

**AGENDA**

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6. **OTHER BUSINESS**



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To : University Planning Committee

From : Christina Bryce  
Assistant Graduate Secretary

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Attached is a new program proposal for the Master of Biomedical Innovation for UPC consideration. Please note that this submission is subject to approval at Graduate Council on Jan. 17, 2023.

Attachment



**NEW PROGRAM PROPOSAL FOR:  
Master of Biomedical Innovation (MBI)**

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# 1. Program

## 1.1 Program Description

The Master of Biomedical Innovation (MBI) program will be a multidisciplinary, project-oriented graduate program focused on bridging the gap between device and health system technology development and its transfer into local, national, and international biomedical markets. By linking the theory and practice of the biomedical innovation process, it will deliver a systematic but responsive approach to the critical, emerging discipline of entrepreneurship. Graduates with the MBI degree will have the knowledge and skills needed to seamlessly foster innovative biomedical approaches to current and future health challenges from the earliest stages (identification of real-life healthcare problems/needs, prototype development and testing) into practical, market-ready ventures. This integrated program will leverage existing partnerships and agreements between the Faculty of Health Sciences, the Hamilton hospital networks, local innovation hubs, and industry partners. MBI graduates will contribute to the growing biomedical and health technology sector, thereby attracting and retaining entrepreneurial talent that leads to the creation of not only improved health care but new jobs, economic growth, and community benefits.

The MBI will be a one-year program requiring three terms to complete. Administratively, the MBI will be housed in the Department of Surgery and will be the cornerstone of the new Marnix E. Heersink School of Biomedical Innovation and Entrepreneurship. The project and course-based curriculum will be anchored by opportunities for immersive experiences and a series of intensive bootcamps that will guide learners through the biomedical innovation and entrepreneurship process.

Learners will apply the theories and entrepreneurship competencies acquired throughout the curriculum to a program-long, venture-oriented project course. The MBI will provide opportunities to identify a biomedical problem to work on and support for those who already have a project in mind. Working in either a clinical or non-clinical environment, depending on the nature of the project, learners will complete a series of milestones that guide the creation of a novel biomedical solution and the formation of an early-stage biomedical venture. At the end of the program, new ventures will be presented at a Final Pitch Bootcamp, where teams will seek support and funding from investors, incubators, and accelerators.

Team projects may include innovations in:

- Medical devices (e.g., implants, surgical tools, diagnostics)
- Therapeutics and diagnostics (e.g., wheelchairs, exoskeletons)
- Digital technologies (e.g., wearable devices, artificial intelligence, mobile applications)
- Drug delivery platforms (e.g., nanoparticles, hydrogels, biomimetics)
- Health systems and processes (e.g., healthcare software, apps, bioinformatics, quality improvement)

The structure and delivery of the program will allow for maximum flexibility, and will include in-person events (e.g., intensive bootcamps) with virtual and online components; as such it will enable learners to balance their various commitments. Housed within the new Heersink School and with a partnership to The Clinic @ Mac (<https://healthinnovation.mcmaster.ca/visit-the-clinic>), a campus-linked health sciences incubator located in the Health Sciences Library, MBI students will have access to collaborations and learning space to drive their innovations forward. Learners will also have access to entrepreneurs, coaches, and mentors, as well as an on-demand resource portal to support ventures at all development stages.

The central goal of the program is to produce graduates equipped with the theory, experience, and skillset to create innovative biomedical solutions, bridging the gap between academia and biomedical

entrepreneurship and innovation. By the end of the program, graduates will have gone through the full life cycle of creating a business and product. With the personalized support of coaches and mentors, they will have learned the skills, and acquired the network and expertise in the healthcare space with our clinicians to be a successful innovator and disruptor in the healthcare arena. Overall, the delivery and experiences outlined for the proposed MBI will be unique within health sciences education and would constitute the first graduate program of its kind in Canada. This document presents a proposal for this program with the goal of an initial offering of the MBI in September 2023.

## **1.2 Proposal Preparation and Consultation Process**

When the demand for a graduate level program in health and biomedical innovation became evident, we began an investigation into the current landscape of existing programs in North America. A competitor analysis and in-depth literature review were conducted to identify the current landscape of health and biomedical innovation education across North America. Surveys and interviews of prospective students, health professionals, faculty, entrepreneurs, and researchers were conducted to gauge interest in biomedical innovation programming, and to identify gaps in the current health entrepreneurship landscape.

Health Sciences and Engineering faculty members involved in the Integrated Biomedical Engineering and Health Sciences undergraduate program (IBEHS), the Michael G. DeGroot Health Innovation, Commercialization and Entrepreneurship (MGD Health ICE) Initiative and the Department of Surgery have collaborated internally on this effort across a three-year period.

The individuals who have contributed to the preparation of this proposal are:

- Mohit Bhandari, Professor and Chair, Department of Surgery
- Katrina Cordovado, MBDC graduate, Program Administrator, The Clinic @ Mac
- John Kelton, Professor, Department of Medicine and Pathology and Molecular Medicine, and Executive Director, Michael G. DeGroot Initiative for Innovation in Healthcare
- Anna Korol, Assistant Professor, Department of Medicine
- Liane Ladouceur, Research Associate, School of Biomedical Engineering
- Sarrah Lal, Assistant Professor, Department of Medicine
- Frances Lasowski, Adjunct Assistant Professor, W Booth School of Engineering Practice and Technology
- Michelle MacDonald, Associate Professor, Department of Biochemistry and Biomedical Sciences, and Co-Director, Integrated Biomedical Engineering and Health Sciences program
- Alan Neville, Professor Emeritus, Department of Oncology
- Gregory Wohl, Associate Professor, Mechanical Engineering, and Co-Director, Integrated Biomedical Engineering and Health Sciences program
- Julian Yabut, former PhD student in the Medical Sciences Graduate Program, and currently a medical student at the University of Toronto

Consultations included:

- Dina Brooks, Professor, Vice-Dean, Faculty of Health Sciences and Executive Director, School of Rehabilitation Sciences
- Sandra Carroll, Vice-Dean, Faculty of Health Sciences and Executive Director, School of Nursing
- Nancy Carter, Associate Professor, Assistant Dean, Graduate Nursing Programs
- Andrew Cheung, Assistant Professor, Medicine
- Michael Hartmann, Professor, DeGroot School of Business, and Executive Director, Executive MBA in Digital Transformation

- Dave Mammoliti, Director, Directors College, EMBA, Executive Education, DeGroot School of Business
- Kenneth Owen, Assistant Professor, Department of Medicine
- Sean Park, Assistant Professor, Department of Medicine
- Heather Sheardown, Professor, Department of Chemical Engineering, and Dean, Faculty of Engineering
- Jonathan Stokes, Assistant Professor, Department of Biochemistry and Biomedical Sciences, and Co-Founder, Phare Bio
- Bill Wang, Assistant Professor, Neurosurgery, and Interventional Neuroradiology, and Founder and Chief Scientific Officer, iMIRGE Medical Inc.
- Leigh Wilson, Business Development Manager, McMaster Industry Liaison Office
- Survey and focus groups of 10 students registered in the Integrated Biomedical Engineering and Health Sciences program's Health, Engineering Science and Entrepreneurship Specialization
- Survey of 28 faculty members from the Faculty of Health Sciences, the Faculty of Engineering and the Faculty of Science who have entrepreneurial enterprises in the biomedical arena
- Members of the Department of Surgery who attended a consultation session on March 31<sup>st</sup>, 2022

### **1.3 Consistency with McMaster's Mission and Academic Plan**

#### *McMaster's Strategic Mandate Agreement*

In the Times Higher Education Impact Rankings of 2022, McMaster University ranked first in Canada and sixth globally for impact on health and well-being, due in part to the Faculty of Health Sciences being positioned at the leading edge of medical education and research in Canada. Some of the Faculty's education offerings include, but are not limited to: Medicine, Nursing, Rehabilitation Sciences, Midwifery, Physician Assistant, a multidisciplinary Biomedical Discovery and Commercialization (BDC) program, and most recently the Integrated Biomedical Engineering and Health Sciences (IBEHS) program with a specialization in Health, Engineering Science and Entrepreneurship (HESE). The Faculty of Health Sciences utilizes a unique interdisciplinary and problem-based approach to the study of health, wellness, and disease. Inquiry-based learning approaches emphasize transferable skills in the biomedical sciences, including oral and written communication, problem-solving, critical thinking, and the acquisition of practical laboratory and research skills. With a strong infrastructure and faculty experience in place for interdisciplinary learning, the MBI program and its graduates will advance the overall McMaster University agenda in the Health Sciences area of growth and will be able to bolster the efforts of the University's most recent initiative: Canada's Global Nexus for Pandemics and Biological Threats (<https://globalnexus.mcmaster.ca/>).

The 2020-2025 Strategic Mandate Agreement (SMA) (<https://www.ontario.ca/page/2020-2025-strategic-mandate-agreement-mcmaster-university>) indicates several priority areas for the Ontario government that we are confident the MBI program would fulfill. As a unique program that aims to attract and develop future health-focused innovators and entrepreneurs, this program will provide students with key skills to not only be skilled graduates, but also new employers that create new jobs and enhance Hamilton-McMaster economic growth. Further, we anticipate our graduates will create exciting new inventions that will attract multiple sources of internal (i.e., institutional) and external funding (i.e., federal, private sector) to provide the necessary capital to scale their inventions and impact communities in Ontario. It is also our intention to maintain complete transparency of salary and ensure accountability of the faculty and staff associated with the new program. Outlined in Section 7 of this proposal, the program will track key performance indicators that measure its priority areas.

#### *McMaster's Current Priorities*



The Faculty of Health Sciences has a history of innovation, excellence, and equity through their existing educational and research programs. For example, it has created two unique and successful undergraduate innovation programs: the Integrated Biomedical Engineering and Health Sciences (IBEHS) program (jointly created and offered by the Faculty of Engineering and the Faculty of Health Sciences) and the Biomedical Discovery and Commercialization (BDC) program (housed in the Department of Biochemistry and Biomedical Sciences). We plan to build upon this spirit of innovation with the MBI program by investing in students that have the potential to be the next generation of biomedical entrepreneurs and innovators. This will be accomplished within the institution-wide objectives to promote equity, diversity, and inclusion (EDI) following the Action Plan currently being enacted at McMaster University (<https://equity.mcmaster.ca/strategy/towards-inclusive-excellence/edi-action-plan/>). Specifically, the MBI program will align with these values by cultivating a community of students that (1) uphold EDI commitments in relation to admissions, curricula, and program delivery, (2) innovate in their academic activities, (3) engage with community partners, and (4) respect diversity on and off campus. This overall vision for the program will align with all five of the Priority Areas of the Institutional Priorities and Strategic Framework 2021-2024 ([https://president.mcmaster.ca/app/uploads/2021/05/Institutional-Priorities-and-Strategic-Framework\\_FINAL\\_5May21.pdf](https://president.mcmaster.ca/app/uploads/2021/05/Institutional-Priorities-and-Strategic-Framework_FINAL_5May21.pdf)) and its Vision Statement: “Impact, Ambition and Transformation through Excellence, Inclusion and Community: Advancing Human and Societal Health and Well-being”. The connection of the MBI Program to these Priority Areas is explained briefly below:

- 1) **Inclusive Excellence:** The MBI Program will facilitate inclusivity and interdisciplinarity in its curriculum and student experience by admitting students from a wide variety of educational and health professional backgrounds who will be given the opportunity to work in teams on biomedical innovation projects. The curriculum will reinforce universal design, and importance of consideration of accessibility, diversity and equity of end-users.
- 2) **Teaching and Learning:** In addition to workshops and bootcamp-style course offerings, the MBI program will incorporate experiential learning, allowing students to access biomedical and/or healthcare settings. The objective of the program is to initiate and advance ideas, products, or systems with the greatest potential to get to market. Through placements and interdisciplinary learning, students will develop insights into new ideas within the program and for the years and decades that follow. MGD Health ICE educational programming and The Clinic @ Mac networking opportunities, for example, will be available even after graduation, ensuring continuity of support and services to enable success.
- 3) **Research and Scholarship:** The MBI program aims to develop future innovators who can develop novel avenues of research and care and contribute to McMaster’s commitment to high quality research. MBI courses will focus on challenge-based, self-directed learning and engagement with a cross-disciplinary group of faculty, clinicians, researchers, and fellow peers who have demonstrated academic success and strong roots in both industry and the community.
- 4) **Engaging Local, National, Indigenous and Global Communities:** The MBI program will contribute to the growing culture of innovation, commercialization, and entrepreneurship in the Hamilton innovation ecosystem. MBI students and graduates will build and strengthen their partnerships with clinical practices, businesses, start-ups, and industry in Hamilton. The MBI program is the seed needed for (1) value creation and implementation, (2) economic development of Hamilton including creation of new jobs and industries, and (3) building companies with regional and global socioeconomic benefits. The MBI program will liaise between student and community partners to aid in the commercialization process and ultimately, attract and retain talent needed for Hamilton economic development.
- 5) **Operational Excellence:** The recruitment of a diverse community of mentors for the MBI Program from industry with experience in the entrepreneurship sector can support leadership training and opportunities for inclusive learning and growth and, over time, support the attraction of high calibre faculty, staff and students.

## 1.4 Program Learning Outcomes

The Master of Biomedical Innovation program emphasizes innovation, translational design and research, experiential learning, and multi-disciplinary entrepreneurship teamwork. Graduates will be equipped to bridge the gap between academia and biomedical entrepreneurship and innovation.

Graduates of the program will be able to:

- Become a founder of a health-focused startup company
- Spin out a new health technology from their academic research or clinical area
- Advance the innovation agenda of an existing health-focused company or organization
- Work for an emerging health or medical technology company
- Leverage the entrepreneurial knowledge and skills acquired in the MBI that are required to transition into a leadership position in various industries

To this end, the overarching learning outcome that will be used to achieve this central goal is:

**Graduates of the program will have the skillset and entrepreneurship competencies to bring innovative biomedical solutions to solve healthcare challenges from research and design stages into practical, market-ready use.**

The MGD Health ICE group has developed a series of core and enabling competencies that reflect the skills required for a successful entrepreneur (See full list, Appendix A1). These form the basis of the program learning outcomes. Upon completion of the graduate program, all graduates of the MBI program will be able to:

- A1: Identify opportunities for new value creation in biomedical and life sciences sectors
- A2: Describe a current and future market landscape
- A3: Design a solution and articulate a value proposition
- A4: Identify and protect intellectual property
- A5: Address regulatory requirements
- A6: Create a team and network
- A7: Acquire necessary resources and funding
- A8: Develop and adapt a business strategy
- A9: Develop and sell key messages for various audiences

## 1.5 Consistency with Graduate Degree Level Expectations

The learning outcomes and competencies identified for this program were specifically developed to align with the guidelines set out by the Ontario Universities Council on Quality Assurance (the Quality Council) for the Graduate Degree Level Expectations (GDLE). Table 1 maps each of the Program Learning Outcomes to the appropriate Quality Council expectation.

Table 1: Program Learning Outcomes and Associated Graduate Degree Level Expectation

Program Learning Outcome	Associated Degree Level Expectation
A1	1,3,4a,4b,5,6

A2	1,2,3,4a,4d
A3	1,2,3,4a,4d,6
A4	1,2,3,4c,5
A5	1,2,3,4b,4c,4d,6
A6	4a,4b,4c,5
A7	1,2,4a,5,
A8	1,2,3,4a,4d,5
A9	3,4a,5

Program learning outcomes outlined in Section 1.4 meet expectations outlined in McMaster's GDLE found here: <https://cill.mcmaster.ca/COU/degree/graduate.html>. If all program outcomes are fulfilled, it is expected the student will receive the MBI degree at the end of the program during November convocation.

## 1.6 Demand for Program

### *i. Evidence of Societal/Labour Market Need*

The Canadian healthcare system is often regarded as an unreceptive and challenging arena for innovation. There is therefore a strong need to be agile and nimble in identifying unmet needs within the healthcare system that will benefit the overall health of Canadians from the perspective of the patients and the healthcare providers. These challenges require innovators that will understand all aspects of the healthcare system and its stakeholders, who will be able to innovate, communicate and implement novel healthcare solutions.

Based on findings from an in-depth literature review and competitor analysis (briefly explained in Appendix A2), the past 10-15 years have seen a rapid increase in the number of programs that teach innovation within academia. The Stanford Biodesign program was one of the first to offer a graduate-level course in biomedical technology innovation in 2003. A recent paper from this group ([Denend et al. 2021](#)) found a significant increase in commitment to careers in biomedical technology and innovation after completing the course, with 82% involved in innovation roles. In a [Frontier Economics report](#) (2014), the Impact of investment in science and innovation in higher education was measured and demonstrated a 37% rate of social returns, which includes an increase in profit for the private and public sector who can make use of the innovations, as well as greater societal gains to health, well-being, security, and efficiency.

Considering the future of education is moving towards a heavy focus on [problem solving, system change, innovation and entrepreneurship](#), it is not surprising that the United States currently boasts programs and courses devoted to innovation in fields such as digital, healthcare, biomedical, design and engineering. Although smaller in comparison, a similar trend is emerging within Canada; as of 2020, there were 13 graduate programs devoted to innovation and/or entrepreneurship. This surge suggests a shift in the approach to business models and the desire for pedagogical support to advance both entrepreneurship and intrapreneurship. Importantly, this lack of accessibility to biomedically-focused innovation programming pushes students to enroll in general business programs that lack the required health-focused expertise or resources needed to become biomedical entrepreneurs. As a result, based on the competitor scan, **none of the existing graduate-level innovation and/or entrepreneurship programs in Canada are devoted to biomedical innovation, nor do any of the programs involve health-focused experiential learning like that which will be provided by the MBI program.**

The recent growth of Canada's biomedical field reported by [The Globe and Mail](#) in November 2019 (e.g., the revenue estimate by IBIS World of \$5 billion in revenues for the medical device industry) captures the growth of Canadian opportunities in this industry. Paired with the [notable growth of Toronto's tech sector](#) (outpacing San Francisco and New York in creating jobs), and the recent launch of the Southern Ontario Pharmaceutical and Health Innovation Ecosystem (SOPHIE) program out of the Innovation Factory located at Innovation Park in Hamilton, McMaster University is set as a prime candidate to provide education in biomedical education. By bringing innovative minds and entrepreneurs from clinical and health science backgrounds (national and international) to grow the Hamilton-McMaster innovation landscape, the MBI program would also address the need to increase economic development in Ontario and meet current and future societal and labour needs, as set out in the 2020-2025 SMA. Similarly, the Ministry of Labour, Training and Skills Development currently projects a growing job market in the financial, communications and business services (National Occupational Classification, NOC 0013) for the GTA from 2020 onwards.

In 2007, the Centres of Excellence for Commercialization and Research (CECR) program was launched by the Canadian government to support the innovation to commercialization continuum, with many of their centres in the health sector. Their most recent program evaluation from September 2017 reports that Canada's strengths in academic research have not fully transferred to the realm of innovation and commercialization, noting that innovators continue to face substantial challenges in accessing funding/investment for earlier, riskier stages of commercialization. The MBI program is designed to equip graduates with the skills necessary to meet and overcome such challenges. With its legacy of innovation and interdisciplinary collaboration, McMaster is uniquely positioned to become a leading (if not the leading) actor in the healthcare innovation space.

