Final Assessment Report

Management Engineering (BASc), Management Sciences (Option, MASc, MMSc, MMSc – Management of Technology, PhD), Type 3 Graduate Diploma in Data Analytics (GDip)

July 2023

Executive Summary

External reviewers found that the Management Engineering (BASc), Management Sciences (Option, MASc, MMSc, MMSc – Management of Technology, PhD), Graduate Diploma in Data Analytics (GDip) delivered by the Department of Management Sciences were in good standing.

"*The overall assessment of the management sciences programs including the undergraduate, graduate (online and in-person), as well as the MSCI option is positive." "The department consists of outstanding faculty members, dedicated staff and thriving students."*

A total of 8 recommendations were provided by the reviewers, regarding the coordination of departmental and interdisciplinary research and programming, revitalizing online learning, and expanding teaching and research space. In response, the program created a plan outlining the specific actions proposed to address each recommendation as well as a timeline for implementation. The next cyclical review for this program is scheduled for 2028-2029.

Enrollment over the past three years*

	MGTE BASc	MSCI Option	MSCI MASc	MSCI MASc – Co-op	MMSc	MMSc – Co-op	MMSc Online – MOT	MSCI PhD
2024-2025	470	40	18	2	37	51	32	39
2023-2024	475	65	22	1	58	44	25	37
2022-2023	464	90	22	0	79	50	26	30

*Based on Active Students Extract from Quest on February 10, 2025.

Completion over the past three years**

	Data Analytics Type 3 GDip
2024-2025	x
2023-2024	x
2022-2023	x

Based on Data Extract from Records on February xx, 2025.

Background

In accordance with the University of Waterloo's Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response of the programs delivered by the Department of Management Sciences. A self-study (Volume I, II, III) was submitted to the Associate Vice-President, Academic, and Associate Vice-President, Graduate Studies and Postdoctoral Affairs on July 6, 2020. The self-study (Volume I) presented the program descriptions and learning outcomes, and an analytical assessment of the programs along with the standard data package prepared by the Office of Institutional Analysis & Planning (IAP). The CVs for each faculty member with a key role in the delivery of the program(s) were included in Volume II of the self-study.

From Volume III, two arm's-length external reviewers were selected by the Associate Vice-President, Academic and Associate Vice-President, Graduate Studies and Postdoctoral Affairs: Dr. Mark Lewis, Operations Research and Information Engineering, Cornell University, and Dr. Ebrahim Bagheri, Electrical, Computer and Biomedical Engineering, Ryerson University.

Reviewers appraised the self-study documentation and conducted a virtual site visit to the University on October 4-8th, 2021. An internal reviewer from the University of Waterloo, Dr. Bryan Smale, Professor in Recreation and Leisure Studies was selected to accompany the external reviewers. The visit included interviews with the Vice-President, Academic & Provost; Associate Vice-President, Academic and Associate Vice-President, Graduate Studies and Postdoctoral Affairs; Dean of the Faculty of Engineering; Faculty Associate Dean of Undergraduate Studies; Faculty Associate Dean of Graduate Studies; Chair of the Department, as well as faculty members, staff and current undergraduate and graduate students. The Review Team also had an opportunity to meet with representatives from the library, and Co- operative Education.

Following the virtual site visit, the external reviewers submitted a report on their findings, with recommendations. Subsequently, the program responded to each recommendation and outlined a plan for implementation of the recommendations. Finally, the Dean responded to the external reviewers' recommendations, and endorsed the plans outlined by the program.

This final assessment report is based on information extracted, in many cases verbatim, from the self-study, the external reviewers' report, the program response and the Dean's response.

Program Characteristics

Doctor of Philosophy (PhD) in Management Sciences

- 4 year research-based program.
- Students take a minimum of 4 graduate courses and conduct independent research with a faculty supervisor, culminating in a dissertation.

Master of Applied Sciences (MASc) in Management Sciences

- 2 year research-based program.
- Students take a minimum of 4 graduate courses and conduct independent research with a faculty supervisor, culminating in a Master's thesis.

Master of Applied Sciences (MASc) in Management Sciences - Co-operative Program

- 2.7 year (8 term) research-based program.
- Students take a minimum of 4 graduate courses and conduct independent research with a faculty supervisor, culminating in a Master's thesis.
- Students also complete 2 co-op work terms (8 months) of full-time paid employment.
- Students are admitted into Co-op in their second term, based on grades in their first term of the MASc.

