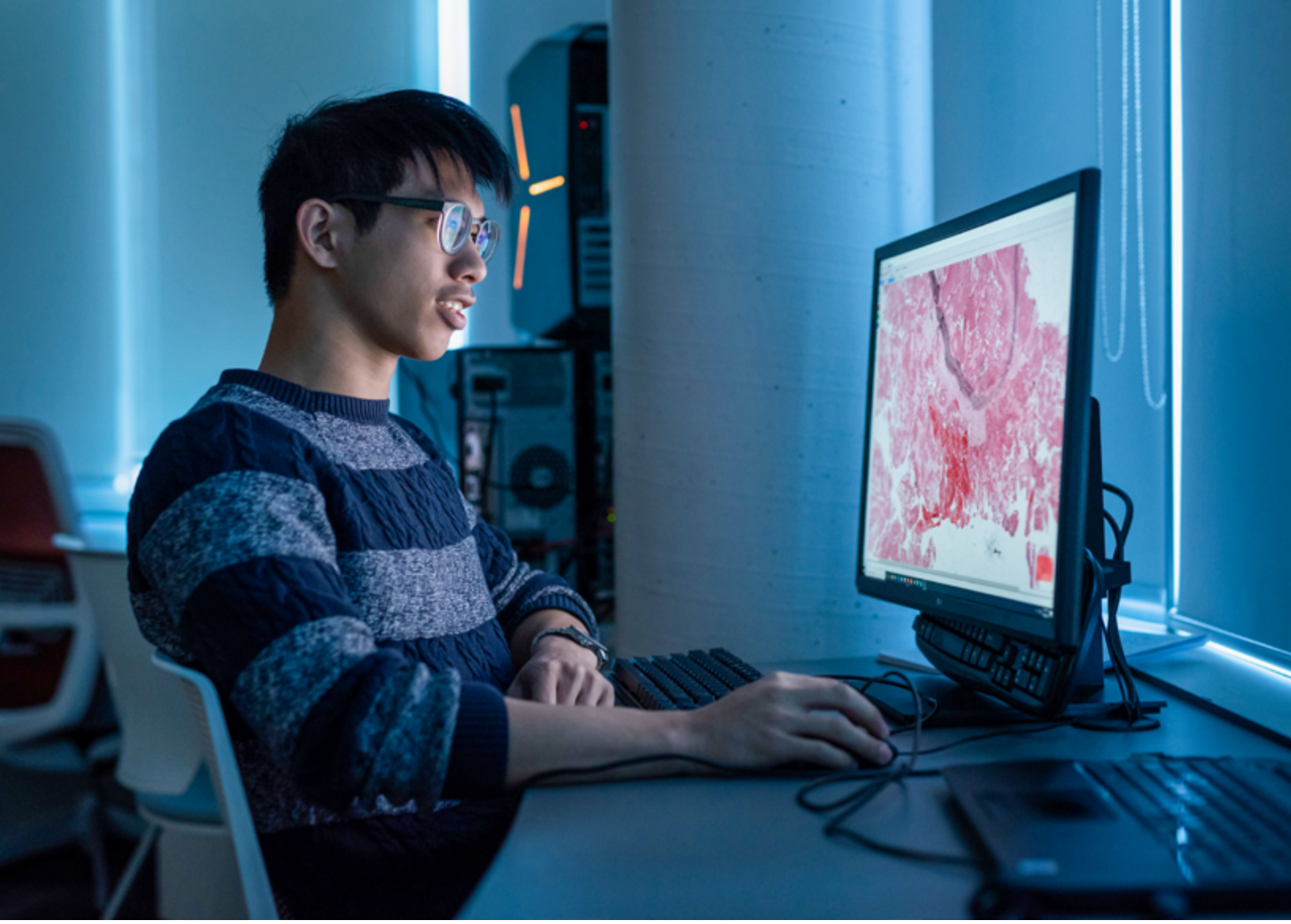


TEGAN STUSIAK	Academic Program Manager, SBME
DR. JOHN MADDEN	Professor, Electrical and Computer Engineering & Associate Member SBME; Director, AMPEL
HELEN SHERIDAN	Chief Human Resources Officer, STEMCELL Technologies
DR. LINDSAY MACHAN	Clinician, Vancouver General Hospital; Associate Professor, Department of Radiology
DR. GABRIELLE LAM	Assistant Professor of Teaching, Materials Engineering & SBME

Supported by Dr. Jane Cooke-Lauder, Bataleur Enterprises.