#### *ii. Evidence of Demand for the MBI*

Evidence for interest in graduate education in health innovation and commercialization is provided by two programs currently operating at McMaster as well as feedback from Researchers, Engineers, and Clinicians (a summary of data collected is included in Appendices A3 and A4):

##### 1. Biomedical Discovery and Commercialization (BDC)

This limited-enrollment four-year undergraduate program, housed in the Department of Biochemistry and Biomedical Sciences at McMaster, is also associated with a 1-year Master's degree in Biomedical Discovery and Commercialization (MBDC) that is focussed on development and commercialization of pharmaceuticals and therapeutics. Approximately 60% of the undergraduate BDC students stay on to pursue the MBDC. The MBDC program has also seen an overall increase in applications in recent years due to an increase in the number of external applicants.

We anticipate that a similar proportion of undergraduate IBEHS Health, Engineering Science and Entrepreneurship Specialization students (described below) will be interested in pursuing the MBI which will focus more broadly on innovation and entrepreneurship in medical technology, health information technology and medical devices.

##### 2. Integrated Biomedical Engineering and Health Science (IBEHS)

McMaster's interdisciplinary (Engineering and Health Sciences) undergraduate IBEHS program is expected to be a key target market for the graduate-level MBI program. Currently, the IBEHS program enrolls approximately 140-180 new students each year who complete an interdisciplinary degree in biomedical engineering and health sciences. To date students have produced multiple innovative and noteworthy projects and commercial devices. One example is [Guided Hands™ from ImaginAble](#)

[Solutions](#), an assistive device that enables people with limited fine motor skills to write, draw, and use a tablet. This device was first conceived in an IBEHS course and supported through Health ICE coaching and mentorship leading to multiple national and international awards, including the National Canadian winner of the 2021 James Dyson Award. Despite success stories such as these, IBEHS student feedback and collected data found that, due to time and accreditation constraints, students reported only little opportunity for entrepreneurship and product/company creation. The MBI would fill this gap and support the structured and guided creation and validation of health technology with a focus on accelerating its development and commercial viability. There was strong interest and agreement from this cohort of students that we surveyed to pursue a Master's degree, one year in length with emphasis on the attributes being proposed in the MBI (see Appendix A3).

### 3. Basic Science Researchers in FHS and Faculty of Engineering

Draft copies of the MBI proposal and a survey were sent to 28 basic science PhD researchers and health professionals. There was unanimous agreement that more education about entrepreneurship and the challenges of commercialization of basic science research was needed within FHS and the MBI should be an option for interested graduate level researchers. Consultations with the Faculty of Engineering have also demonstrated that there is interest from Biomedical Engineering as well as Engineering graduates in a graduate degree in Biomedical Innovation (see Appendix A4).

### 4. Health Professionals

Consultations with health professionals from several clinical departments, the School of Rehabilitation Sciences, and the School of Nursing have shown considerable interest in the development of the MBI. Practicing health professionals from hospitals and private industry were suggested to be good candidates to recruit to this graduate program.

#### *iii. Justifiable Duplication*

A comprehensive competitor analysis and in-depth literature review was conducted at the outset of this program proposal to scan all graduate level programs in health and biomedical innovation, entrepreneurship, commercialization and/or design with findings summarized in the appendix (Appendix A5). Based on this scan, we can state with confidence that the MBI program does not duplicate any graduate programs in Ontario and will be the first to offer clinical immersion as an option within the program. Of the 13 current programs in Canada, only 1 of the programs is focused on health innovation—University of Toronto's Master of System Leadership, and Innovation—however, this program differs in its focus on health systems science, health policy and organizational behaviour, and is designed only for emerging physician leaders. None of the other 12 programs are devoted to biomedical innovation, nor do any of the programs involve health-focused experiential learning akin to the proposed MBI program.

The MBI program addresses three key opportunities that make it unique and unlike similar, existing programs:

- A biomedical innovation-specific graduate program in Canada
- The only graduate program in Canada to offer a clinical immersion opportunity
- An entrepreneurship program uniquely rooted in the Faculty of Health Sciences. Comparative innovation and entrepreneurship programs are predominantly housed within the School of Business or Faculty of Engineering. These programs provide broad, overarching education for entrepreneurship across all fields, but do not have the distinct expertise needed to navigate the complexities of biomedical technology and health-focused innovation.

Informal feedback collected from graduates of McMaster’s MBDC program reported a lack of knowledge in medical technology regulation and reimbursement. With this insight in mind, a primary goal of this program will be to overcome healthcare system resistance by creating biomedical innovators who are deeply familiar with the nuances of the medical regulatory and reimbursement environment in Canada and the U.S. and thus prepared to navigate them.

An important goal of the MBI program is to foster health innovation within the Hamilton community surrounding McMaster University. The Faculty of Health Sciences has existing collaborations with community partners to foster innovation, including connections with The Forge, Innovation Factory, the Michael G. DeGroot Initiative for Innovation and McMaster Industry Liaison Office. The MBI program will draw on these connections and their resources as we cultivate world-class talent.

### 1.7 Degree Nomenclature

A study in *Design Management Review* from 2017 highlights the importance of consistency of program names between academic institutions. It compared the recognizability and stature that is afforded to MBA programs to the more recent development of programs in Design Management. With the variety of names and lack of consistent curricula, challenges are presented in defining value for potential employers. We believe that the *Master of Biomedical Innovation (MBI)* clearly delineates the focus and training that will be provided to students.

## 2. Admission & Enrolment

### 2.1 Admission Requirements

The minimum admission criteria are as follows:

- Completion of an undergraduate honours degree
- A minimum B+ average in the last two years of study of an honours degree
- Introductory level innovation and entrepreneurship education or demonstrated involvement in innovation and entrepreneurship projects. This experience can be through education or self-directed means (e.g., invention, product or service design, start-up company creation)

The following application material is required from all applicants:

- Statement of Intent
- CV/Resume
- Undergraduate and graduate (if applicable) transcripts
- One-way video essay
- Interview of finalists

Based on the number of applications, selected candidates that meet all the above criteria will be invited for rounds of virtual and/or in-person interviews. We plan to admit 20 new net students for the first cohort of this program, increasing enrolment across 5 years as indicated by the table below. Many programs in the Faculty of Health Sciences have separate admission streams for Indigenous applicants and Black applicants. There are currently discussions within the Faculty and across the University to extend these admission streams to other programs.

Academic Year	2023-2024	2024-2025	2025-2026	2026-2027	2027-2028
Full-time	20	25	30	35	40
<b>Total Enrolment</b>	20	25	30	35	40

The MBI program aims to attract high-calibre students that have the motivation to innovate in the health and biomedical fields. With a rapidly growing innovation sector and infrastructure (e.g., Health ICE, The Forge, Synapse Consortium) in the McMaster-Hamilton space, we anticipate MBI graduates to add to this growing culture of innovation. By attracting and retaining talent into the overall Ontario innovation ecosystem, this program strives to create new jobs that result in future economic and community impact, thereby contributing to Ontario's 2020-2025 SMA mandates.

## 2.2 Alternative Requirements

N/A

## 3. Structure

### 3.1 Administrative, Governance and Communication

The MBI program will be administered by the Faculty of Health Sciences with an administrative home in the Department of Surgery. Key elements include:

- A **Program Director** will coordinate the program, oversee curriculum development, implementation and quality improvement. This individual will liaise and coordinate with faculty members, as well as external experts, both of whom will teach within the curriculum and serve as mentors on multidisciplinary group projects. The Program Director will sit on the Faculty of Health Sciences Graduate Policy and Curriculum Council and will report to the Vice-Dean Graduate Studies and the Chair of the Department of Surgery. The Vice-Dean Graduate Studies sits on Graduate Council and reports to the Vice-Provost and Dean, Graduate Studies. A new Program Director will be selected every 5 years. All communications related to the program will originate from the Program Coordinator or Program Director.
- A **Program Coordinator** will be hired to support the administration of the program, serve as the primary contact for student inquiries, admissions, calendar changes, and degree audits, and support teaching faculty as needed (i.e., assisting faculty members with oversight and coordination of coaches and mentors).
- The **Program Operating Committee** will be chaired by the Program Director. Members of the Operating Committee will include four MBI-affiliated faculty members and two students registered in the Program. The function of the Operating Committee will be to review and develop curriculum and policy recommendations for the MBI program. When required, proposed changes to the program and curriculum will be presented for approval to the Graduate Curriculum and Policy Committee of the Faculty of Health Sciences with subsequent approval from Faculty Executive.
- An **Advisory Committee** will be assembled for the program which will consist of representatives from each of the major areas of study for this degree, including Health Sciences, Engineering and Business. Representation from academia, healthcare and industry will be included in this group. The function of the Advisory Committee will be to provide feedback on the MBI program's objectives and activities as they relate to the current needs of the biomedical field; provide updates on technological advances as well as economic, societal, and cultural shifts; and secure connections to the engineering and health professions, industry, and government.

## 3.2 Structure and Regulation

### *Ensuring Achievement of Program Learning Outcomes*

As described above, the Program Director will be primarily responsible for overseeing all academic components of the MBI program. This individual will work closely in collaboration with the Vice Dean, Graduate Education (Faculty of Health Sciences), who chairs the Faculty of Health Science Graduate Curriculum and Policy Committee to assess programs, courses, and enrollment. The Program Director, with assistance from the Program Coordinator, will be responsible for collecting data, surveys, and feedback for the preparation of the documentation required for the cyclic IQAP reviews.

To ensure students can meet the specified Program Learning Outcomes, student progress will be reviewed at the end of each term by the Program Director. Instructors of 700 level courses will inform the Program Director of students who are at risk during the duration of the course. This will enable the Program Director to take action to ensure students who are at risk get the help and support needed to successfully finish the degree on-time (i.e., a meeting to talk about struggles and to decide on next steps). If a student fails to achieve a mark higher than a B- in any of the required courses, the student will be subject to remediation in a similar manner that is done in the DeGroot School of Medicine if students fail to meet expectations. Remediation may include repeating an assignment with coaching and guidance provided by a faculty member assigned from the MBI program (not the course instructor). If the student fails to remediate, the student will fail the course and will be required to repeat it the following year. In this case, the student will be able to continue with other courses. Attendance and participation at the bootcamps is mandatory.

The course instructor for the Project Courses (MBI 701, 702 and 703, described below) plays an important integrative role in the program. The instructor for the Project Courses will ensure that students/teams have been matched with an appropriate coach and project, and will also collect reflections from students at the end of each term to track progress. The instructor will check in regularly with coaches to monitor progress (at least monthly), or sooner if issues arise, to ensure that individuals and teams are healthy, functioning and progressing well with their project. The instructor will also be responsible for organising and coordinating Bootcamps and the parallel embedded curriculum for Personalized Coaching and Leadership.

The progress of all students in the program is reviewed each term by the Program Director with support from the Program Coordinator. Students who must be absent for a required bootcamp or assessment under extenuating circumstances must contact the Program Coordinator and Course Instructor right away for accommodation. Students who request a leave of absence from the program due to extenuating circumstances will receive credit for courses that were completed and graded. These students may need to repeat MBI 701, 702 and 703 upon return to the program due to the changing nature of the teams and projects.

## 3.3 Program Length

The MBI will require a one-year commitment. The one year of study in the proposed MBI provides students the opportunity to take a solution from observed need through solution iteration, and for some solutions, to implementation and market-readiness. We have seen success with the one-year Master's program at McMaster with the MBDC (Master of Biomedical Discovery and Commercialization). The one-year timeframe remains competitive with other course-based Master level programs and comparable programs in biomedical innovation (i.e., the Master of Entrepreneurship and Innovation (MEI) at Queen's University, Master of Management of Innovation (MMI) at the University of Toronto, and Master of



Science in Bioengineering Innovation and Design at Johns Hopkins University) and was also the preferred duration indicated by our student surveys.

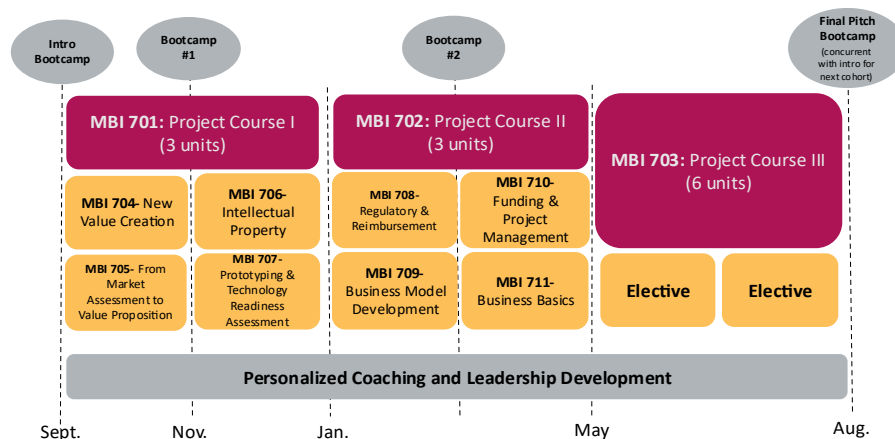
## 4. Curriculum and Teaching

### 4.1 Program Content

A key aspect of biomedical innovation and entrepreneurship education is the integration of experiential and immersive educational models that simulate the complexities of technology development and transfer. Individuals or teams of learners will work on a biomedical innovation project in partnership with a clinical department, research lab or relevant stakeholder group. Learners will identify and/or validate a biomedical need by engaging with their partner (e.g., clinicians, researchers, administrators, end users) and gain an understanding of the system-level barriers unique to biomedical technology implementation in their project-focus area. Importantly, the partnerships developed within the MBI will form the foundation for innovation and, concurrently, provide the infrastructure and personnel required for technology testing and pilot studies, and potential for future funding and support. All learners, whether working on a clinical or lab-based innovation, will be linked to mentors with up-to-date experience in healthcare technology entrepreneurship. Regular meetings between teams and their coaches and entrepreneurship mentors will ensure that students feel supported and innovation projects are monitored and adjusted as necessary.

#### Overview of the Program

Students enrolled in the MBI program will focus on the theory and application of biomedical innovation and entrepreneurship, integrating content from the fields of Health Sciences, Business, and Engineering. The following is a list of the proposed courses and bootcamps for students with a schematic overview of curriculum implementation and timeline (Figure 1).



**Figure 1:** A proposed phase timeline and proposed MBI courses and bootcamps. Depicted are 1.5-unit courses (gold), project courses (maroon), and mandatory bootcamps (grey) in the degree timeline.

The MBI program will accommodate learners who enter the program with or without an existing idea for an innovation project. For all learners, the experiential, project-based courses (MBI 701, 702, 703) will give students the opportunity to apply concepts from courses and bootcamps to their innovation project, over the 12-month program. Within these project courses, students will be evaluated on the completion of a set of milestones that focus on establishing the desirability, feasibility and viability of their innovation. All learners will have access to personalized coaching, mentorship and leadership development throughout the entirety of the project to ensure milestone completion and project progress, and to facilitate project scope modifications where necessary to meet these requirements. The required milestones will demonstrate the application of MBI program learning objectives and entrepreneurship competencies, and will be required as follows:

- Milestone 1: Identify and validate the biomedical need
- Milestone 2: Assess the existing and emerging market landscape
- Milestone 3: Develop and test prototype
- Milestone 4: Outline IP and regulatory strategy of proposed solution
- Milestone 5: Determine necessary resources and funding strategy
- Milestone 6: Develop a business model for your proposed solution/company
- Milestone 7: Pitch your final innovation

In the MBI 701 Project Course, there will be the following options for learners to define the health or biomedical problem that they will be focusing on developing an innovative solution to for the duration of the program. All students in the program will experience the same academic rigour and entrepreneurship mentorship and support, and these options provide maximum flexibility:

1. Select your own problem through clinical immersion experience: students can participate in a clinical immersion experience to identify and validate a biomedical problem to work on during the remainder of the project courses, following a structured needs finding method first developed by [Stanford Biodesign](#).
2. Those without an existing project will have the option to select and validate a problem from a provided database consisting of problems identified by healthcare providers, with opportunities provided to validate the problem through conversations with HCPs or visits to a clinical environment.
3. Validate your own idea (defined before starting the program through lab-based research, previous educational projects, or other means)

All learners will be required to participate in one-day clinical immersion experiences in each bootcamp (defined below), which will provide experiential value to them as well as opportunity to gain greater insights into how their own projects may fit into the clinical environment.

*Project Courses and Bootcamps:*

*701, 702, 703: Project Course I, II, III, Delivered Sept-August (3, 3, 6 units)*

Students will be encouraged but not mandated to undertake the Project Course as members of a team, which will each be assigned a coach who will meet regularly with the team to assess both project progress and how concepts delivered in the online courses are being applied to the project. Students will also have the option to individually progress through these courses with their own identified project innovation. Progress in the projects will also be assessed at the Bootcamps throughout the year. Teams will present updates on their projects as part of the Bootcamp activities. During the third semester Project Course

(703) there will be no other core courses scheduled to allow teams to complete their business and commercialization plans and take two elective courses.

*Bootcamps:*

Each of the 4 Bootcamps will be 3-5 days in duration and attendance is mandatory. The first is introductory, for program orientation, team formation, networking, planning for clinical immersions (if applicable to a learner) and project discussions. There will also be short talks to introduce students to the course work of the curriculum block that follows. At the subsequent Bootcamps, curricular material from the previous curriculum block will be reviewed along with introductions to the next block of courses, project updates given, opportunities for networking provided and guest speakers invited. There will also be exercises where learners will be expected to apply knowledge from the courses through case studies, group discussions, or other assignments. Each bootcamp will include a one-day clinical immersion experience, where learners will be spread across various clinical areas within local hospitals, followed by a discussion period the next day where they will share experiences with others who were immersed in a different clinical environment. This element of the bootcamps will provide value to all learners by providing an understanding of the clinical environment and a new perspective that they can then apply to their team/individual projects. The final Bootcamp will take the form of a “Pitch” competition, where each team will present the progress of their innovation project. Starting in the 2024 academic year, the introductory bootcamp will overlap with the final pitch bootcamp for the graduating cohort, so incoming students will be exposed to this element at the start of the program.

*Online Core Courses:*

These 1.5-unit core courses will be delivered as online modules, but there will be bi-weekly check-ins with instructors and with coaches, either in-person or virtually to assess progress both in the project and the core course.

*MBI 704. New Value Creation (1.5 units)*

This initial course is designed to allow learners to identify unmet needs, identify potential root causes of observed problem(s), and validate them. Students will also learn how the healthcare system functions so that they can identify important stakeholders in the healthcare space. They will develop decision matrices for prioritizing observed needs.

*MBI 705. From Market Assessment to Value Proposition (1.5 units)*

In this course, students will learn to assess whether there are available alternatives already on the market that solve the identified problem and estimate market size, including dollar size and number of users. They will identify potential barriers to market entry and strategies to overcome them. They will validate the product-market fit for the proposed problem solution (innovation), identify risks and risk mitigation strategies in alignment with industry standards, and learn how to articulate a competitive advantage for their proposed solution.

*MBI 706. Intellectual Property (1.5 units)*

This course will cover how to conduct patent searches and how IP can be protected in a variety of innovation domains e.g., device, pharma, digital or diagnostic. Students will learn how to maintain confidentiality in external-facing communications e.g., NDA's and collaborate with entities such as MILO to execute an IP strategy.

*MBI 707. Prototyping and Technology Readiness Assessment (1.5 units)*

Starting at the point where basic research activities have been conducted and/or published, this course will take students through topics such as design thinking, proof of concept, and pilot scale prototypes in both simulated and operational environments to the stage of full-scale prototypes and final configuration, successfully tested in a real-world environment.