Master of Management Sciences (MMSc)

- 16-month (4 term) course-based program.
- Students take a minimum of 8 graduate courses (4 required core courses; 4 electives).
- Note that it can be completed in 1 year, if students choose to do so.

Master of Management Sciences (MMSc) - Co-operative Program

- 1.7 year (5 term) course-based program.
- Students take a minimum of 8 graduate courses.
- Students also complete 2 co-op work terms (8 months) of full-time paid employment.
- Students are admitted into Co-op in their second term, based on grades in their first term of the MMSc.

Master of Management Sciences (MMSc) - Management of Technology (offered online)

- Part-time course-based program completed online.
- Students take a minimum of 8 graduate courses (6 required core courses; 2 electives).

Graduate Diploma (GDip) in Data Analytics (GDDA)

- Specialized diploma available to students in the MMSc program.
- Students take 4 designated data analytics graduate courses (3 required courses; 1 elective) while completing their MMSc degree.

Bachelor of Applied Science (BASc) – Management Engineering

- 5 year undergraduate honours degree program.
- Students complete 8 academic terms on campus and either 5 or 6 co-op work terms (20-24 months) of full-time paid employment.

Option in Management Sciences

- Specialized option available to undergraduate students in other Engineering programs.
- Students take 6 designated Management Sciences (MSCI) courses (3 required courses; 3 electives) while completing their BASc engineering degree program.

The Management Sciences Department offers graduate courses and research degrees in three fields:

- *Applied Operations Research (AOR)*, including topics such as deterministic and stochastic optimization, discrete event simulation, production and inventory management, distribution, logistics and supply-chain management, network models, operations analytics, simulation modeling, etc.
- *Information Systems (IS)*, including topics such as big data analytics, human-computer interaction, text analytics, information retrieval, database management, etc.
- *Management of Technology (MOT)*, including topics such as organizational behaviour, strategic management, applied economics, organizations and technical systems, international project management, etc.

PhD and MASc research students typically specialize in one of the three areas, whereas MMSc and GDDA students tend to take courses across all three areas. Students in the MMSc-MOT Online program specialize in Management of Technology.

Summary of Strengths, Challenges and Weaknesses based on Self-Study Strengths

Interdisciplinary breadth and depth of training in AOR, IS, MOT:

- Technical problems in management and organizations are multi-dimensional and their solutions require diverse skills in system analyses, modeling, optimization, data analytics, information system design, and an understanding of organizations, economics, and human behaviour. To varying degrees, all of their graduate and undergraduate programs provide training across the AOR, IS and MOT areas, providing students with the skills and knowledge to solve complex problems in today's organizations.
- Their MASc/PhD programs are highly flexible and students can tailor their program to suit their academic needs and research interests. Students appreciate the strong emphasis on research in Management Science.
- They have a good breadth of undergraduate courses that cover important and complementary knowledge and skills, which are available both to their own Management Engineering students, and to students from other departments who take the MSCI Option.

High quality faculty with diverse interests and perspectives:

- The wide range of faculty disciplinary expertise, teaching and research interests in the Management Sciences gives their students opportunities to study and conduct research across the areas of AOR, IS, and MOT.
- 3 of their 23 professors hold Canada/Ontario Research Chairs, a high department ratio within the Canadian academic context.
- Management Science has an ethnically diverse faculty complement that is well balanced across the Assistant, Associate and Full Professor ranks.
- Management Sciences strives for a collegial environment in which all members are supported and can work together to contribute to their teaching and research goals.

Strong demand for Management Science programs from high quality applicants:

- The Management Engineering BASc program has seen increased demand and the quality of their students is on par with other UW engineering departments. Management Science students are among the best at the University of Waterloo, and frequently win faculty-level awards based on their academics and leadership.
- MMSc applications have nearly doubled since the launch of the GDDA in 2017, enabling Management Science to increase both enrolment and student quality.
- Management Science receives many more MASc/PhD applications each year than they are able to admit, so they can be selective in research program admissions.
- The MSCI Option has the highest enrolment among the 11 undergraduate options available to students within the Engineering Faculty.

Increasing research funding:

- Annual research funding has increased by about 50% over the 7-year review period.