LIST OF EXTERNAL ADVISORY COMMITTEE MEMBERS (2018-2020)

DR. C. ROSS ETHIER, (CHAIR)	Georgia Institute of Technology & Emory University, Georgia Research Alliance Lawrence L. Gellerstedt, Jr. Eminent Scholar in Bioengineering & Wallace H. Coulter Dept. of Biomedical Engineering
DR. DOUGLAS LAUFFENBURGER	MIT, Ford Professor of Biological Engineering, Chemical Engineering, and Biology & Head of Department of Biological Engineering
DR. ALISON MARSDEN	Stanford, Associate Professor and Wall Center Scholar Departments of Pediatrics, Bioengineering, and Mechanical Engineering & Member of Bio-X
DR. CECILIA GIACHELLI	University of Washington, Chair and Professor Department of Bioengineering & W. Hunter and Dorothy Simpson Endowed Chair



LIST OF QUESTIONS GUIDING THE FORMATION OF THE STRATEGIC PLAN

The following questions and challenges emerged from the early interviews and have guided the development of the strategic direction:

1 How best to balance the ongoing tension between creating employable graduates with specific applicable skills and providing a solid theoretical foundation that enables life-long learning?

2 What is the optimal approach to constructing the undergraduate curriculum: would a more dominant core BME curriculum with various structured options have advantages? Is there a desirable balance of curriculum specialization vs. keeping students path options open and flexible?

3 How might we develop an integrative undergraduate curriculum providing engineering, design, technology, and biology fundamentals given the accreditation requirements?

4 How might we attract more top Canadian students into the graduate program?

5 How might we optimize diversity among our set of students, faculty, and staff and create an inclusive collaborative environment and culture? How do we build a culture, working with the different cultures of the Faculties of Medicine and Applied Science, that reflects a deep academic rigour and entrepreneurial spirit; that is supportive of students being challenged on a regular basis, in a constructive way, so that they gain the confidence to work and learn with a skill set and approach that converges biology with rigorous engineering fundamentals to drive novel and high impact heath impacts?

6 How best to organize researchers to enable the types of collaborations that lead to transformational outcomes while integrating clinical perspectives and being driven by identified health/patient needs?

7 How do we foster a BME identity, an umbrella-commonality or brand, with which students, faculty, and staff identify, and yet maintain an inclusive and collaborative attitude towards the rest of the academic community, including others working in the broader biomedical engineering system?

8 Given current structures and resources how might we lead in helping to resolve current issues facing the healthcare system and, at the same time, continue to address transformative opportunities that are much longer term in demonstrating impact?

9 How best to leverage and align with the recognized strengths and capabilities of UBC (i.e., reputation and infrastructure) and the Founding Faculties i.e., Medicine's expertise in such disease states as: cancer, neurology, and diabetes; and Applied Science's engineering strength, community orientation, and human centred approach, while also being agile and building the relationships needed (within and across UBC as well as with industry) for the School to succeed?

10 There are numerous opportunities and options for collaboration across UBC, including with research centres such as the Centre for Blood Research, International Collaboration on Repair Discoveries, Centre for Hip Health and Mobility, Institute for Computing, Information and Cognitive Systems and the Michael Smith Laboratories as well as with various clinical departments in the Faculty of Medicine. Similarly, there are numerous opportunities to collaborate with external stakeholder organizations such as industry and healthcare providers. Where best to dedicate time and resources?

11 How do we position SBME as the exemplar for excellent interdisciplinary convergent research and education on campus?

12 How does the SBME develop the credibility to be the nexus on campus for the integration of technology and engineering as it relates to human health and advancing clinical practice?

13 How strategically worthwhile is it to push significantly outside the "academic" box with our translational efforts. What resources and infrastructure are critical vs. nice- to-have?

ABBREVIATIONS

APSC	Faculty of Applied Science
ASEE	American Society for Engineering Education
BME	Biomedical Engineering
BRC	Biomedical Research Centre
CEAB	Canadian Engineering Accreditation Board
CEEA	Canadian Engineering Education Association
CREATE	Collaborative Research and Training Experience Program
EAC	External Advisory Committee
EiS	Engineers in Scrubs
FoM	Faculty of Medicine
FoS	Faculty of Science
MASc	Masters of Applied Science

MEng	Masters of Engineering
SBME/The School	The School of Biomedical Engineering
SPAC	Strategic Planning Advisory Committee
UBC	The University of British Columbia
USRA	Undergraduate Student Research Award

SBME UBC

SCHOOL OF BIOMEDICAL ENGINEERING

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