*MBI 708. Regulatory and Reimbursement (1.5 units)*

Processes for technology testing and market approval are controlled by regulatory standards that are specific to the type of innovation e.g., drug, device, diagnostic or digital domain. This course provides an overview of the requirements and industry standards across the different innovation domains in relation to regulatory guidelines for ventures as well as the opportunities and challenges for reimbursement. Elective courses will be available to take a deeper dive into regulatory requirements for specific venture domains.

*MBI 709. Business Model Development (1.5 units)*

In this course students will learn how to evaluate and determine the most appropriate business model for viability and revenue generation within the healthcare space, how to create a go-to-market strategy and determine the costs and benefits of potential exit options.

*MBI 710. Funding and Project Management (1.5 units)*

This course reviews various innovation ecosystems within the healthcare sector, emphasizing the importance of building relationships and coalitions to acquire necessary resources. Students will learn how to use project management platforms to manage resources.

*MBI 711. Business Basics (1.5 units)*

This course provides students with an overview of concepts related to financial accounting, incorporation, partnerships, HR, payroll, etc., that are essential to the management of a successful business.

*Electives:*

Students will take two 1.5-unit electives in the spring/summer term. One will be chosen from the regulation and reimbursement selection based on project focus and one will be chosen from the list of electives below.

- Regulation and Reimbursement (choose one from the following)
  - o Therapeutics
  - o Devices
  - o Diagnostics
  - o Digital Health
- Special Topics in Biomedical Innovation
- Complexity Science and Adaptive Systems

*Personalized Coaching and Leadership Development:*

Personalized coaching and leadership development will be incorporated longitudinally into the project courses (MBI 701, MBI 702, and MBI 703) and bootcamps. Coaches will come from the partnership with

The Clinic @ Mac and their extensive network of faculty members with experience in business development and commercialization. These experts will meet with teams and individuals at regular check points throughout the program to ensure that the project and teamwork are progressing well while considering areas of strength and weakness. They may also identify a need for intervention or remediation for an individual or a team. Coaches will work under the supervision of the course instructor for MBI 701, 702 and 703, with regular progress reports. The course instructor will respond to areas of need identified by the coaches, as appropriate, to support the learner or group. Each bootcamp will also provide professional development programming by faculty members, which may include expert guest speakers.

*Mentors:*

The Clinic @ Mac also has an extensive network of members from industry who will be brought in to serve as mentors throughout the program, so that students can engage in informal coffee chats, or more formal panel discussions. The instructor for the project courses (MBI 701, MBI 702, and MBI 703) will coordinate and liaise with mentors to schedule these sessions throughout the year. Mentors will not be responsible for grading students. Only McMaster faculty members will be permitted to assess students.

The curriculum described above aims to introduce students to the fundamentals needed to innovate in healthcare and biomedical fields. These fields will be explored within MBI courses, providing students with new perspectives to innovation in Canada and the rest of the world. These insights will assist students in developing their own business and marketing plans for funding and reimbursing their solutions and building profitable, sustainable ventures.

## **4.2 Program Innovation**

Unique aspects of the MBI program include the following:

- An immersion experience will be a unique opportunity provided to students in this program, taking an experiential learning approach that diverges from the traditional theory-based programming found in many course-based master's degrees. Through their immersion, students will be expected to validate existing unmet needs in the healthcare or biomedical spaces and to propose an evidence-based solution.
- Aspects of the Biodesign Fellowship program at Stanford University have been adopted to provide MBI students with a unique and effective program. In the MBI program, students will be paired with a faculty coach as well as one or more mentors.
- The program will be anchored by a total of four 3–5-day intensive bootcamps. During these mandatory bootcamps, learners will come together for guest lectures, case-based interactive workshops and design sessions that introduce the next phase of the biomedical innovation process and create an innovation community and network. In-person events or bootcamps will be planned to allow for learners to balance with their other commitments. Bootcamps will be hosted at The Clinic @ Mac facility.
- At the end of the program (i.e., at the final bootcamp), students will present their innovation in a pitch competition to a diverse audience consisting of industry, faculty, members of the McMaster Innovation ecosystem, investors, and incubators/accelerators. This event will provide students with valuable experience in an environment closely resembling venture capital pitches. The final pitch bootcamp will also help to demonstrate achievement of the program learning objectives (as

outlined in Section 1.4) and provide an opportunity for overlap between the outgoing and incoming cohort.

The program will use a blended and flexible learning approach (e.g., virtual, in-person, immersion experiences), so that students living in the Greater Toronto and Hamilton area and beyond can be fully immersed in the MBI curriculum. Any student requiring accommodations will be supported by the Program Director. In addition, Student Accessibility Services (SAS) will be contacted to brainstorm solutions to foreseeable barriers and develop appropriate accommodation plans.

Ultimately, it is our goal to prepare graduates for successful careers. By providing a multidisciplinary program that challenges students to push the boundaries of their own education and, in turn, the boundaries within healthcare, we hope to stimulate creativity, inventiveness and progress. The MBI program will enable students to develop a combination of intrapreneurial and entrepreneurial skills that will permit a range of career directions upon graduation.

### **4.3 Mode(s) of Delivery**

The outline below highlights the proposed modes of delivery:

- 12-month experiential program
- 12-month innovation project course (team or individual based)
  - Project support through MBI faculty and The Clinic @ Mac coaches and mentors
- In-person and distance learning:
  - In-person:
    - Immersion experiences
    - Four 3-5-day bootcamps
  - Learning at a distance
    - Online courses

By combining in-person immersion and bootcamps with online formats for courses, the blended model will provide the flexibility and autonomy needed to complete the program learning outcomes. For all lectures delivered in this course, closed captioning will be available. Courseware will primarily comprise of peer-reviewed papers that are available using McMaster's Library access to archives (e.g., Google Scholar, PubMed etc.). Courses will be hosted primarily through McMaster University's learning management system, *Avenue to Learn*. Synchronous sessions with online video conferences will be scheduled using various available platforms such as Microsoft Teams or Zoom at the discretion of the instructors. These precautions will be taken to ensure that students have access to all materials at any time to accommodate schedule and life conflicts.

### **4.4 Experiential Learning**

Experiential learning will be an integral part of the MBI program. For those choosing a clinical immersion experience connections have been established with innovative health care practitioners in Hamilton Health Sciences, St. Joseph's Healthcare Hamilton, and Joseph Brant hospitals. The MBI will leverage this network to provide opportunities for MBI students to shadow clinicians or their healthcare teams to conduct needs-finding investigations. The experiential learning components and personalized coaching will be overseen by the instructor for the Project Courses (MBI 701, 702 and 703).

Additional opportunities for experiential learning will be provided through mini-projects and other activities during bootcamps. Bootcamps will be the main touch point for in-person learning throughout this program

and will include team activities that will allow students to iterate and fail quickly. Failure is an important part of venture creation, and it is our goal to allow students to fail first in a safe space that will maximize learning opportunities.

#### **4.5 Accessibility**

The Faculty of Health Sciences strives to meet the needs of its students, staff, and faculty in terms of accessibility. Every effort will be made to ensure that the program meets the expectations of the university in terms of accessibility. The program will be prepared to provide equitable learning opportunities for all students and will be prepared to accommodate individuals with disabilities to allow clinical immersion for all students.

Courses will be designed and delivered with a diversity of learning styles and Universal Design in mind to create an inclusive and accessible classroom environment. For each course, a course syllabus including a statement regarding the duty to accommodate students with disabilities, and a complete course reading list will be provided prior to the beginning of the term. As the program will be delivered primarily through online resources, all lecture material as well as other course content (e.g., assignments, supplementary materials, etc.) will be made available electronically, and appropriate practices will be followed to ensure accessibility (please refer to <http://accessibility.mcmaster.ca>). To ensure principles of Universal Design are followed, alternative formats to online content will be provided as needed.

The Faculty of Health Sciences recognizes that individuals may require some adjustments to support their performance throughout the bootcamps. The Master of Biomedical Innovation program will work with the individual seeking accommodation to ensure the university's goal of accommodation is maintained, understanding that the nature of the accommodation is specific to the individual and will be determined on a case-by-case basis. A Faith and Spirituality Day Calendar will be consulted to ensure the proposed dates of bootcamps will not conflict with observance days that could affect participation.

#### **4.6 Research Requirements**

As a course-based Master's degree, the MBI program will not include any mandatory research components and therefore, no research requirements.

### **5. Assessment of Learning**

#### **5.1 Methods of Assessing Students**

Students will be assessed using methods that will accurately assess program learning objectives. We envision students working in small teams throughout the 12-month program that will leverage their skills and project development experiences to develop new solutions to current health and/or biomedical issues under the supervision of a coach. Courses may use but are not limited to:

- Coach evaluations
- Oral presentations/seminars
- Written evidence-based opinion/position papers
- Written self-reflections on skills development and skill acquisition
- Final Pitch Bootcamp presentation

Through these main assessment types, we can assess MBI student knowledge, communication, problem-solving, critical thinking, solution identification, and personal reflection skills. Further, the

assessments are also used in other course-based Master's programs at McMaster (MBDC, MSc Global Health, MEEI/MTEI) and externally (Queens University MMIE). These assessments will address and assess all the program learning outcomes listed in Section 1 of this proposal. Students will receive a final grade for each course. Students will be assessed for group work, but the majority of the assessment will be based on individual work. No more than 50% of the grade in a course will be based on group work.

Students will apply knowledge learned in the classroom and bootcamps in their 12-month project course, where the application of the program learning outcomes will be assessed. Assessments will have added flexibility to be done or handed in through virtual or in-person formats to accommodate any challenges that may arise and prevent students from completing important assessments to satisfy program learning outcomes. If additional barriers do arise, MBI faculty will take these into account on a case-by-case basis but will always prioritize student learning and educational integrity with respect to alternative accommodations.

In addition to the measures outlined in section 7.1 to monitor program quality on a course-by-course basis for the first five years of the program, the Program Director will conduct a random sample of Final Bootcamp Pitch presentations bi-annually and will analyze the presentations to determine how well all of the program learning outcomes and competencies are being achieved by students in a way akin to the way that Graduate Attributes are measured for engineering programs accredited by the Canadian Engineering Accreditation Board. This assessment coupled with alumni surveys will be used to make improvements and enhancements to the program to ensure the quality of the student learning experience. The Program Director will also provide a sample of the Final Bootcamp Pitch presentations and a qualitative and quantitative (based on grades) summary report of learning outcome indicators to the Advisory Committee for feedback. This assessment plan and outcomes will be reviewed during the cyclical program review every 7 years.

## **5.2 Curriculum Map**

Below is a curriculum map created for MBI students that indicates the teaching activities and learning opportunities, and how the MBI program intends to assess for evidence of program learning outcome completion.



Program Learning Outcome	Master's Degree Level Expectations (DLEs)	Course Alignment	Teaching Activities & Learning Opportunities	Assessments and Evidence
<b>Identify</b> opportunities for new value creation	1,3,4a,4b,5,6	MBI 701 MBI 704	Teaching: PC, OP, WR, OC Learn Opp: PC	Coach evaluations on application of DLE's to individual or team Project, from both oral presentation and written reports. Oral presentation of project development at Bootcamps
<b>Describe</b> a current and future market landscape	1,2,3,4a,4d	MBI 701 MBI 705	Teaching: WR, OC Learn Opp: PC	Coach evaluation of the application of the DLE's to the Project in both written reports and oral presentation
<b>Design</b> a solution and articulate a value proposition	1,2,3,4a,4d,6	MBI 701 MBI 705 MBI 707	Teaching: OP, OC Learn Opp: PC, BC	Oral presentation to Coaches at the first bootcamp, with a written report on the application of the DLE's of MBI 704 and 705 to the project
<b>Identify</b> and protect intellectual property	1,2,3,4c,5	MBI 701 MBI 706	Teaching: OP, WR, OC Learn Opp: PC, BC	Provide a written report on the application of the relevant Intellectual Property issues to the project
<b>Address</b> regulatory requirements	1,2,3,4b,4c,4d,6	MBI 702 MBI 708	Teaching: OP, WR, OC Learn Opp: BC	Oral presentation or seminar to Coaches and fellow students at the second bootcamp describing regulatory issues applicable both to the project and to written cases
<b>Create</b> a team and network	4a,4b,4c,5	MBI 702 MBI 709	Teaching: OP, WR Learn Opp: BC, PC	Assessment of team creation by coaches and written self-reflections by students on team skills development
<b>Acquire</b> necessary resources and funding	1,2,4a,5	MBI 702 MBI 703 MBI 710	Teaching: SR, OC Learn Opp: BC, PC	Oral presentation to Coaches on funding strategies and the use of project management platforms to manage resources
<b>Develop</b> and adapt a business strategy	1,2,3,4a,4d,5	MBI 702 MBI 703 MBI 709 MBI 710 MBI 711	Teaching: SR, OC Learn Opp: PC	Written report describing the business strategy for commercializing the project, go-to-market plan and provide an exit strategy
<b>Develop</b> and sell key messages for various audiences	3,4a, 5	MBI 702 MBI 703 MBI 709 MBI 711	Teaching: SR Learn Opp: PC, BC	Oral presentation to peers and Coaches at the Final Pitch Bootcamp

Curriculum Map of the MBI program outlining the Program Learning Outcomes (PLOs), how they align with Degree Level Expectations (DLEs) and map onto the MBI courses. For each PLO, the teaching activities and learning opportunities students will be exposed to are noted, as well the assessments and evidence that will be collected to determine that students have achieved the PLO before they graduate. Abbreviations: Project course (PC), Oral presentations (OP), Written evidence-based reports (WR), Online/virtual courses (OC), Bootcamps (BC), Self-reflection (SR).

### **5.3 Demonstrating Student Achievement**

In the MBI program, success will be defined as graduates who are prepared to tackle the unstructured problems within the healthcare system. This preparedness will take on many forms and will be a challenging metric to quantify. The primary identifier of student success will be in the successful completion of the year-long project course. It will be here that students will demonstrate their understanding of many key concepts, out of necessity for their application to new solutions.

## **6. Resources**

### **6.2 Graduate Programs**

The Faculty of Health Sciences' Department of Surgery has a history of health innovation and a commitment to entrepreneurship. With this culture, the Department will serve as an appropriate administrative home for the MBI program. In collaboration with McMaster MGD Health ICE, the Department will ensure the MBI program launches with success and has access to faculty, networks, resources, and experienced support needed to enable the program's vision. This will be facilitated by the assistance of the Faculty of Health Sciences and FHS Graduate Studies Office. In tandem with new hires and staff, the resources forecasted will directly support the needs at program inception and future program expansion. This permanent home for the program and the necessary expertise in the Department of Surgery is an important opportunity for the MBI program.

#### **6.2.1 Administrative, Physical and Financial Resources**

##### *Administrative Resources*

A Program Director (0.4 FTE) in the Faculty of Health Sciences will preside over the program, ensuring the overall vision is enacted. The program will leverage the focused time of one other faculty member (0.5 FTE) to guide curriculum development and course delivery. Other McMaster faculty will be recruited to deliver the bootcamps, facilitate course curriculum and provide coaching, with involvement of external, experienced biomedical entrepreneurs to serve as mentors in the program. The program will be supported by a Program Coordinator (1.0 FTE) who will work collaboratively with the existing MGD Health ICE team to ensure deliverables are achieved and both faculty and learners are well-supported.

##### *Physical Resources*

The MBI program will have access to state-of-the-art working and meeting space within the recently established Marnix E. Heersink School of Biomedical Innovation and Entrepreneurship within MDCL. Learners will also be able to access The Clinic @ Mac, providing resources and co-working space in the Health Sciences Library. Classrooms can also be booked via FHS for rooms in HSC and MDCL. The MDCL space will have both teaching and administrative office space that will be used to accommodate future hires for launch and growth of the program.

##### *Financial Resources*

The Department of Surgery is research intensive with a strong track-record of funding from senior faculty members. Specifically, the department is home to three Canada Research Chairs: Dr. Mohit Bhandari in Musculoskeletal Trauma and Surgical Outcomes, Dr. Sheila Singh in Human

Cancer Stem Cell Biology and, most recently, Dr. Richard Whitlock in Cardiovascular Surgery. In recent years, this department has been increasing their research focus, increasing total research grant money from \$7.2 million for 2016-2017 to \$15.8 million for 2017-2018. Additionally, the department received a record-setting grant of more than \$14 million as part of the launch of a fracture management program. Publications are also increasing over time, moving from 286 to 315 between 2016-2017 to 2017-2018 and increasing to 371 in 2020.

Curriculum development and start up costs for the new program will be funded by Michael G. DeGroote Initiative for Innovation in Healthcare and the newly established Marnix E. Heersink School of Biomedical Innovation and Entrepreneurship.

## 6.2.2 Library, Technology and Laboratory Resources

### *Library Resources*

MBI students will have complete access to the library resources across Campus. This includes the Health Sciences Library, which contains an extensive collection of books and journals. Students will also have access to online journals and the library's online collection using their MacID on and off campus. Further, a physical space within the Health Sciences Library is the home base for The Clinic @ Mac and a hub for content on health innovation, entrepreneurship and commercialization which will also be accessible to MBI students. Other libraries such as the H.G. Thode Building and Innis Library are other options for resources that focus on the natural sciences and business, respectively. Online collections of these libraries will also be available to MBI students. (See Exhibit A6 for letters of support.)

### *Technology and Laboratory Resources*

MBI students will have access to Technology resources used for communication and remote accessibility. Students will have on-demand access to UTS services for any troubleshooting needs for communication. Programs that use virtual settings to access lectures (Zoom, Microsoft Teams, Webex), courseware (*Avenue to Learn*) and asynchronous video (MacVideo, Avenue to Learn) will also be made freely accessible to students. On Campus, students will have a MacID that can be used to access free internet campus-wide and at other McMaster campuses. The Centre for Simulation-Based Learning (CSBL) is also an available state-of-the-art facility that can be used by MBI students due to the clinical focus, especially students with disabilities that cannot go into active clinical environments. There is no laboratory setting in this program.

## 6.2.3 Faculty

Considering prior success with the Integrated Biomedical Engineering and Health Sciences program, MGD Health Innovation, Commercialization and Entrepreneurship initiative, the Health Leadership Academy and several other education programs, we have demonstrated the ability to draw on the large complement of existing faculty members within the Faculty of Health Sciences from across all departments to mount high quality educational programming. This includes research faculty and clinical faculty who are themselves entrepreneurs or consultants, many of whom also have a background in business or engineering.

Faculty Member	Credentials	Rank	Home Unit	Available for Coaching?
M. Anvari	MD, PhD	Full	Surgery	Y
M. Bhandari	MD, PhD	Full	Surgery	Y
V. Chaudhary	MD	Full	Surgery	Y

S. Galloway	BA, CPA, CMA	Staff	FHS Finance	Y
W. Hanna	MD	Full	Surgery	Y
J. Kelton	MD	Full	Medicine	Y
Y. Khan	MD, Executive Master in Digital Transformation and Innovation Leadership	Full	Surgery	Y
A. Korol	PhD (Biomedical Engineering), MSc (Medical Sciences)	Assistant	Medicine	Y
S. Lal	MBA, MEng, LLM	Assistant	Medicine	Y
F. Lasowski	PhD (Chemical Engineering)	Assistant	Booth School of Engineering Practice and Technology	Y
M. MacDonald	PhD (Medical Sciences)	Associate	Biochemistry	Y
J. McKillop	PhD	Full	Psychiatry	Y
A. Neville	MD	Emeritus	Oncology	Y
K. Owen	PhD (Information Systems)	Assistant	Medicine	Y
S. Park	PhD (Education)	Assistant	Medicine	Y
J. Stokes	PhD (Biochemistry)	Assistant	Biochemistry	Y

The Faculty of Health Sciences has an extensive complement of faculty members from ten clinical departments and two non-clinical departments that range from part-time and full-time clinical faculty to full-time PhD research faculty and full-time teaching professors. Education programs in the Faculty of Health Sciences traditionally draw from this pool of faculty members to deliver educational programming as faculty members are required to teach a minimum number of hours per year.