Management Science graduates are in demand for employment in important and growing industries:

- The mix of AOR, IS, MOT in their programs, provides marketable skills to students in an increasingly technical, data-driven, service-based economy. Although traditional industries, such as manufacturing have declined, Management Science graduates fit the changing technical management and analytical needs of the emerging jobs and industries, particular in information technology, data science and analytics, consulting, logistics and supply-chain management, and healthcare.
- Management Science students thrive based on their co-op experiences and have high employment rates and receive positive evaluations from employers. Likewise, their students obtain good jobs after graduation.
- Their students have demonstrated strong annual performance in conferences and competitions organized by Canadian and international academic and professional organizations.

Collaborative relationship between faculty and students:

- The relationship between the Department and its students is strong and based on continual improvement by seeking student feedback while also measuring learning outcomes.

Challenges

Financial uncertainty under the new UW/Engineering budget model:

- The new decentralized Waterloo Budget Model (WBM) and Engineering Budget Model (EBM) tie Department funding closely to program and course enrolment levels, creating financial incentives for growth, but also for departmental sub-optimization. Management Sciences has traditionally provided a great deal of service teaching for other Engineering departments, but some have begun replacing MSCI undergraduate service courses (e.g., MSCI 261) with their own courses. There is also less incentive for departments to cooperate in course scheduling so students can access MSCI Option electives.
- Solutions to budget uncertainty include: a) increasing the attractiveness of MSCI electives to students in other departments (e.g., by expanding course offerings in popular topics like Data Analytics); and b) reducing financial dependence on service teaching, by increasing enrolment levels in their own course-based (i.e., BASC, MMSc, MMSc-MOT Online) programs.

Need for more dedicated teaching space:

- Management Science has reached or exceeded capacity in their main teaching classroom and main teaching/computer lab, limiting further growth in the MGTE and MMSc programs. So far, the department has had limited success negotiating for increased space under the current UW and Engineering space allocation system.

Increasing demand for data analytics courses within Management Sciences and across UW:

- Student demand for data analytics courses has been growing quickly at both the graduate and undergraduate levels. To meet this demand, Management Sciences would like to develop a set of introductory analytics courses, similar to those in the GDDA program, that would be available to students in all of Management Science course-based programs (i.e., BASc, MSCI Option, MMSC, MMSc-MOT Online). We had a type 3 diploma approved,

our GDip in Data Analytics, which had initial applicants in W2024 which were all denied due to being below average in math scores – we feel these early days that applicants were choosing this program because they knew they couldn't get into our MMSc degree program. However, in Spring 2024, we began to see more suitable applicants, though only a few, so we deferred these to Fall 2024, which now has 28 applicants, 19-20 of which are likely to receive offers. This rapid increase is a positive sign, and we expect that with continued advertising and awareness that this will continue to grow. In addition, they also wish to develop a set of more advanced, research-oriented data analytics courses that would serve the needs of their PhD and MASc research students, and also introductory courses for students who lack basic technical skills (e.g., programming) needed to succeed in advanced courses.

- There are many challenges to achieving these objectives, including difficulties hiring high quality faculty members in the competitive data analytics job market. They are currently recruiting new data analytics faculty members across the OR, IS, and MOT areas, who would contribute to new course development in data analytics, both on-campus and online.

<u>Increasing enrolment while increasing student quality:</u>

- The new funding model creates strong financial incentives for enrolment growth; yet they do wish to grow by admitting students of lower quality. Management Science is continually challenged to attract more and more high-quality students across all of their programs.

<u>Increased government funding emphasis on performance and "Work Integrated Learning" (WIL):</u>

- The Ontario government recently announced changes to its university funding model, whereby a higher percentage of government grant money will be "performance based", including an increased emphasis on WIL in coming years. Management Science is well-positioned for this change at the undergraduate level, due their strong Management Engineering co-op program. Their MMSc/MASc co-op programs are also successful, but their large international student population makes it challenging to provide meaningful WIL content to all graduate students, particularly in MASc/PhD research programs.

<u>Difficulties attracting and retaining high quality faculty members:</u>

- Since 2012, Management Science experienced considerable faculty turnover, including several new hires, retirements, and resignations to take jobs elsewhere. They believe they offer faculty members a very attractive and supportive research and teaching environment, with high quality students and more flexibility and intellectual freedom than many of their competitors. Nonetheless, Management Science faces stiff competition for hiring and retaining strong faculty candidates in all three areas, due to higher pay scales in business schools compared to Engineering, and increased demand from industry for PhD level researchers with OR and IS skills in data analytics.