As the home department for the MBI program, the Department of Surgery has 100 full-time faculty members (clinical and non-clinical) among 11 divisions: cardiac surgery, general surgery, neurosurgery, ophthalmology, orthopaedic surgery, otolaryngology, pediatric surgery, plastic surgery, thoracic surgery, urology, and vascular surgery. Several faculty members from these divisions are also involved in our *Innovators in Scrubs* undergraduate course. (See Exhibit A6 for letters of support.)

The MBI program will also draw faculty members from The Clinic @ Mac where a network of coaches and mentors has been developed over the last two years. This network of faculty members from the Faculties of Engineering, Science and Health Sciences are entrepreneurs themselves who will be able to provide guidance to students in the MBI program. (See Exhibit A6 for letters of support.)

We also have commitments from industrial partners to contribute to the educational mission of the program by teaching courses, acting as coaches or acting as mentors. While we have a wide network through The Clinic @ Mac, we already have commitments in writing from some of these partners indicated in the table below.

Name	Credentials	Company	Position	Available for Coaching?
M. Antonakos	MBA	Allarta Life Sciences	Founder and COO	Y
A. Giovinzio	MBA	Red Granite Capital	Chairman and CEO	Y
H. Stover	PhD	Allarta Life Sciences	Founder and CEO	Y

### 6.2.4 Student Financial Support

As a course-based Master's degree, the primary source of financial support for students in the MBI program will be internal program-funded merit-based scholarships available to graduate students who qualify, as included in the program budget.

### 6.2.5 Faculty Research Funding

As a course-based Master's degree, the MBI program will not include any mandatory research components. Individuals will not be funded for research within their role as an MBI student.

### 6.2.6 Supervision

As the MBI program does not contain any mandatory research components, there is also no requirement for official faculty supervision. Faculty members teaching within the MBI program and faculty members/members from industry from The Clinic @ Mac will be engaged for coaching of the year-long project course in capacities that are relevant to student projects.

## 7. Quality and Other Indicators

### 7.1 Academic Quality of the Program

Measuring quality in the MBI program will be primarily driven by tracking program and student-specific key performance indicators (KPIs) annually over the first 5 years after program inception. In the short-term, we will focus on key performance indicators that track the growth of the program and the success of MBI alumni. Over time, we will begin to track our primary long-term indicator of the success of the MBI program: the number of biomedical innovations and inventions produced within the year-long project course. The Program Director will oversee measurement and monitoring of the key performance indicators with the Program Coordinator for each term. The data will be reviewed with the Operating Committee and Advisory Committee annually for feedback, planning and implementation of new measures as required.

The key performance indicators that we will track over the first 5 years will focus on the growth of the program and measures of student success after graduation:

Program-facing KPIs:

- Exit surveys completed by students upon completion or departure from the program
- Number of new affiliations made (Hamilton Health Sciences and St. Joseph's Healthcare hospital networks, etc.)
- Number of companies launched by students and alumni
- Number of patients impacted because of products of alumni
- Number of biomedical innovations created by MBI alumni

- Amount of IP generated for innovations
- Funding secured from external sources by MBI alumni (grants, venture, angel, etc.)

Student-facing KPIs:

- Student assessments
- Student reflections conducted at the end of each term
- Number of students who successfully create a start-up
- Number of students who are employed after the program
- Number of fellows and clinicians
- Number of students that enter The Clinic @ Mac health sciences incubator
- Success rate of acceptance into start-up education, accelerator, or incubator

Tracking these KPIs are pragmatic and realistic success measures that will demonstrate the quality of the MBI program. Specifically, these KPIs will demonstrate the program's impact on the Hamilton-McMaster Healthcare Innovation Landscape, a continuously growing sector that we intend MBI graduates to help accelerate. KPIs can also be used to increase new stakeholder buy-in (i.e., new faculty involvement, external and internal funding opportunities, new demographic of incoming MBI students). Lastly, these KPIs will provide vital information for the next 5 years of the program, identifying strengths and weaknesses to amplify and address, respectively, in the subsequent 5 years.

Students will also be encouraged to engage in McMaster and community events throughout their degree. Existing events such as Hacking Health, Delta Hacks, and Hack for Change will be promoted to these students, with the administration also working to cultivate more of these events which will focus specifically on biomedical innovation. Additionally, events held by the McMaster MGD Health ICE group and the Health Leadership Academy will be advantageous learning and networking opportunities for these students. The level of student engagement will be assessed using surveys such as the National Survey of Student Engagement (NSSE) or Classroom Survey of Student Engagement (CLASSE).

The Program Director and Program Coordinator will have an open-door policy when it comes to hearing student feedback and concerns. Programs will also often have a student society with a representative that will liaise with the Program Director to address areas of weakness/concern (or strength) of the program. Seeking anonymous formative feedback from students early on in each semester allows for change to be prompt, if appropriate. In the case where change is not an appropriate response to the feedback received, then a discussion will ensue to provide a rationale and explanation to students. Alternatively, or in addition, student focus groups or town halls with the program leadership has proven to be effective in ensuring a strong and positive student experience. Lastly, McMaster's MacPherson Institute for Leadership, Innovation and Excellence in Teaching provides a Course Refinement service where members from the MacPherson Institute visit a classroom in the absence of a faculty member to engage students in discussion about areas of strength and concern about a course or program which is then communicated in summary to the Program Director. A formal Course Refinement will be conducted within one month of the start of each term.

In response to the collected data, KPIs and feedback from all sources, an annual education retreat for all faculty members and coaches will ensure continuous quality improvement with respect to teaching and learning, and program delivery. Additionally, holding three or four monthly 'calibration meetings' during the summer months with all faculty members or course leads will ensure that courses within the program have been well integrated, that there are no gaps in the curricula, and that there are smooth transitions throughout the 12-month program.

## 7.2 Intellectual Quality of the Student Experience

The program will have mandatory touchpoints between students and faculty coaches to ensure students are keeping up with content and succeeding in the program. A 1:1 coaching structure will be put in place for students/teams as part of their year-long project course, providing student-faculty interactions through this course. Faculty members will be among the coaches that students will have access to for support on this project, which will allow for engagement and ongoing communication. These points of contact will be important to ensure student success. Acknowledging that students come from varying backgrounds, this just-in-time model could mean that students move through content at different times throughout the year. For this reason, faculty will stay in tune with the progress of each of the student groups.

The faculty that will be involved in the delivery of course content for the MBI program will inherently bring diversity and a breadth of knowledge to the program, as most will come from the Faculty of Health Sciences and have expertise directly pertinent to its program offerings. For example, all faculty involved in HESE's *Innovator's in Scrubs* course, MGD Health ICE, The Clinic @ Mac, and surgeons/clinicians from the Department of Surgery have the expertise required to execute a reimagined student experience in biomedical innovation. We predict the synergy that will be created by combining faculty from different disciplines will ensure the intellectual quality of the MBI program.

Beyond access to faculty mentorship, students will also be paired with mentors from industry through The Clinic @ Mac. These mentors will not only provide guidance to students for projects and coursework throughout the program but will allow for connections to the biomedical industry after graduation. This will be one of multiple ways that the program aims to ensure the success of graduates from the MBI program.

## Appendix

### Exhibit A1

*List of major and enabling competencies that reflect the skills required for a successful entrepreneur, developed by the MGD Health ICE group*

*Identify opportunities for new value creation:*

- Develop a decision matrix to help with prioritization of unmet needs
- Identify unmet needs and articulate as need statement
- Identify the potential root cause(s) of the observed problem(s)
- Identify and prioritize stakeholders in the healthcare space
- Map out the current workflow/infrastructure
- Validate the problem (through publications, hospitals, stakeholder interviews, etc.)
- Conduct background research into your area of interest

*Assess the market landscape:*

- Identify and research currently available alternatives to solve the identified problem
- Explain industry and trends to clarify current and future possibilities
- Present measurable market size including dollar values and expected number of users
- Segment the market using demographic, behavioural and psychographic characteristics
- Size the market based on TAM, SOM, TM and quantify using bottom-up or top-down approaches
- Compare and contrast competition including product features
- Identify potential market barriers and strategies to overcome them (ex. SWOT analysis)

*Design a solution and articulate a value proposition:*

- Create and implement an innovation development plan (concept, prototype, MVP) that progressively tests and de-risks your solution
- Validate the product-market fit for your proposed solution
- Develop elements of differentiation to offer sustainable competitive advantage
- Quantify impact on various processes (economics, outcomes, efficiencies, etc.) in the environment or market of interest
- Identify foreseeable risks and risk mitigation strategies in alignment with industry standards or best practices as applicable
- Develop a decision matrix to determine the best solution
- Understand and articulate solution's benefits and competitive advantage by outlining specific differentiating features

*Identify and protect intellectual property:*

- Conduct patent searches
- Evaluate IP protection mechanism and identify relevant requirements (novelty usefulness, non-obviousness)
- Determine confidential aspects of the novel solution and mechanisms for maintaining confidentiality in externally facing communications (ex. NDAs)
- Collaborate with relevant parties (e.g., legal support, MILO) to develop and execute an IP strategy

*Address regulatory requirements:*



- Determine solution's classification (ex. medical device, drug, biologic, wellness products, etc.)
- Identify specific requirements and industry standards, and develop a strategy based on FDA and Health Canada guidelines for venture (ex. clinical plan, QMS, safety tests, submissions, etc.)

*Create a team and network:*

- Develop a network that aligns with overall strategy
- Demonstrate entrepreneurial leadership, team building, and collaboration, utilizing project management and communication tools
- Articulate team skills and identify areas of gaps, strategize to fill gaps

*Acquire necessary resources and funding:*

- Describe innovation ecosystems
- Describe the healthcare sector to build strategic relationships and coalitions
- Use project management platforms (e.g., Jira, Trello, Asana) to manage resources
- Develop a funding strategy including relevant funding sources connected to development plan

*Develop and adapt a business strategy:*

- Evaluate and determine the most appropriate business model for viability and revenue generation within the healthcare space
- Create a go-to-market strategy
- Develop an exit-strategy by comparing the costs and benefits of potential exit options

*Develop and sell key messages for various audiences*

- Communicate to align with various audiences and/or business needs (e.g., funding, user acquisition, feedback, partnerships)
- Develop a non-confidential pitch deck that concisely communicates your innovation plan to various audiences
- Demonstrate effective visual communication by developing pitch decks to maximize clarity of message delivery
- Develop pitches of varying lengths for different audiences (e.g., elevator pitch)

## Exhibit A2

*Background research completed to understand the overall appetite of a program centred around biomedical innovation*

1. **Competitor Analysis** – This was completed to gain a better understanding of the current landscape of graduate-level biomedical innovation programming in North America. This analysis was completed in December 2020. The general workflow for this analysis is provided below:
  - Programs that satisfied two criteria: 1. a graduate education and 2. provided programming related to innovation were categorized based on subject focus: Engineering, Design, Digital, Business, Leadership, and Innovation Management.
  - Programs were assessed for:
    - Level and length
    - Target Audience
    - Program Format
    - Course Topics
    - Projects or practicums
    - Noteworthy features
  - Created an *“Innovation Programming Scan”* deliverable that includes Canada, European Union and United States Programs that teach Innovation
2. **In-depth Literature Review and Systematic Analysis** – Completed June 2020
  - Written systematic review of innovation programming and pedagogical best-practices in the fields of health, bioengineering and design
  - Gap analysis
  - Report of qualitative and quantitative measures
  - Created an *“In-Depth Literature Review and Systematic Analysis”* deliverable that includes journal articles about Innovation Education within the last 15 years
3. **Continuous consultation with undergraduate and graduate students** from IBEHS, School of Biomedical Engineering and Medical Sciences using formal and informal methods (e.g., interviews, focus groups, surveys).
4. **Formation of ad-hoc Advisory Committee** including faculty from IBEHS, Health ICE, Health Leadership Academy (HLA), clinicians, entrepreneurs, and external industry consultants.
5. **Engaged with community partners in the Hamilton space** (i.e., doctors, innovators, Health ICE) to act as mentors for future students.

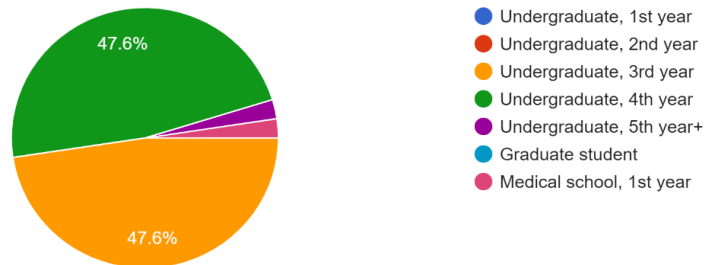
### Exhibit A3

A survey of 3<sup>rd</sup> and 4<sup>th</sup> year IBEHS students suggesting interest in Graduate level training

Below are results of an informal survey conducted of upper year undergraduate students in IBEHS. 42 responses were received between February 2 and 11, 2021.

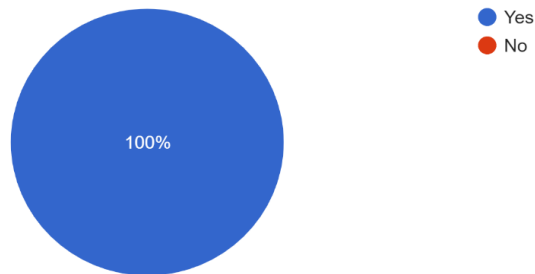
What level of education are you working on?

42 responses



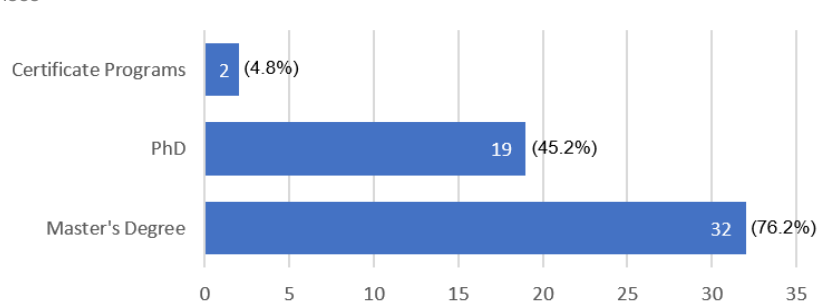
Have you considered additional studies?

42 responses



If yes, which of the following program options have you considered?

42 responses



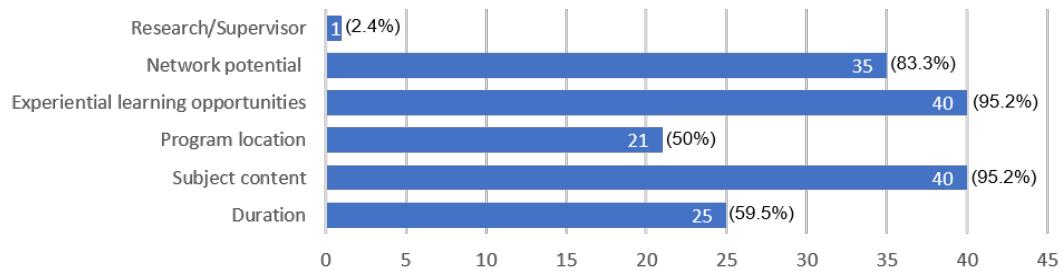
Please indicate the ideal length of a graduate program for you.

42 responses



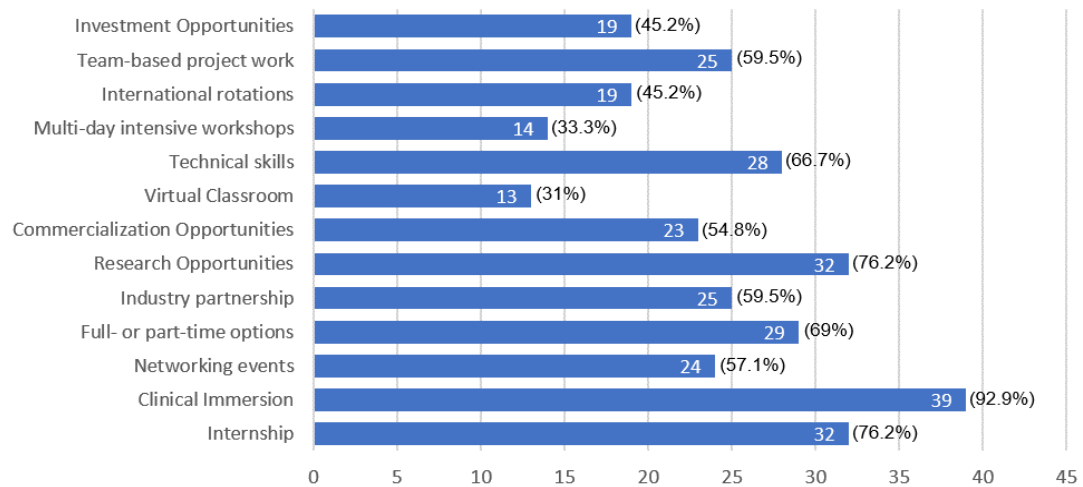
Please list any components of a graduate studies program that would be critical for you to consider applying.

42 responses



Please indicate which program components would be most interesting to you.

42 responses



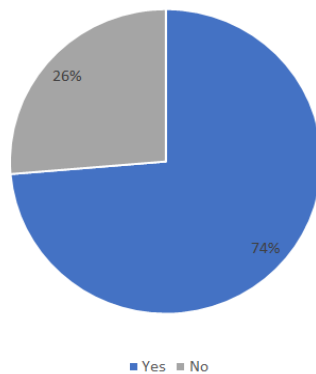
## Exhibit A4

*An informal survey of basic science researchers and clinicians at McMaster suggesting interest in Graduate level training focused on biomedical innovation*

Below are results of an informal survey conducted of basic science and clinician researchers in the Faculty of Science, Faculty of Health Science, and Faculty of Engineering. 28 responses were received between November 5 and December 5, 2021.






Would this training program have been valuable to you or your colleagues had it been previously available?

21 responses



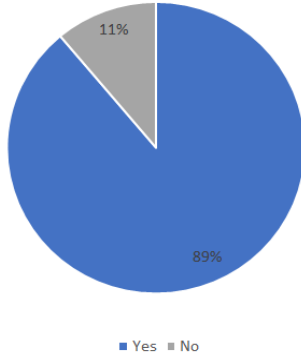
Summary of key themes from additional comments provided:

Why MBI would be valuable:

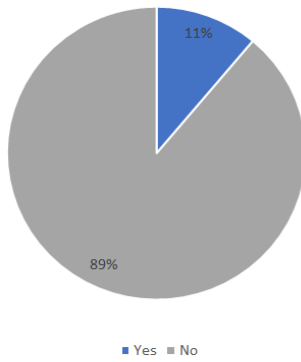
-  Education on navigating regulatory, reimbursement, IP, clinical, and market environment
-  Provides connections & skillsets needed to take innovation to market
-  Clinical immersion- framing problems by working directly with patients
-  12-month program length (ideal for clinicians)
-  Training can grow highly skilled innovation workforce in the biomedical sector

Would you recommend this training to individuals in your institution?

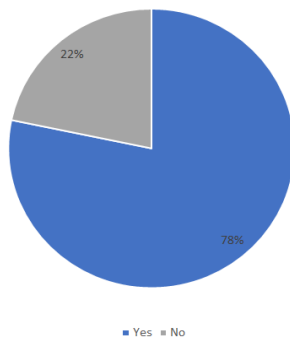
18 responses



Is there too much of a focus on innovation in the clinical setting?  
18 responses



Does the program itself and its delivery appear to be innovative?  
23 responses



## Exhibit A5

*Competitor analysis in Canada of various Universities providing Innovation and Entrepreneurship Masters programs.*

University	Faculty	Program Name	Duration
Queen's	Engineering and Smith School of Business	Master of Entrepreneurship and Innovation	12 months full-time
Toronto	Institute for Management and Innovation, (joint Administration, Business Management, Engineering Management)	Master of Management of Innovation	12 months full-time
McMaster	Engineering	Master of Engineering/ Technology Entrepreneurship and Innovation	20 months full-time
Ryerson	Engineering and Architectural Science	Master of Engineering Innovation and Entrepreneurship, Biomedical Engineering track	16 months full-time
Western	Engineering	Engineering in Medicine	12 months full-time, option for longer duration part-time
Ontario College of Art and Design (OCAD)	N/A	Design for Health	24 months full-time, 36 months part-time
McMaster	Health Sciences	Masters of Biomedical Discovery & Commercialization	12 months full-time
Guelph	Department of Molecular and Cellular Biology and Department of Business Management	Master of Biotechnology	12 months full-time, optional extension of research project to 16 months
Alberta	School of Business	MBA with Specialization in Innovation and Entrepreneurship	20 months full-time
McMaster	Social Science	Master of Public Policy in Digital Society	12 months full-time
Waterloo	School of Entrepreneurship and Business	Master of Business, Entrepreneurship, and Technology	12 months full-time, 36 months part-time
Toronto	Institute for Management and Innovation	Masters of Biotechnology	24 months full-time
Windsor	Science	Master of Science in Translational Health Science	12-months full-time

## **Exhibit A6**

### *Letters of Support from Key Stakeholders of the Program*

The following pages include four letters of support from:

- Dr. John G. Kelton, Executive Director, Michael G. DeGroot Initiative for Innovation in Healthcare
- Dr. Mohit Bhandari, Professor and Chair, Department of Surgery
- Jennifer McKinnell, Director, Health Sciences Library
- Dr. Heather Sheardown, Dean of Engineering





Dr. John G. Kelton  
Executive Director  
Michael G. DeGroot Initiative for Innovation in Healthcare

1280 Main St. W., HSC 3H50  
Hamilton, ON L8S 4K1

Tel: 905.525.9140  
Ext: 21706  
Fax: 905.524.2983  
Email: keltonj@mcmaster.ca

September 1, 2022

Dear Dr. Michelle MacDonald,

**Re: Letter of Support for the Master of  
Biomedical Innovation Program**

It is with pleasure and enthusiasm that I can write a letter of support in consideration of the Master of Biomedical Innovation (MBI) Graduate Program within the Department of Surgery in the Michael G. DeGroot School of Medicine at McMaster University. A number of years ago, Dean Paul O'Byrne charged me with helping to develop a culture of innovation and entrepreneurial (I&E) activity within the Faculty of Health Sciences at McMaster. With funding provided by a generous gift from Mr. Michael G. DeGroot and subsequently Dr. Marnix E. Heersink, we have been developing a number of complementary initiatives. The Master of Biomedical Innovation will be the pinnacle of all of these initiatives. The program is unique in that it is project-based, using the problem-based learning approach of Health Sciences. The curriculum covers the key competencies of I&E. These competencies in turn were developed by educators and entrepreneurs under the guidance of Dr. Alan Neville.

When we looked for a home department for this master's program, Dr. Mohit Bhandari, Chair of Surgery, expressed his highest level of enthusiasm, and in meetings with members of the department a similar level of enthusiasm was apparent. The development of this MBI has followed a number of steps including a "competitor analysis" performed by an outside consultant, the development of core competencies, a number of pilot educational programs, and most recently, content development by key educators including yourself, Michelle. I anticipate this master's will be both important and highly sought after.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "John G. Kelton".

John G. Kelton, CM, MD, FRCP(C)  
Executive Director, Michael G. DeGroot Initiative for

Innovation in Healthcare Distinguished University  
Professor, McMaster University  
Fellow, Royal Society of Canada  
Emeritus Dean and Vice President, Michael G. DeGroote Medical School, Faculty of Health  
Sciences



**MOHIT BHANDARI**, MD, PhD, FRCSC, O.Ont, C.M.  
Professor and Chair | Department of Surgery  
Canada Research Chair | Distinguished University Professor  
McMaster University

Lakeview Lodge, 3<sup>rd</sup> Floor  
Juravinski Hospital and Cancer Centre  
711 Concession Street  
Hamilton, Ontario L8V 1G3  
Tel: 905-521-2100 Ext. 73188  
Email: [bhandam@mcmaster.ca](mailto:bhandam@mcmaster.ca)

July 20, 2022

Dr. Michelle MacDonald  
Acting Director, MBI  
Co-Director  
Integrated Biomedical Engineering & Health Sciences  
Via email: [Macdonml@mcmaster.ca](mailto:Macdonml@mcmaster.ca)

Dear Michelle,

On behalf of the Department of Surgery, I am pleased to provide you with a letter of support for the Masters of Biomedical Innovation Graduate Program (MBI). The MBI will be unique in Canada as the only entrepreneurship education program that is biomedical-specific, matching healthcare-oriented student innovators with entrepreneurs whose mentorship will facilitate innovation project development. The one-year flexible curriculum delivery will be particularly attractive to members of my Department. Innovation and Entrepreneurship constitute one of the six pillars of the new C.R.E.A.T.E. strategic plan for the Department of Surgery and thus the opportunity to be the host Department for this new Program is completely in line with the direction in which the Department is moving.

To this end, we have been actively engaging members of our Department in discussions about the MBI. I remain confident that the Department will be able to provide a number of individuals who can be mentors and coaches for the MBI, and our trainees and junior members will certainly be encouraged to take this Program. I am also engaging surgical chairs from other institutions to discuss MBI as a potential stream of graduate study for their surgical trainees.

I look forward to collaborating with you and the other members of the Working Group who have been designing this very innovative graduate degree program.

Yours sincerely,

A handwritten signature in black ink, appearing to read "Mohit Bhandari".

Mohit Bhandari O.Ont, C.M. MD, PhD, FRCSC  
Distinguished University Professor  
Chair, Department of Surgery  
Senior Tier Canada Research Chair  
McMaster University



Health Sciences  
Library

Jennifer McKinnell,  
Director, Health Sciences  
Library Health Sciences  
Centre 2B28 1280 Main  
Street West Hamilton,  
ON L8S 4K1

(905) 525-9140 x 24381  
(905) 528-3733  
mckinn@mcmaster.ca  
hsl.mcmaster.ca

September 8, 2022

Michelle MacDonald, PhD  
Co-Director, Integrated Biomedical Engineering & Health Sciences  
Program Department of Biochemistry and Biomedical Sciences

Dear Dr. MacDonald,

I am writing in support of the new Master of Biomedical Innovation program. There are many areas where the Health Sciences Library (HSL) is well poised to support this new program. We have a history of working with experiential and evidence-based learning programs. The librarians and front-line staff are well versed in the processes necessary to teach learners the merits of finding, evaluating, and using the information to apply evidence-based practice and evidence-informed decision-making. However, when trying to understand the impact of any new program on the McMaster libraries, three aspects must be considered: collections, services, and space.

The HSL subscribes to and purchases a vast collection of journals, books, evidence-informed decision-making tools, and video content in subjects related to biomedical sciences, health care research, evidence-based practice, and the social determinants of health. The University Library (managed through Thode, Innis, and Mills Libraries) also provides extensive access to related information. Our interprofessional and interdisciplinary approach to licensing content means that, in most cases, we are already invoiced as a major research institution (meaning our subscription costs fall into the highest billing tier). As a result, adding new students and faculty will not bump us into a new payment category, nor will it force us to renegotiate the terms of our existing licenses.

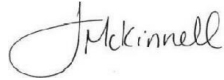
In terms of providing comprehensive health industry information, there are content gaps. As outlined in the proposed budget, the allocation of additional resource funds will be necessary to address these gaps.

The HSL has unused capacity in some of its service areas. Given the program's proposed size and the study level, the HSL can more than support these students through walk-in help and interlibrary loan services. However, the HSL will struggle to meet demand when considering complex graduate research support. Over time, the impact of this new program, combined with the pressures generated from McMaster's larger health innovation community, may require additional staff to meet demand. Assuming funds to hire other employees are currently limited, I recommend that curriculum developers work closely with the HSL to ensure ample time to plan learner interventions and information management support activities. It may be necessary to develop self-paced modules and other asynchronous learning activities to ensure the students develop the advanced information evaluation, use, and management skills we normally expect from our graduate students. Eventually, additional librarian support will be required.

McMaster's libraries have been operating well beyond space capacity for many years. Students often report that they cannot find a place to study in the library. However, it is unlikely that the proposed additional students will create significant extra strain on existing library space.

I am intrigued and excited to learn of the newly proposed Master of Health Innovation program. I believe the HSL is ready and willing to support the new learners. Although there are some areas where creative problem-solving and careful planning are required, I am endorsing the program proposal. Please feel free to contact me if you require additional information.

Yours sincerely,



Jennifer McKinnell  
Director, Health Sciences Library

---

**BRIGHTER WORLD**



September 30, 2022

Dr. Michelle MacDonald  
Acting Director, Master of Biomedical Innovation  
Co-Director, Integrated Biomedical Engineering and Health Sciences

Dear Michelle,

On behalf of the Faculty of Engineering, I am pleased to provide you with a letter of support for the Master of Biomedical Innovation Graduate Program (MBI). We, in Engineering, are enthusiastic about this program, and we look forward to partnering with our colleagues in the Faculty Health Sciences.

To my knowledge, the proposed Master of Biomedical Innovation (MBI) will be unique in Canada because it is an entrepreneurial-focused health program training students who have interest in health innovation with regard to all aspects of innovation and entrepreneurship. The content ranges from evaluating areas of care for opportunities to innovate, to the creation of systems or devices that will enhance overall patient care in its broadest sense. Engineering students and faculty are typically skilled with regard to devices, systems analysis, and "making products". Health Science students have unique expertise in the provision of care. I personally believe that this partnership, along with other partners from across the university, will provide unique opportunities for all.

Over the past two years I, and other colleagues in Engineering, have been working with you Michelle, Dr. Neville, Dr. Kelton, among others, to create this program and I am pleased that it is now moving forward to the operational stage. I can commit that we in Engineering anticipate assistance with problem sourcing, problem development, coaching, mentoring, and potentially teaching. We will certainly be encouraging our students to participate in the Master of Biomedical Innovation Graduate Program (MBI).

Congratulations on taking the Master of Biomedical Innovation to this point, and I look forward to it being implemented

Sincerely,

Heather Sheardown  
Dean of Engineering

# McMaster University



**MASTER OF BIOMEDICAL INNOVATION**

**Nov 11, 2022**

Reviewer 1

Name: John Frampton

University Address: Dalhousie University

Reviewer 2

Name: Kieran Murphy

University Address: University of Toronto

Internal Reviewer

Name: Leonard Waverman

Department: McMaster



**Executive summary:**

The mission of the proposed McMaster University, Master of Biomedical Innovation (MBI) program will be to provide multidisciplinary, project-oriented graduate-level education and training to accelerate biomedical innovation. This program will serve to bridge an important gap between medical device design and health systems technology. It will also complement McMaster University's existing undergraduate and graduate programs in medical science and innovation. The content will be delivered in the form of 1.5 credit hour courses, bootcamps, and experiential learning activities over the course of 1 year. While similar in format to other graduate level programs in innovation, the fact that the program will be situated in the Department of Surgery, which has been internationally recognized for innovation in medical education and clinical research, will certainly provide a range of experiences that set this program apart from other programs in Ontario and across Canada focused on educating and training future inventors, innovators, and entrepreneurs.

Through remote interviews with faculty members who participated in developing the program and its curriculum and interested students, the reviewers were able to assess the suitability of the overall program structure, its fit within McMaster University's mission, academic plan, and strategic mandate, and its feasibility with respect to the planned resource allocation. The review team enthusiastically supports the mission of this new program. On the subsequent pages, we have provided comments and recommendations that we hope will facilitate the program approval process and the subsequent program launch.

## Outline of the Visit

Was the site visit: In person:  Virtual site visit:  [Desk Review](#):

If the review was conducted either virtually or via desk review, was this format agreed to by both external reviewers? Yes  No

Was sufficient rationale provided by the Provost/Provost's delegate for an off-site visit?

Yes  No

For those reviews that included an in-person or virtual visit, please indicate the following (or insert the site visit schedule below):

- **Who was interviewed?**

- Vice-Provost and Dean of Graduate Studies (Dr. Steve Hranilovic)
- Acting Program Director (Dr. Michelle MacDonald) and Acting Administrator (Sarah Bouma)
- Curriculum Planning Group (Dr. Anna Korol, Dr. Fran Lasowski, Dr. Michelle MacDonald, Dave Mammoliti, Dr. Alan Neville, and Dr. Greg Wohl)
- Personalized Leadership (Karen Belaire, Dr. John Kelton, Rebecca Repa, and Dr. Kevin Smith)
- Faculty of Health Sciences Administration (Dr. Susan Denburg and Dr. Steven Hanna)
- External Experts (Fiona Bergin, Hugh Hoogendoorn, Dr. Renaud Jacquemart, Randy Peterson, Karen Scraba, and Dr. Leigh Wilson)
- Deputy Provost (Matheus Grasselli)
- Faculty Group (Dr. Wael Hanna, Dr. Michael Hartmann, Dr. Yasser Khan, Dr. Anna Korol, Dr. Michelle MacDonald, Dr. James MacKillop, Dr. Sean Park, and Dr. Bill Wang)
- Prospective Students (Deena Al-Sammak, Emnpreet Bahra, Daniel D'Souza, Lianna Genovese, Serenna Gerhard, Chris Griffiths, Jake Howran, Yuman Irfan, Tyler McKechnie, John Milkovich, and Sophini Supramanian)
- Senior Advisors (Dr. Mohit Bhandari, Dr. John Kelton, Dr. Alan Neville, and Dr. Heather Sheardown)

- **What facilities were seen?**

-None were seen in person. Video renderings were presented to show the planned departmental and learning spaces.

- **Comment on any other activities relevant to the appraisal.**

-The review was conducted via Zoom in the form of group interviews.

**In order to continuously improve the effectiveness and efficiency of site visits/virtual site visits, please comment on the following:**

- **How effective was the proposal brief in preparing you for the visit/virtual site visit?**

- The proposal did a good job of outlining the vision for the program and provided enough general information for the reviewers to understand the overall program structure and prepare questions about the details of the curriculum for the interviews.

- **How could the logistics of the visit/virtual site visit be improved?**

-Some of the sessions (those with 3 interviewees or fewer) could have been a bit shorter and other sessions (some with >9 interviewees) could have been slightly longer.

## **PROGRAM**

- **Comment on if the program's objectives clearly described**

-The proposal provided an overview of the key program objectives that will serve as a framework to develop a detailed curriculum. Overall, the proposal was thoughtfully prepared. The Program Committee may wish to provide additional written details in the following areas.

1) The proposal refers to a gap between device and health systems technology that will be addressed by the MBI program. Outlining some specific problems that need to be addressed to fill this gap would help to motivate the objectives of the program and distinguish it from other graduate level programs in biomedical science and innovation.

2) A major strength of the program is its emphasis on project-oriented and experiential learning. Students entering the program will work on either an individual project or (more preferably) a group project. It would be helpful to prospective students, faculty members, and mentors/coaches to have additional information about appropriate subject areas and scope for these projects. Providing an example of an ideal project would be helpful for students considering the program. The mentors/coaches will be a key part of the student experience. The team has done an admirable job of recruiting mentors/coaches already and is encouraged to continue to do so as they approach the program launch so that students will have access to a diverse range of skillsets and perspectives. It is recommended that the team develops a strategy for vetting projects at the beginning of the program.

3) It is recommended to begin mapping program objectives to program participants, including identifying faculty members who will teach courses and bootcamps and working with them to develop detailed syllabi/activity schedules.

- **Comment on the appropriateness of the degree nomenclature, given the program's objectives**

-Master of Biomedical Innovation (MBI) seems appropriate.

- **Comment on the consistency of the program with McMaster's mission and academic plan; whether the program learning outcomes are clear, appropriate and aligned with the undergraduate or graduate Degree Level Expectations.**

-The program is in alignment with McMaster's mission and academic plan. The Department of Surgery, several other academic units, and prospective students are all clearly in support of the program. The plans presented will be strengthened by including additional details about the projects, courses, and bootcamps, some of which were discussed in the interviews.

- **McMaster's Current Priorities and Strategic Mandate Agreement should be at the forefront of program design. This information can be found in the links provided below:**
  - i. **McMaster's Strategic Mandate Agreement:**  
<https://ira.mcmaster.ca/app/uploads/2020/11/McMaster-SMA3-Agreement-August-31-2020-SIGNED-FINAL.pdf>
  - ii. **McMaster's current priorities:**  
[https://president.mcmaster.ca/app/uploads/2021/05/Institutional-Priorities-and-Strategic-Framework\\_FINAL\\_5May21.pdf](https://president.mcmaster.ca/app/uploads/2021/05/Institutional-Priorities-and-Strategic-Framework_FINAL_5May21.pdf)

**Comments:**

See above.

**Specific Recommendations (where applicable):**

As noted above, the Program Committee may wish to provide additional details in the program proposal. The Program Committee is also encouraged to begin drafting detailed syllabi and preparing learning materials.

**ADMISSION & ENROLMENT**

- **Comment on whether the admission requirements (including any alternative requirements) are appropriately aligned with the program learning outcomes (and/or Degree Level Expectations) established for completion of the program.**

-The admission requirements include completion of an undergraduate honours degree, with a minimum of a B+ average in the final two years of study. There is also a requirement for introductory level entrepreneurship and innovation education along with practical experiences, which the team may wish to soften so as not to exclude students who for many reasons may not be exposed to entrepreneurship and innovation prior to learning about the MBI program. Candidates who meet the minimum admissions criteria will be invited for interviews.

- Are there any applicable alternative admission requirements, including how the program recognizes prior work or learning experience, and if so, are they appropriate?

-None were presented.

**Comments:**

See above.

**Specific Recommendations (where applicable):**

The program committee may wish to soften the requirements around entrepreneurship education and practical experience.

## STRUCTURE

- **Comment on how the program's structure and regulations meet the specified program learning outcomes.**

**NOTE:** The Quality Assurance Framework requires a clear distinction between program objectives, program-level learning outcomes, and [Degree Level Expectations](#). See the [Guidance on Program Objectives and Program-level Learning Outcomes for details on the distinction](#).

The program's structure mostly addresses learning outcomes A1-A9.

- **Is the program's structure and the requirements to meet the program objectives and program-level learning outcomes appropriate?**

Generally, yes. This should become clearer once detailed syllabi and course materials have been developed.

- Do the program's structure, requirements and program-level learning outcomes ensure students meet the institution's Undergraduate or Graduate Degree Level Expectations?

Generally, yes. This should become clearer once detailed syllabi and course materials have been developed.

- Does the (proposed) mode of delivery facilitate students' successful completion of the program-level learning outcomes?

Given the emphasis on group/experiential learning and projects, the mode of delivery seems appropriate.

- Does the curriculum address the current state of the discipline or area of study?

Yes, in a general sense. The structure of the curriculum is in line with other successful graduate level programs in innovation.

### **Comments:**

See above.

### **Specific Recommendations (where applicable):**

The Program Committee is advised to begin drafting detailed syllabi and course materials so that it is clear to everyone involved with the program how the program elements address specific learning outcomes and fulfill Degree Level Expectations.

## CURRICULUM AND TEACHING

- **Comment on how the curriculum reflects the current state of the discipline or area of study; evidence of significant innovation or creativity in the content and/or delivery of the program; the appropriateness and effectiveness of the modes of delivery at meeting program learning outcomes; and how teaching in the program prioritizes areas of accessibility and removes barriers to learning.**

### ***Comments:***

The program curriculum and teaching will provide dedicated innovation and entrepreneurship education and training focused on medical innovation. The program will be situated in the Department of Surgery offering students access to mentorship from leaders in clinical research.

### ***Specific Recommendations (where applicable):***

Draft syllabi should be developed and included with the proposal as it moves forward. Syllabi should include example topics, assignments, etc., and evaluation metrics. By including syllabi and bootcamp details it will also be easier for the team to make an argument for the uniqueness of the program.

## ASSESSMENT OF LEARNING

- Comment on the appropriateness and effectiveness of the proposed methods of assessment in demonstrating achievement of the program learning outcomes, as well as the extent to which the program(s) assess graduating student achievement of the program learning outcomes.
- Are the plans in place to monitor and assess the following, both appropriate and effective?
  - i. The overall quality of the program;
  - ii. Whether the program is achieving in practice its proposed objectives;
  - iii. Whether its students are achieving the program-level learning outcomes; and
  - iv. How the resulting information will be documented and subsequently used to inform continuous program improvement.

***NOTE: Programs should ensure that the plans for monitoring and assessing student achievement provide an assessment of students currently enrolled as well as post-graduation metrics. Please see [Guidance on Assessment of Teaching and Learning](#) for further details and examples of measures for assessing teaching and learning that meet the requirements of the Quality Assurance Framework.***

**Comments:**

These details were not presented in the program proposal.

**Specific Recommendations (where applicable):**

Details about assessment of learning should be included in the program proposal and in the syllabi to be developed. It will be important to identify a strategy for assessment of the bootcamps.

**RESOURCES TO MEET PROGRAM REQUIREMENTS**

- Comment on evidence that there are adequate human, physical and financial resources to sustain the quality of scholarship produced by undergraduate students.
- Given the program's class sizes and cohorts as well as its program-level learning outcomes:
  - a) Is the number and quality of core faculty who are competent to teach and/or supervise sufficient to achieve the goals of the program and foster the appropriate academic environment?
  - b) When adjunct/sessional faculty play a large role in the delivery of the program, is their role appropriate? Are plans in place to ensure the sustainability of the program and the quality of student experience and if so, are these suitable?
  - c) Is the provision of supervision of experiential learning opportunities adequate, if applicable?
  - d) Taking into consideration implications for other existing programs at the university, is the administrative unit's planned use of existing human, physical and financial resources appropriate?
  - e) Are there adequate resources available to sustain the quality of scholarship and research activities produced by students, including library support, information technology support, and laboratory access?

**NOTE: External Reviewers are not expected to assess the financial viability of a program, and internal budgets are not under the purview of the External Review of a New Program Proposal. Provide a general assessment of the administrative unit's planned use of existing financial resources.**

**Comments:**

The list of participants is impressive and collectively the number of participants and various areas of expertise are adequate to launch the program.

***Specific Recommendations (where applicable):***

Mapping program participants to specific curriculum elements (such as classes, bootcamps, project supervision) should help to demonstrate that resources and expertise are in place.

**QUALITY AND OTHER INDICATORS**

- Please provide commentary on the indicators the department will use over the first five years to document and to demonstrate the quality of the program.
- Comment on the quality of the faculty (e.g., qualifications, funding, honours, awards, research, innovation and scholarly record, appropriateness of collective faculty expertise to contribute substantively to the program and commitment to student mentoring).
- Comment on any other evidence that the program and faculty will ensure the intellectual quality of the student experience.
- Comment on any evidence of how faculty members will ensure the intellectual quality of the student experience.

-The reviewers did not have any specific comments related to quality and other indicators.

**CONFIDENTIAL SECTION**

Provide any commentary or recommendations on confidential areas.

***Comments:***

None.

***Specific Recommendations (where applicable):***

None.



## SUMMARY & RECOMMENDATIONS

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Provide a brief summary of the review. Please include commentary on any clearly innovative aspects of the proposed program together with recommendations on any essential or otherwise desirable modifications to it, as applicable.

Recommendations that are clear, concise, and actionable are the most helpful for universities as they prepare to launch new programs. Include specific steps to be taken on any essential or otherwise desirable modifications to the proposed program.

*NOTE: The responsibility for arriving at a recommendation on the final classification of the program belongs to the Appraisal Committee. Individual reviewers are asked to refrain from making recommendations in this respect.*

### Recommendation 1:

Consider expanding the pool of clinical mentors, for example, by including additional mentors from anesthesia, ER, critical care, interventional radiology, interventional neuroradiology, vascular surgery, cardiology, and other tool using professions.

### Recommendation 2:

At a high level, the program is exciting and has potential to accelerate innovation at McMaster among young innovators. To ensure that the program can be launched in the near future, the team should start developing detailed materials for courses, projects, and bootcamps.

### Recommendation 3:

The projects are viewed as the most important program element. It is recommended that students be strongly encouraged to work on projects in groups. This will also make administration and management easier.

### Recommendation 4:

Care should be taken in mentoring students to ensure that they appreciate that many business ventures fail, and that innovation often involves an element of risk. The Program Committee may wish to shift the emphasis towards learning how to think and work with an innovation mindset rather than starting a business.

### Recommendation 5:

Each program element should have an instructor or team member mapped to it. Drafting detailed syllabi and course materials should help identify program responsibilities and areas where additional expertise is needed.

### Recommendation 6:

Continue to review other similar programs around the world to avoid pitfalls and identify successful strategies to build a great program that can be adapted to meet student needs as the innovation landscape shifts.

Recommendation 7:

This is an ambitious program to be covered in three terms. The first year will give the Director and the faculty a very good indication of whether the time frame allowed is sufficient or should be increased by one term or more.

Recommendation 8:

Consider a formal committee structure to support student success.

Signature: **John Frampton** \_\_\_\_\_

Signature: \_\_\_\_\_  



Date: \_\_\_\_\_  
November 17, 2022

Signature: **Leonard Waverman** \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: **Kieran Murphy** \_\_\_\_\_

Signature: \_\_\_\_\_  


Date: \_\_\_\_\_  
Nov 17 2022

Recommendation 7:

This is an ambitious program to be covered in three terms. The first year will give the Director and the faculty a very good indication of whether the time frame allowed is sufficient or should be increased by one term or more.

Recommendation 8:

Consider a formal committee structure to support student success.

Signature: John Frampton \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: Leonard Waverman \_\_\_\_\_

Signature:  \_\_\_\_\_

Date: 12/11/2022 \_\_\_\_\_

Signature: Kieran Murphy \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Master of Biomedical Innovation

External Review  
Program Response

*December 14, 2022*

On behalf of the curriculum planning group for the Master of Biomedical Innovation (MBI) graduate degree, we are appreciative of the review panel's time and expert assessment of the program. It was encouraging to read that the panel, *"enthusiastically supports the mission of the new program"* and considers that, *"a major strength of the Program is its emphasis on project-oriented and experiential learning."*

The review panel provided eight recommendations for consideration by McMaster University to improve the program and guide it to a successful implementation. To best respond to the reviewer's feedback, supplemental planning material has been created by the planning group and added to this narrative response. The appendices provide examples of more detailed curricular information and planning documents cited by the reviewers as important to the review process to assess teaching activities and graduate-level expectations.

**Response to Recommendations:**

**Recommendation 1: Consider expanding the pool of clinical mentors:**

The MBI program is being developed in collaboration with the Michael G. DeGroot Health Innovation, Commercialization, and Entrepreneurship group that has created a health innovation incubator called, *The Clinic*. Through *The Clinic*, there is a growing number of mentors (currently ~20) with varied expertise, interested in advising McMaster health innovators. The Clinic is actively developing its network within the Faculty of Health Sciences and is leading events to introduce clinical faculty members, with biomedical innovation and entrepreneurship experience, to learn about opportunities to be a mentor in the MBI and other Clinic initiatives. For example, a recent 'innovation synergy' meeting brought together innovation-minded faculty from the Faculty of Health Sciences, Department of Medicine, and biomedical engineers from the Faculty of Engineering to network and discuss opportunities for collaborations in project development. From meetings such as these, we expect to recruit clinical and non-clinical project mentors for project teams in the MBI.

**Recommendation 2: The team should start developing detailed materials for courses etc.**

The program team is actively building curricular plans, program content, and bootcamp-based experiences. To demonstrate the progress of this work outlines for three courses are provided (Appendix A) and an overview of the first bootcamp is also attached (Appendix B). These outlines describe the course objectives, student activities, required readings and student

assessment. A course instructor has been identified for each of these courses. Planning for the remaining courses is underway with an expected completion of Spring 2023.

**Recommendation 3: Students should be encouraged to work in groups.**

The MBI Planning Group is aware of the importance of the “Co-Founder” factor in successful innovations and will strongly encourage students to work on a project in a team.

**Recommendation 4: Promote innovation mindset over starting a business.**

This is an important recommendation. The planning group heeds the feedback that the proposal over-emphasizes the value proposition that an MBI student will graduate the program as an entrepreneur with a marketable product. The planning group is in full agreement that the opportunity for students will be to develop expertise in biomedical entrepreneurship and gain an innovation mindset. Revisions to the proposal language will be made and emphasized in the recruitment strategy through marketing materials and promotion plans.

**Recommendation 5: Each program element should have an instructor.**

Course construction and faculty recruitment for course leadership is underway. A preliminary list of course instructors is attached (Appendix C). Recruitment is expected to be complete by Spring 2023.

**Recommendation 6: Continue monitoring similar programs and strategize to meet student needs in a changing innovation landscape.**

An environmental scan of Canadian comparator programs is provided (Appendix D). A scan of international programs has been completed and can be made available upon request. The MBI Planning Group will continue to monitor the entrepreneurship education environment, scanning university/college websites, social media announcements, meeting, and conference announcements, etc. Feedback from external mentors and collaborators, as well as international partners at the University of Alabama Birmingham, Marnix E. Heersink Institute for Biomedical Innovation and Entrepreneurship to ensure the program remains responsive to the evolving innovation learning landscape.

**Recommendation 7: Monitor program time frame sufficiency.**

The Program Director and the planning group will be carefully following the progress of the first cohort of MBI students to monitor objective achievement within the one-year timeframe. Given that production of a marketable innovation, the product is not required for degree completion, the planning team remains confident that the twelve-month timeframe will be appropriate.

**Recommendation 8: Formal committee structure to support student success.**

An Academic Progress Committee will be formed to review students struggling to achieve program objectives and will offer recommendations to support their success. Students will also be supported with a program faculty advisor who will help guide their learning journey in the MBI.

## **Response to Additional Report Commentary**

### **1. Program Objectives:**

The MBI will be the first biomedical innovation graduate degree program in Canada that will offer students the opportunity for students to innovate across the health innovation continuum from the design of new devices to health system solutions. The proposal provides examples of potential projects that have developed out of The Clinic. For example, the proposal describes a successful student-led innovation of an assistive device that enables people with limited fine motor skills to write and draw. Another student team has developed a modified “manipulable” endotracheal tube to combat the problem of difficult airway curvatures. Both projects have progressed along the innovation pathway; the former is now commercially available. Potential MBI students will be made aware of such projects and the supportive educational entrepreneurship ecosystem that has allowed these innovations to develop successfully.

### **2. Admission & Enrolment:**

The review panel suggested that program prerequisites be broader. The planning team appreciated this feedback and will be revising the criteria to identify entrepreneurship and innovation education or experience as an asset but not a requirement for admission.

### **3. Structure:**

Each course is based on one or more of the nine competencies and their associated enabling competencies as detailed in the MBI Proposal (Exhibit A1 page 30). Each learning outcome identified in the proposal relates to one of the competencies and is mapped to the corresponding graduate degree-level expectations (MBI Proposal, page 8).

#### **Assessment of Learning:**

As noted in the MBI Proposal, students will receive a final grade for each course. The format of assessment will be similar for each course and will be defined as the course curricula are further developed. Students will attend a case-based bi-weekly tutorial and will be assessed on their performance in the tutorial, via contribution to discussion, ability to apply the course concepts to the case, collaboration with fellow students, and professional behaviour. Assessment during bootcamps will include oral pitch presentations on the status of their projects to peers and team self-reflections on their performance in project development. Lastly, during each quarter course, students will undertake a written reflection on their application of the course concepts to their project as well as a written assignment commentary on an entrepreneurship case. For the project courses (MBI 701, 702, 703), each team of students will make an oral presentation and a written report to their coach that assess their attainment of milestones for their project that reflects the program learning outcomes/competencies.

Milestones are detailed below:

**Milestone 1: Identify needs**

- What is the health/biomedical need you have identified; what value can be gained through solving the identified need and to whom is this value brought

**Milestone 2: Assess market landscape**

- Prepare a 1-2 page depiction of the existing and emerging solution landscape (clinical, utilization, economic) for your identified area and relevant needs; prepare a gap analysis of the solution landscape (charts, graphs, visuals)

**Milestone 3: Develop prototype**

- Prepare a 1-2 page depiction of your ideation process and solution front-runners based on the need criteria, existing solution landscape and initial stakeholder feedback through prototype testing

**Milestone 4: IP and Regulatory Strategy**

- Create a spreadsheet outlining your analysis of relevant patents; consider the medical classification and regulatory pathway of your proposed solution; discuss the development process of your proposed solution

**Milestone 5: Funding Strategy**

- How will you acquire the necessary resources and funding to move your innovation forward; outline potential pitch competitions and incubators you can access; determine your customer/beneficiary and how you propose to acquire them

**Milestone 6: Pitch product or process**

- Prepare a 5-minute pitch of your proposed solution; What is your technology readiness level (TRL); outline the testing plan, proposed timeline and resources needed to progress this project.

**Appendix A:**  
**Course Outlines for MBI**

The following pages include outlines of the following MBI courses:

Appendix A1: Course Outline for MBI 701- Clinical Immersion Stream Project .....	6-10
Appendix A2: Course Outline for MBI 704- New Value Creation .....	11-16
Appendix A3: Course Outline for MBI 706- Intellectual Property .....	17- 21



**Appendix A1:**  
**Masters of Biomedical Innovation (MBI)**  
**MBI 701 – Clinical Immersion Stream Project**  
**Fall 2023 Course Outline**

**COURSE DESCRIPTION**

This is an experiential, project-based course that gives students the opportunity to apply concepts from courses and bootcamps to an innovation-driven project. Students will work in teams to identify and design solutions for unmet clinical needs based on exposure to real-world healthcare environments and clinical stakeholders. Students will be evaluated on the completion of a set of milestones that focus on the desirability, feasibility and viability of their innovation with access to personalized coaching, mentorship and leadership development. Emphasis will be placed on user-centred design, entrepreneurship competencies, and development of teamwork and communication skills.

**INSTRUCTOR AND CONTACT INFORMATION**

Instructor: Anna Korol  
[korola3@mcmaster.ca](mailto:korola3@mcmaster.ca)

Office Hours: TBD

**LEARNING OUTCOMES**

Upon successful completion of the course, the student should be able to:

A1	<b>Identify</b> unmet clinical needs in a healthcare setting and prioritize using a decision matrix
A3	<b>Evaluate</b> the value proposition of a biomedical product or process
A9	<b>Communicate</b> with various stakeholders engaged in the healthcare system
A6	<b>Engage</b> in co-creation and collaboration when designing novel tools and services
A4	<b>Outline</b> the procedural and documentation requirements related to intellectual property and biomedical technology testing
A6	<b>Implement</b> strategies for effective leadership and conflict management when working in a team setting

## COURSE REQUIREMENTS

### Textbooks

There is *no required textbook* for the course. All required reading materials will be made available for free as online documents through the course management system (Avenue) and through use of peer-reviewed literature available online through the [McMaster library](#).

### Hospital Placement Health and Safety Training Requirements

To enter hospitals, students require health and safety clearance from the Faculty of Health Sciences Health Screening Office and the Hamilton Health Sciences Student Affairs office.

Placements are located within a healthcare setting. The hospitals and healthcare facilities continue the requirement to wear a **medical mask** while indoors, therefore you will be required to wear a mask during placements and to follow all guidelines required by the hospital site. The university continues to monitor the situation closely and update the [covid19.mcmaster.ca](https://www.mcmaster.ca/covid19) website.

## COURSE ACTIVITIES

This course will be delivered through roundtable coaching sessions, and on-site hospital placement. Students will initially be placed in small groups in one of four different clinical areas to identify opportunities for innovation (Interventional Radiology, Neurosurgery, Vascular Surgery, Cardiology). Through observation and discussion with clinicians in these clinical areas, students will begin to identify unmet needs (problem identification) On-going meetings with the clinicians and support from their coaches will allow students to prioritize unmet needs, develop needs statements, identify root causes of the observed problems and proceed to problem validation through literature searches and communication with potential stakeholders. The desirability, feasibility and viability of solving these needs will inform the clinical project focus for MBI 702.

**COACHING SESSIONS:** Two hours every other week

The purpose of the coaching time will be to:

- Introduce project milestone concepts through the Biomedical Innovation Roadmap
- Receive coaching and access to external mentors as project progresses
- Lead discussions with project teams to share project progress and placement experiences
- Seek feedback through team-team check-in meetings
- Protected time and space to collaborate and ideate as a team on completion of milestones
- Make oral presentations to coaches to allow for assessment of application of course concepts to your project.

**HOSPITAL PLACEMENTS:** After the first placement (approximately 4 hours), subsequent meetings with the clinician, either in the clinical setting or in an office setting will be determined by the need for further observations to clarify the unmet needs/problem identification and their prioritization.

The purpose of this block is to:

- Identify unmet clinical needs and opportunities for innovation in a healthcare setting
- Communicate with various stakeholders engaged in the healthcare system
- Test the desirability, feasibility and viability of a novel tool or service in a clinical setting

7

## ASSIGNMENTS AND EVALUATION

Throughout the course, you will complete a set of milestones and oral presentations that reflect your ability to apply the concepts learned in MBI 704,705 and 706 to your project:

<b>Individual Assessments</b>	<b>Weight</b>
Oral Presentations(OP)	25%
OP 1 Clinical area background and the healthcare system	
OP 2 Needs finding and filtering process	
OP 3 Assess market landscape and existing/emerging solutions	
OP 4 IP and Regulatory Considerations	
Instructor and Coach impression mark	10%
<b>Team-Based Assessments</b>	
Biomedical Innovation Project-Milestone template completion	40%
Milestone 1 Problem Identification	
Milestone 2 Assess Market Landscape	
Milestone 4 IP and Regulatory Strategy	
Final Assessment	25%
Final Report and Application	

## GRADE CONVERSION

At the end of the course your overall percentage grade will be converted to your letter grade in accordance with the following conversion scheme.

LETTER GRADE	PERCENT	LETTER GRADE	PERCENT
A+	90 to 100	B+	75 to 79
A	85 to 89	B	70 to 74
A-	80 to 84	B-	60 to 69
F	0 to 59		

## ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at: [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity)

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations

## AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically via A2L so it can be checked for academic dishonesty. Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software.

**All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

## LATE AND MISSED ACADEMIC WORK

Where students miss a scheduled deliverable or are absent for a required component for legitimate reasons as determined by the course instructor, the weight for that deliverable/component will be distributed across other evaluative components of the course at the discretion of the instructor. Documentation explaining the circumstances that resulted in missing the scheduled deliverable or assessment must be provided to the course instructor within five (5) working days of the missed deadline.

If you do not submit documentation for a missed deliverable or the course instructor determines that your reason is not legitimate, you will automatically lose 10% for each day your deliverable is late.

## POTENTIAL COURSE MODIFICATIONS

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

**Appendix A2:**  
**Masters of Biomedical Innovation – Fall 2023**  
**MBI 704 – Opportunities for New Value Creation**  
**Course Outline**

**COURSE DESCRIPTION**

This initial course is designed to allow learners to identify unmet needs, identify potential root causes of observed problem(s), and validate them. Students will also learn how the healthcare system functions so that they can identify important stakeholders in the healthcare space. They will develop decision matrices for prioritizing observed needs.

**INSTRUCTOR AND CONTACT INFORMATION**

**Instructor:** Professor Michael Hartman  
**Support Instructor:** Sean Park  
**Email:** [mhartma@mcmaster.ca](mailto:mhartma@mcmaster.ca)

**LEARNING OUTCOMES**

Upon completion of this course, MBI students will be able to:

- Develop a decision matrix to help with prioritization of unmet needs
- Identify unmet needs and articulate as need statement
- Identify the potential root cause(s) of the observed problem(s)
- Identify and prioritize stakeholders in the healthcare space
- Map out the current workflow/infrastructure
- Validate the problem (through publications, hospitals, stakeholder interviews, etc.)
- Conduct background research into your area of interest

## REQUIRED READINGS

Barsoux J-L et al. Identifying Unmet Needs in a Digital Age. *Harvard Business Review*; July-August 2022.

Jacoby, A. (2017). Reframing the problem: Design thinking essentials. Reading: *Academic Conferences International Limited*.

MacFadyen, J. S. (2014). Design Thinking. *Holistic Nursing Practice*, 28 (1), 3-5. doi: 10.1097/HNP.000000000000008.

Roberts, J. P., Fisher, T. R., Trowbridge, M. J., Bent, C. (2016). A design thinking framework for Healthcare Management and Innovation. *Healthcare*, 4(1), 11–14. Doi: 10.1016/j.hjdsi.2015.12.002

Saidi, T., Mutswangwa, C. T., & Douglas, T. S. (2019). Design thinking as a complement to human factors engineering for enhancing medical device usability. *Engineering Studies*, 11(1), 34–50. Doi: 10.1080/19378629.2019.1567521

## SUPPLEMENTARY READINGS

Liedtka J. Why Design Thinking Works. *Harvard Business Review*. September-October 2018

McCarthy et.al. Unmet needs: relevance to medical technology innovation. *J.Med. Eng. Technol*, 2015;39(7): 382-387

*What is a decision matrix?* ASQ. (n.d.). Retrieved November 11, 2022, from <https://asq.org/quality-resources/decision-matrix> .

## COURSE ACTIVITIES

### Introductory Bootcamp (In-Person)- Needs Finding & Problem Exploration

Day 1: Lecture with panel and a Q&A introducing the needs exploration, problem identification and prioritization, worked example with entrepreneurs

Day 2: Mini-Project focused on needs-finding with a team related to the clinical theme of the week (device, digital, pharma streams)

Day 3: Facilitated session bringing in: 2-4 clinicians, 2-4 patients, 2-4 researchers for students to identify unmet needs live

Day 4: Mini-Project group presentations

MBI- 704, New Value Creation, 2023-2024

12

### **Content Delivery (Online, asynchronous)**

Each week there will be one 20 minute video of an entrepreneur explaining how they have applied the course learning objectives to their health start-up. These worked examples will feature medical devices, digital health, diagnostics, and pharmaceuticals across the duration of the course.

### **Tutorials (Online, synchronous)**

Bi-weekly tutorials will be two hours in duration and focus on a group-based guided discussion of written case studies demonstrating application of course concepts to medical device, digital health, diagnostic, or pharmaceutical innovation projects. Students will be evaluated on participation and contributions to discussions at these sessions.



## ASSIGNMENTS AND EVALUATION—MBI 704

Students' grades will be calculated as follows:

<b>Deliverable</b>	<b>Evaluated by:</b>	<b>Weight</b>
Written assignment, week1	Instructor	40%
Written assignment, week 3	Instructor	40%
Tutorial Evaluation	Tutor	20%
Total		100%

*PLEASE NOTE: Any late submissions will incur a 10%, per day, late penalty.*

## GRADE CONVERSION

At the end of the course your overall percentage grade will be converted to your letter grade in accordance with the following conversion scheme.

LETTER GRADE	PERCENT	LETTER GRADE	PERCENT
A+	90 to 100	B+	75 to 79
A	85 to 89	B	70 to 74
A-	80 to 84	B-	60 to 69
F	0 to 59		

## ACADEMIC INTEGRITY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at: [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity)

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations

## AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically via A2L so it can be checked for academic dishonesty. Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software.

**All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to [www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity).

## LATE AND MISSED ACADEMIC WORK

Where students miss a scheduled deliverable or are absent for a required component for legitimate reasons as determined by the EMBA Academic Director, the weight for that deliverable/component will be distributed across other evaluative components of the course at the discretion of the instructor. Documentation explaining the circumstances that resulted in missing the scheduled deliverable or assessment must be provided to the EMBA Academic Director within five (5) working days of the missed deadline.

If you do not submit documentation for a missed deliverable or the EMBA Academic Director determines that your reason is not legitimate, you will automatically lose 10% for each day your deliverable is late.

## POTENTIAL COURSE MODIFICATIONS

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

**Appendix A3:**  
**Masters of Biomedical Innovation – Fall 2023**  
**MBI 706 – Intellectual Property**  
**Course Outline**

**COURSE DESCRIPTION**

Protecting one's invention is the most important aspect of creating a successful health innovation! Intellectual Property comes in many different shapes and forms: patent (protecting the function or design of your solution), trademark (protecting a specific name or phrase), copyright (protecting written framework) or a trade secret (the know how or secret recipe to your solution). All can act as a competitive advantage and allow the commercialization and monetization of ideas. This course is designed to allow learners to identify the types of IP and how they can create an IP strategy that supports their businesses. Students will be able to search IP literature and identify if their ideas are patentable and will have freedom to operate. Resources available at the Clinic and McMaster will be identified to assist with IP strategies and support.

**INSTRUCTOR AND CONTACT INFORMATION**

**Instructor:** Frances Lasowski  
**Email:** Lasowsfj@mcmaster.ca

**LEARNING OUTCOMES**

Upon completion of this course, MBI students will be able to:

- Conduct patent searches
- Evaluate IP protection mechanism and identify relevant requirements (novelty usefulness, non-obviousness)
- Determine confidential aspects of the novel solution and mechanisms for maintaining confidentiality in externally-facing communications (ex. NDAs)
- Collaborate with relevant parties (e.g. legal support, MILO) to develop and execute an IP strategy

## REQUIRED READINGS & RESOURCES

- MILO IP Handbook
- CIPO Intellectual Property: It's yours. Own it. Factsheet
- CIPO IP Foundations Series
- CIPO IP Management Series
- Kelly Holloway & Matthew Herder (2019) A responsibility to commercialize? Tracing academic researchers' evolving engagement with the commercialization of biomedical research, *Journal of Responsible Innovation*, 6:3, 263-283, DOI: [10.1080/23299460.2019.1608615](https://doi.org/10.1080/23299460.2019.1608615)
- Link, A. N., Danziger, R. S., & Scott, J. T. (2018). Is the bayh-dole act stifling biomedical innovation? *Issues in Science and Technology*, 34(2), 33-35.
- Other relevant IP readings to cases

## COURSE ACTIVITIES

### Bootcamp 1 (In-Person)

Day 1: IP searches and resources available through McMaster

Day 2: IP debate (teams will be given cases that went to court or are before the courts over patent infringement and compensation)

### Content Delivery (Online, asynchronous)

Each week there will be one 20 minute video outlining the basics of IP or the nuances of IP for different health care areas (i.e. pharmaceuticals, medical devices, digital health solutions, etc). These will include case studies of specific companies that used creative IP strategies to secure their strategic advantage in the market place.

### Tutorials (Online, synchronous)

Bi-weekly tutorials will be two hours in duration and focus on a group-based guided discussion of written case studies demonstrating application of course concepts to medical device, digital health, diagnostic, or pharmaceutical innovation projects. Students will be evaluated on participation and contributions to discussions at these sessions.

<b>ASSIGNMENTS AND EVALUATION</b>
-----------------------------------

Students' grades will be calculated as follows:

<b>Deliverable</b>	<b>Evaluated by:</b>	<b>Weight</b>
Bi-Weekly Assignments (3)	Instructor	36%
IP Debate	Instructor	10%
Final Report (In Residency)	Instructor / Capstone Faculty / Sponsor	30%
Tutorial Assessments	Instructor/Tutor	24%
Total		100%

*PLEASE NOTE: Any late submissions will incur a 10%, per day, late penalty.*

## GRADE CONVERSION

At the end of the course your overall percentage grade will be converted to your letter grade in accordance with the following conversion scheme.

LETTER GRADE	PERCENT	LETTER GRADE	PERCENT
A+	90 to 100	B+	75 to 79
A	85 to 89	B	70 to 74
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## ACADEMIC INTEGRITY

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If you do not submit documentation for a missed deliverable or the EMBA Academic Director determines that your reason is not legitimate, you will automatically lose 10% for each day your deliverable is late.

## **POTENTIAL COURSE MODIFICATIONS**

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.



# Appendix B: Masters of Biomedical Innovation Fall 2023 Bootcamp

	Monday September 11	Tuesday September 12	Wednesday September 13	Thursday September 14	Friday September 15
<b>MORNING</b> 8:30 a.m. – 12 p.m.	Program Orientation Faculty and Student Introductions Icebreaker Activity	Reflection MBI 705 Market Assessment Activities, Guest Speakers TBD	Immersion Innovation Experiences Biointerfaces Institute Makerspace 3D Printing	Reflection MBI 704 New Value Creation Activities, Guest Speakers TBD	Reflection MBI 705 Pitch Fundamentals and Practice Pitch Activites
<b>LUNCH</b> Noon- 1:00 p.m.	Lunch Guest Speaker: Dr. Kevin Smith	Lunch	Lunch	Lunch Guest Speaker: Rebecca Repa	Lunch
<b>AFTERNOON</b> 1:00 – 4:30 p.m.	MBI 704 New Value Creation Activities, Guest Speakers TBD	MBI 704 New Value Creation Activities, Guest Speakers TBD	Immersion Innovation Experiences McMaster Hospital Network Locations TBD	MBI 705 Value Proposition Activities, Guest Speakers TBD	MBI 701 Pathways to Problem Identification and Validation
<b>EVENING</b> 5:00 – 8:30 p.m.	Opening Dinner Guest Speaker: Dr. Marnix Heersink	Dinner Coaching and Mentoring Activities		Innovation Synergy Networking Event	

### Appendix C

#### Master of Biomedical Innovation

##### Preliminary Course Instructor Summary

	<i>Name</i>	<i>Title</i>	<i>Department</i>
<b>701</b>	Anna Korol	Assistant Professor	Medicine
<b>702</b>	Bill Wang	Assistant Professor	Surgery
<b>703</b>	Anna Korol	Assistant Professor	Medicine
<b>704</b>	Michael Hartmann	Professor	Medicine
<b>705</b>	t.b.d.		
<b>706</b>	Frances Lasowski	Adjunct Professor	Engineering
<b>707</b>	Sean Park	Assistant Professor	Medicine
<b>708</b>	t.b.d.		
<b>709</b>	Michael Hartmann	Professor	Medicine/Business
<b>710</b>	Jon Stokes	Assistant Professor	Biochemistry
<b>711</b>	t.b.d.		
Electives	Jon Stokes	Assistant Professor	Biochemistry
	Mehdi Moradi	Associate Professor	Engineering

**Appendix D:  
MBI Comparison to Existing Masters Programs**

<b>University</b>	<b>Faculty</b>	<b>Program</b>	<b>Unique Offerings</b>
McMaster University	Health Sciences	Master of Biomedical Innovation (MBI)	<p>Learners will apply the theories and entrepreneurship competencies acquired throughout the curriculum to a program-long, venture-oriented project course, with opportunities to identify a biomedical problem to work on or start with a project idea the student already has in mind.</p> <p>Team projects may include innovations in medical devices, diagnostics, therapeutics, digital technologies, or drug delivery systems.</p> <p>By the end of the program, graduates will have gone through the full life-cycle of creating a business and product with the personalized support of coaches and mentors as well as leadership training.</p> <p>Students will have access to The Clinic @ Mac facility offering commercialization support, events, collaborative workspace, and access to resources.</p>
McMaster University	Engineering	Master of Engineering/Technology Entrepreneurship and Innovation (MEEI/MTEI)	<p>The Enterprise Project is at the heart of this program, spanning the entire study period. This project will result in both a business and a viable Proof-of-Concept.</p> <p>Evaluation for the project consists of three defence-like presentations to a 5-person Enterprise Advisory Committee to ensure students are effectively applying skills and competencies from the courses to this project.</p>
McMaster University	Health Sciences	Master in Biomedical Discovery & Commercialization (MBDC)	<p>Includes an internship in sectors related to the pharmaceutical or biotechnology industry.</p> <p>Biomedical consulting projects train students to create business plans, market assessments and a pitch deck for new ventures. Teams are paired with an entrepreneur or company to gain first-hand experience.</p>
University of Toronto	Institute for Management and Innovation	Master of Management Innovation (MMI)	<p>Designed for individuals interested in pursuing management careers in technology-focused organizations.</p> <p>The final 4 months of the 12-month program are dedicated to a mandatory internship.</p> <p>One-on-one coaching and mentorship opportunities are available as well as professional development workshops to assist in internship searching.</p>
Queens University	Smith School of Business	Master of Management Innovation and Entrepreneurship (MMIE)	<p>Provides students with business and design skills to succeed as entrepreneurs, including a year-long project opportunity for experiential learning.</p> <p>Three highly intensive, on-campus bootcamp style sessions spread throughout the program designed to develop business acumen.</p> <p>Access to pan-university incubator/accelerator, engineering labs and SparQ Maker space.</p>

December 21, 2022

Dr. Steven Hranilovic  
Vice-Provost and Dean of Graduate Studies  
Gilmour Hall, 212, McMaster University  
1280 Main St. West  
Hamilton, ON L8S 4K1

**Re: Master of Biomedical Innovation (MBI) New Program Review - Faculty's Response**

Dear Steve,

We thank Drs. Frampton, Murphy, and Waverman for their thoughtful review of the proposed Master of Biomedical Innovation program in the Faculty of Health Sciences. We agree with their assessment that a major strength of the proposed program is its project-oriented and experiential approach. In addition to overall commentary, the reviewers make a number of helpful suggestions for ensuring the success of the program. We have reviewed the program team's response to the review report, and we are confident that they are appropriately addressing the recommendations in the run-up to the program's launch.


The reviewers prudently request that more detail be provided regarding the assessment of learning, draft course outlines, and teaching staff assignments. The program team has responded appropriately, with additional details. Although we recognize that curriculum details and staffing arrangements are necessarily tentative at this time, we agree that these details are helpful for appraising the scholarly weight and the required capacity for instruction, and we are reassured by the program team's response. The program has a good start in recruiting clinical mentors to work with students and we expect that the work of expanding and diversifying this pool will be continuous and ongoing.

We agree with the reviewers' suggestion to encourage students to work on their projects in groups. We recognize that individual assignments are the norm for graduate education, and so we encourage the program to search out the best practices for group-based assignments and evaluation. The reviewers also recommend that curriculum should emphasize an innovation mindset, rather than the expectation that the students will start a business arising from their work in the course. The program team notes the wisdom of this, generally, as well as appropriately emphasizing that this addresses the reviewers' question of whether the 12-month curriculum is realistic.

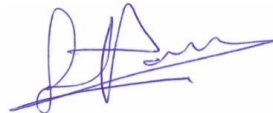
Once again, we thank the reviewers for their insightful report. We thank the program team for their well-crafted self-study and thorough response to the review. We are confident that this innovative program will be a successful and sustainable addition to the line-up of excellent graduate programs in

Health Sciences at McMaster University. Finally, we thank the staff in the School of Graduate Studies for their significant support in mounting a successful site visit.

Sincerely,



Susan Denburg  
Executive Vice-Dean and  
Associate Vice-President, Academic  
Faculty of Health Sciences



Steven Hanna  
Vice-Dean and  
Associate Dean of Graduate Studies  
Faculty of Health Sciences

cc: Christina Bryce, Assistant Graduate Secretary  
Stephanie Baschiera, Associate Registrar and Graduate Secretary

**New Graduate Program or Existing Program Undergoing Major Changes (more than 30%)**

**Details of Resource Implications and Financial Viability**

**Faculty:** Health Sciences

**Program Name:**

Master of Biomedical Innovation

**A. FINANCIAL SUSTAINABILITY OF PROGRAM**

Complete New Graduate Program Budget template (appendix A1) which will populate table below:  
 In the case of Interdisciplinary programs, also append the Draft MOU between faculties. (Appendix A2)  
 In the case of Collaborative programs, also append the Draft MOU between institutions. (Appendix A3)

REVENUE	2023/24	2024/25	2025/26	2026/27	2027/28
Program Generated Gross Graduate Revenue	\$475,500	\$821,705	\$1,003,568	\$1,185,697	\$1,356,848
Other Revenue (Specify)	\$300,000	\$150,000	\$50,000	\$0	\$0
<b>Total Gross Revenue</b>	<b>\$775,500</b>	<b>\$971,705</b>	<b>\$1,053,568</b>	<b>\$1,185,697</b>	<b>\$1,356,848</b>
University Fund / Research Infrastructure Contribution	-\$22,476	-\$38,840	-\$47,436	-\$56,045	-\$64,135
Total Support Unit Allocations (Indirect Costs)	-\$226,690	-\$255,768	-\$285,212	-\$315,969	-\$346,811
<b>NET REVENUE</b>	<b>\$526,335</b>	<b>\$677,097</b>	<b>\$720,920</b>	<b>\$813,683</b>	<b>\$945,902</b>
Total Teaching Costs	-\$241,625	-\$255,656	-\$269,889	-\$284,334	-\$299,000
Total Admin Salaries & Benefits	-\$98,250	-\$101,198	-\$104,233	-\$107,360	-\$110,581
Total Student Support (From operating)	-\$50,000	-\$60,000	-\$70,000	-\$80,000	-\$100,000
Total Capital/Equipment Costs	-\$10,000	\$0	\$0	-\$10,000	\$0
Total Other Direct Expenses - Supplies/Services/Travel etc	-\$43,500	-\$43,500	-\$53,500	-\$53,500	-\$63,500
Total Share of Faculty's Central Expenses	-\$90,345	-\$156,124	-\$190,678	-\$225,282	-\$257,801
<b>PROGRAM EXPENSES</b>	<b>-\$533,720</b>	<b>-\$616,478</b>	<b>-\$688,300</b>	<b>-\$760,476</b>	<b>-\$830,882</b>
<b>IN-YEAR (Surplus/ Deficit)</b>	<b>-\$7,385</b>	<b>\$60,620</b>	<b>\$32,620</b>	<b>\$53,207</b>	<b>\$115,019</b>
<b>Total Grad support per FT student (Scholarship, Taship) excluding RA</b>	<b>\$2,500</b>	<b>\$1,364</b>	<b>\$1,296</b>	<b>\$1,250</b>	<b>\$1,370</b>

If the program is showing an ongoing going deficit please indicate whether it is truly incremental to the current faculty financial position. Provide a rationale for proceeding with ongoing negative returns.

**B. NUMBER OF STUDENTS**

	FT	PT	
Intended Steady-state annual intake	40		Year achieved: <span style="border: 1px solid black; padding: 2px;">2026</span>
Intended Steady-state total enrolment	40		Year achieved: <span style="border: 1px solid black; padding: 2px;">2026</span>
Number of International Students included in steady state	2	0	
Proposed number of additional students to University at steady state: ( i.e. Are the program students additional (net new) or redistributed from other existing programs within the Faculty or in other Faculties. )			40
Will there be an impact to enrollments in Programs in other Faculties?	No		If yes, Please Describe:

**C. FORMAT OF INSTRUCTION**

	Fall	Winter	Summer (May-June)	Summer (July-August)	Annual program units?
During which terms will the program run?	X	X	X	X	30

Is there a co-op or internship as part of the program?

No Describe:

What percentage of instruction will be online?

What percentage of instruction will be off campus?

If either is greater than zero please provide information:

The new Master of Biomedical Innovation is designed to be maximally flexible. Course work will be primarily delivered online, with four short-duration, in-person bootcamps.

**D1. PROPOSED TUITION FEE**

reference: [http://www.mcmaster.ca/bms/student/SAC\\_fees\\_grad.html](http://www.mcmaster.ca/bms/student/SAC_fees_grad.html)

Is approval being sought for a Ministry-funded Program?

No Do Standard Tuition rates apply ? (If No, specify fees below)  No

**Proposed Tuition Fee:**

	Domestic		International	
	Full Time	Part Time	Full Time	Part Time
Per Year :	\$ 34,500		\$ 60,000	
Per Term (if applicable):	\$ 11,500		\$ 20,000	
Per Course (if applicable):				

Rational for proposed fees (describe or append results of market assessment) and describe how they adhere to MTCU policy if seeking ministry funding :

See attached market comparison. Tuition Fee has been proposed to be in alignment with other comparator professional masters programs

**D2. SUPPLEMENTARY FEES**

reference: [http://www.mcmaster.ca/bms/student/SAC\\_fees\\_grad.html](http://www.mcmaster.ca/bms/student/SAC_fees_grad.html)

Will regular Mandatory Supplementary Fees apply?

Full Time  Yes Part Time  No Modified only  No

If no, please contact [Dean of Grad Studies](#) for guidance and provide resulting proposed applicable fees and rationale:

Are there other mandatory costs for students? (Coop/Internship fees, supplies, books, uniform, equipment, field trips, professional exam fees, etc?)

NO Describe & Approximate amounts:

**E. EXTERNAL RESOURCES: donations, special grants, research overhead, endowment funds, Space, etc.**

Please provide information about any external funds or resources that will be available to the program.

	Onetime	Ongoing	Value \$	Details
<i>eg. Access to lab space</i>		x	\$ 1	CANMET - Longwood
The Marnix E. Heersink School of Biomedical Innovation and Entrepreneurship is providing program start-up funds until the program reaches steady-state enrollment and/or program solvency. Students will also access donor-funded scholarships and awards.	X		\$ 500,000	

**F. FACULTY RESOURCES - Please append evidence of endorsement from other faculties affected if necessary.**

If courses are also being taught in other faculties, please list

Faculty:  Engineering Faculty:  N/A Faculty:  N/A

Incremental FTEs required:	Health Sciences	Engineering	N/A	N/A	Comments
Faculty - Tenure Track		X			Engineering Faculty with experience in Biomedical Innovation may teach in the program (roles of sessional, coach or tutor)

Faculty - Sessional and CLAs	1.7				In addition to teaching CLA and sessional faculty, CAWAR FHS faculty primarily within the Department of Surgery and across clinical departments will be recruited as tutors and coaches to support program delivery.
Staff	1				Existing staff within The Clinic will provide additional administrative support as needed (marketing, event coordination etc.). Finance and HR support via the Department of Surgery
Teaching Assistants					
<i>Additional Non-salary costs in other Faculties</i>					

Increases in FT faculty are for modeling purposes only and does not imply approval to hire. Normal approval processes apply.

**G. OTHER RESOURCE IMPLICATIONS:**

*Unless otherwise defined in the categories below, please use these descriptions to define impact:*

- No Impact:** Can be dealt with as part of normal, daily operations. No budgetary or resource impact.
- Minor:** Can be dealt with in a mutually agreed timeframe using existing personnel. Resources pre-approved or readily available. No disruption to other approved work priorities.
- Major:** Must be scheduled as a project (not able to deal with as part of regular operations). Budget not approved or readily available; source of funding to be determined. May require external resources. May require reprioritization of previously approved tasks.

**1. PHYSICAL FACILITIES** - Please contact [Coordinator, Design and Space Management x23898](#) for assistance in determining additional resource costs if needed.

Please indicate the likely space resource implications of the proposal	Impact	New Sq Ft Required	Approx Existing Sq Ft required	Comments (include location and for new space, plans to fund and acquire space)	If major new central budget req'd, estimate \$
Faculty space- Offices,Labs,seminar rooms, student space, etc	Minor	-	200.0	<b>A space is being created for the Marnix E. Heersink School of Biomedical Innovation and Entrepreneurship, which will serve as the home for the MBI. This project is underway (in MDCL) with an expected completion of September 2023. This project (\$1.5M) is funded through the Heersink gift.</b>	
Other space (excluding registrar controlled classrooms)	None				

Facilities  
Facilities

**2. TECHNOLOGY RESOURCES** - Please contact [UTS Director, Technology x21888](#) for assistance in determining impact if needed.

Please indicate the likely impact on central technology resources for the proposal	Impact	Are additional resources required to support this program? If so, please list.	If Major, estimate \$
UTS Computer Labs and Software	None		
Network/Internet/Cloud services access & usage	Minor		
Audio-Visual / Telecommunications	Minor		
Wireless Connectivity	Minor		
Other (Please specify)	Minor		

UTS  
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**3. LIBRARY SERVICES** - Please contact [Associate University Librarian, Collections x26557](#) for assistance in determining impact if needed.

Please indicate the likely Library resource implications of the proposal	Impact	Are additional resources required to support this program? If so, please list.	If Major, estimate \$
Staffing (Add'l service desk staff, add'l librarians, new staff with skills/knowledge not currently present)	Minor	Discussions with HSL have begun around the shared recruitment (and funding) of a librarian with innovation and entrepreneurship resource expertise that could support The Clinic (FHS Incubator) and the MBI, among other initiatives within FHS.	
Collections, One Time Purchases (books, ebooks, purchased online resources)	Minor	no significant additions	

Libraries  
Libraries



Collections, Ongoing Subscriptions/licenses (print or online journals)	Minor	no significant additions		Libraries
Technology and Computing (new or add'l hardware/software, increased digital storage capacity)	None			Libraries
Library Spaces (study space, new or specialized user or collection spaces)	None	students will have access to their own space and The Clinic (in the HSL library)		Libraries
Other (Please specify)	None			Libraries

**4. OFFICE OF THE UNIVERSITY REGISTRAR - Please contact the Registrar for assistance in determining impact if needed.**

Please indicate the likely resource implications of the proposal	Impact (Select)	Support required	Area Responsible	If Major, estimate \$
Admissions/Recruitment	Minor	Recruiting and Admissions aligned with current 101 processes	SGS	
Student Record Support (maintaining records, transcripts, grades, student card, etc)	Minor	Standard services for graduate program		
Class Scheduling Services	None	Managed by Dept/Faculty		
Classrooms	None	Scheduled into Faculty controlled classrooms or only summer term or off campus		

**5. STUDENT SUPPORT - Please contact Assistant Dean, Student Services for assistance in determining impact if needed.**

Please indicate any other possible resource impacts	Impact	Please Describe any impacts on the support areas	If Major, estimate \$
Student Services - International Student support	Minor		
Student Services - Athletics & Rec, Health/Counselling, Career	Minor		
Residences	None		
Grad Scholarships/Bursaries*	Minor	\$ - Avg. Annual Draw on Scholarship pool	\$ -

\*If you are anticipating OSAP funding for these students please contact SFAS to provide additional information to activate approval from MTCU

**6. MIETL- Please contact Educational Consultant for assistance in determining impact if needed.**

Please indicate any other possible resource impacts	Impact	Please Describe any impacts on the support areas	If Major, estimate \$
Re/Development of blended or online courses	Minor	Course Development being managed through the Department (MGD HealthICE and Heersink School); liaising with MacPherson as required	
Learning Management System (Avenue to Learn)	Minor		
Training and development for TAs or faculty	Minor		
Research on teaching and learning initiatives	Minor		
Other (Please specify)	Minor		

**7. OTHER**

Please indicate any other possible resource impacts	Impact	Please Describe any impacts on the support areas	If Major, estimate \$
Financial Services	None		
Human Resources	Minor		
Advancement	None		
Research Services Office	None		
Other (Please specify)	None		

Please provide names below and check box to verify that approval has been obtained by each:

	Check box
Department Chair/ Area Director <u>Mo Bhandari, Chair, Department of Surgery</u>	X
Faculty Dean or Director of Administration <u>Sue Galloway, Executive Director Finance, FHS</u>	X
Associate Vice-President , Finance & Planning (Academic) <u>Susan Denburg, Executive Vice-Dean &amp; AVP Academic, FHS</u>	X
Submitter <u>Sarah Bouma, Director, MGDII/Heersink School</u>	

## Exhibit A5

*Competitor analysis in Canada of various Universities providing Innovation and Entrepreneurship Masters programs.*

University	Faculty	Program Name	Approximate Tuition	Duration
Queen's	Engineering and Smith School of Business	Master of Entrepreneurship and Innovation	Canadian: \$35,490 per year International: \$51,705 per year	12 months full-time
Toronto	Institute for Management and Innovation, (joint Administration, Business Management, Engineering Management)	Master of Management of Innovation	Canadian: \$32,500 per year International: \$61,200 per year	12 months full-time
McMaster	Engineering	Master of Engineering/Technology Entrepreneurship and Innovation	Canadian: \$9,720 per year International: \$45,045 per year	20 months full-time
Ryerson	Engineering and Architectural Science	Master of Engineering Innovation and Entrepreneurship, Biomedical Engineering track	Canadian: \$29,639 per year International: \$54,314 per year	16 months full-time
Western	Engineering	Engineering in Medicine	Canadian: \$13,761 per year International: \$43,500 per year	12 months full-time, option for longer duration part-time
Ontario College of Art and Design (OCAD)	N/A	Design for Health	Canadian: \$9,080 per year International: \$21,939 per year	24 months full-time, 36 months part-time
McMaster	Health Sciences	Masters of Biomedical Discovery & Commercialization	Canadian: \$19,845 per year International: \$68,307 per year	12 months full-time
Guelph	Department of Molecular and Cellular Biology and Department of Business Management	Master of Biotechnology	Canadian: \$9,909 per year International: \$23,331 per year	12 months full-time, optional extension of research project to 16 months
Alberta	School of Business	MBA with Specialization in Innovation and Entrepreneurship	Canadian: approx. \$15,500 per year International: approx. \$30,000 per year	20 months full-time
McMaster	Social Science	Master of Public Policy in Digital Society	Canadian: \$29,100 per year International: \$55,500 per year	12 months full-time
Waterloo	School of Entrepreneurship and Business	Master of Business, Entrepreneurship, and Technology	Canadian: \$34,254 per year International: \$64,701 per year	12 months full-time, 36 months part-time

Toronto	Institute for Management and Innovation	Masters of Biotechnology	Canadian: \$21,675 per year International: \$47,109 per year	24 months full-time
Windsor	Science	Master of Science in Translational Health Science	Canadian: \$9,877 per year International: \$26,433 per year	12-months full-time

**MEMO**

DATE: January 10, 2023

TO: University Planning Committee

FROM: Dr. Karen Mossman, Vice-President, Research



RE: Closure of Institute for Multi-Hazard Systemic Risk Studies (INTERFACE)

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On behalf of the Institute for Multi-Hazard Systemic Risk Studies (INTERFACE) Governing Board, I request the formal closure of INTERFACE as a Senate approved Research Institute and its transition to a Research Group.

INTERFACE was established as a McMaster Senate approved Research Institute in March of 2015 reporting to the Office of the Vice-President, Research. In Spring of 2021, as per the policy [Guidelines for the Governance and Review of Research Institute, Centres and Groups](#), INTERFACE underwent a five-year external review. The External Review Board (ERB) met with various stakeholders (faculty members, external organizations, students and staff) and provided their report to the INTERFACE Governing Board. The report addressed both areas of strengths and weaknesses. The ERB recommended that the Institute look to a) increase faculty membership and external engagement to truly constitute a multi-disciplinary and collaborative Research Institute as defined in RCI policy and b) become more independent and financially sustainable from central funding support. The Governing Board then tasked the Director to develop and administer a new plan to fulfil those recommendations.

In Spring of 2022 following up on the implementation of the ERB recommendations, the INTERFACE Governing Board assessed that the Institute had not achieved any increase in faculty engagement, nor demonstrated the ability to build towards operation without significant and continuing university funding support. Deliberations resulted in the Governing Board unanimously voting to transition INTERFACE from an Institute to a Research Group. The Director was informed in June 2022 that the Governing Board would be recommending that INTERFACE transition to a Research Group with effect from December 31<sup>st</sup> 2022 (providing a six month ramping down period).

The five-year ERB report is attached for information.

KM:jt

## External Review of the McMaster Multi-Hazard Institute: INTERFACE

Submitted March 15<sup>th</sup>, 2021

### **External Review Board Members:**

**Chair:** Mr. Jerry Hopwood, President, University Network of Excellence in Nuclear Engineering  
Ms. Marlene Lenarduzzi, Head, Counterparty Credit Risk and Market Risk Strategic Initiatives, BMO Financial Group  
Dr. Miroslav Nastev, Research Geo-Scientist, Environment and Energy of Natural Resources Canada

### **Mandate:**

The External Review Board (ERB) has been constituted to provide an external review of the McMaster “Interface” multi-hazard institute. The ERB looked at status and the progress over the initial five years, and assessed the institute according to the Terms of Reference provided by McMaster (attached). The ERB reviewed the supporting documentation, and met the institute team and stakeholders on February 24<sup>th</sup>. We were able to carry out sufficient review, to complete our evaluation and recommendations.

### **ERB View -- the Context:**

The vision of the institute as a multi-disciplinary platform that focuses on systemic risk assessment, analysis, and management is timely. The ERB recognizes that society and systems are greatly interconnected, thus the Institute’s multi Hazard approach to assessing and managing risks offers a unique value proposition. This value is somewhat evidenced by the Institutes success in attracting grants, broad membership and numerous publications.

### **Institute Performance**

The institute has completed its first five years of operation. It has successfully progressed towards the goals of its establishment proposal. There is still some way to go to fully achieve these goals and to take its place as a self-standing entity. In the context of McMaster’s portfolio of institutes, this does not seem unreasonable. The institute is one of the smallest at McMaster, but is executing research of significance, and with a broad, and increasingly multi-disciplinary coverage, and this is consistent with McMaster institute expectations. So far, the institute has been driven largely by the energy, entrepreneurship and enthusiasm of its director. The institute has gathered a significant number of funded projects, and has delivered on publication, but needs to do more to connect with the stakeholders who can gain value from the work. The institute has broadened somewhat from a starting point focused on civil engineering, but there is much more scope for broader studies.

### **Strengths:**

- Energetic and passionate leader in Wael El Dakhkni. Wael is viewed as an excellent researcher who is able to attract a “dream team” of top talent and supporters to the institute.
- Faculty and membership feel the work is meaningful, and are highly complementary of the Institute’s accomplishments and the quality of the Director.
- Students are highly satisfied with their studies for the Institute; view the experience as unique and providing unique benefits via opportunities to collaborate across faculties and with industry.

- Institute has already achieved significant project results that “show the way” forward

**Weaknesses:**

- Wael is overwhelmed with too much work and lack of stable support.
- Lack of stable funding envelop makes it difficult to hire and provide employees with stability
- The institute has no dedicated space for members to meet, collaborate, and benefit from colocation. The institute seems be caught in a bureaucratic ‘no-man’s land’ where it is not eligible for faculty space due to its tie to the VP of Research.
- Lack of clear business plan that articulates how the vision will be achieved concretely
- Lack of outreach and promotion to bring visibility and build relationships with stakeholders
- External stakeholders were not able to articulate specific benefits they achieved from their involvement with the institute
- The institute has not built a senior leadership, and does not have natural successor at this point.

**Opportunities:**

- Complex problems such as Climate change, global pandemics provide demand for the institutes multi-disciplinary approach to risk assessments – the recent multi-sectoral emergency in Texas is a prominent example.
- Tremendous opportunities to expand cross faculty engagement – particularly with social sciences, health sciences, the Climate Change institutes, and others
- The university has resources to support promotion, webinars... that could provide a cost-effective way to increase external awareness of the Institute

**Threats:**

- Wael may become frustrated by the lack of support and leave to join a university that is more supportive or perhaps join the private sector or let the institute collapse.
- The institute’s unique value proposition may be overtaken by initiatives elsewhere

**Recommendations:**

The Director has got the institute going well through the initial challenging phase. We recommend he continue in his role. We do recommend that he needs senior assistance with day to day organizing capabilities to complement Wael’s strengths—a “COO” role.

The institute governance should be adjusted as seen fit by McMaster, to:

- Provide a stable funding mode, sufficient to provide support to the Director
- Provide a stable home for the Institute, (a single host faculty), with a dedicated space, while encouraging and enabling a broader set of multi-disciplinary projects
- Creating a clear governance relationship with Wael to a single representative individual, who represents McMaster but can also provide a sponsor role and act as a mentor
- Set up a regular reporting process to give an appropriate level of structure and guidance, consistent with other McMaster Institute processes; for instance providing progress against

goals, a scorecard or dashboard of status, and the opportunity to record challenges or obstacles to progress.

- Encourage the Director to achieve key goals for the next period:
  - o Develop a well-structured business plan
  - o Outreach and promotion of the institute
  - o Stronger relationships with external stakeholders

Report prepared by External Review Board:

Jerry Hopwood

Marlene Lenarduzzi

Miroslav Nastev