Insufficient curriculum flexibility and integration:

- BASc students want more flexibility in accessing electives and international exchange opportunities, and in satisfying the required natural science and engineering currently found in three required Mechanical Engineering courses. As Management Science adds new faculty members, they should be able to add electives in the areas of data analytics, software, and operations research. Furthermore, a higher level of integration of these technical streams is desirable, both in courses and throughout the curriculum, which they can obtain from increased faculty collaboration on design of course components.
- MMSc students also want more choice in elective courses. Technically-oriented students want more IS and data analytics electives; management-oriented students want more business and MOT electives. New data analytics hires should help address the former concern; a recent decision to open up MMSc-MOT Online electives to the on-campus MMSc students helps address the latter.
- PhD and MASc students want more advanced electives in IS and MOT. The OR area offers regular research seminar courses on advanced topics, but Management Science has not established the same depth offerings in IS or MOT. Further hiring and changes to the standard course offerings can hopefully improve the availability of research seminar courses in these areas.

Weaknesses

Need for more research funding and student funding flexibility to increase PhD/MASc admission:

- Although overall research funding has increased, further increases are needed to support their MASc, PhD graduate programs. Funding availability varies across areas, with MOT facing the greatest challenge to raise funds. Funding also varies within areas, with some topics attracting much more than others. A challenge is to shift research directions to topics that may attract more funding, while maintaining research quality and respecting the academic freedom of researchers. For example, data analytics may be relatively

attractive to research funders, so collaborations between OR/MOT researchers and those working on data analytics may have the potential to attract increased funding (i.e., operations analytics; behavioural aspects of big data, etc.)

- Funding availability has a direct effect on the number of research students each professor can admit and supervise. All PhD/MASC students receive minimum funding, most of which is paid from the supervisor's individual research budget. In Engineering, rules restrict the use of TA funding and most forms of "third party" funding (i.e., only recognized government scholarships are permitted) in a student's funding package, whereas other UW Faculties do not restrict the use of such sources. Many of their students work as TAs, their average student funding levels are considerably higher than the minimum required, yet they are not permitted to count such sources when making PhD/MASc admission offers. The recent cancelation of university level funding for International MASc students has also reduced their ability to support graduate students.
- Relaxing the graduate student funding rules in Engineering would go a long way to enabling Management Science faculty members to admit more research students. Increasing the number of students admitted would likely increase the research and publication output of faculty members, increasing the likelihood of obtaining more grant funding, and thereby enabling them to support still more students in the future. Restricting the number of students has the opposite effect, reducing research and publication output, grant competitiveness, and the ability to support future students.

<u>Need for a new MMSc-MOT Online program strategy:</u>

- Demand is too low for the MSCI-MOT Online program, and several courses are taught by part-time lecturers rather than regular tenure-stream faculty members. A planning committee has been established to formulate a new strategy for the long-term viability of the program, to ensure the quality is on par with on-campus programs and enrolment levels are financially sustainable.
- In general, the goal is to the shift the program's focus towards data analytics, and reduce emphasis on traditional MOT topics of innovation, strategy, project management, etc. This would align the program more closely with the MMSc program on campus and capitalize on Department strengths in OR and IS, and industry demand for data analytics professionals.

<u>Large graduate program class sizes in core courses and popular electives:</u>

- Management Science class sizes vary substantially in the graduate programs, with large enrolments in MMSc core courses and popular GDDA electives. To maintain program reputations for quality, they need to offer more frequent, smaller class sections, but this increases teaching needs and associated costs.

External awareness and reputation of our programs:

- The interdisciplinary nature of their Department and programs means that they are not directly comparable to many existing engineering or business school programs. While this has many advantages, it also makes it difficult to communicate the value of a degree in Management Sciences or Management Engineering to applicants and employers.
- Undergraduate applicants have confused the BASc program with business programs due to its name, but open houses and better recruitment materials are helping prospective students to understand that Management Engineering is an engineering program with roots in industrial engineering. Although successful at securing co-op and full-time employment, Management Science students often need to explain the program to employers. Students from other engineering departments also sometimes perceive the program as having low levels of technical content. This misperception may originate from the complementary studies service courses that they teach to many engineering students, and from the design of the MSCI Option, which is biased towards complementary studies topics. Adding new data analytics course to the MSCI Option would hopefully change these perceptions. Management Science is also considering the creation of a new, more technically-oriented Option, that would expose students from other engineering programs to Management Engineering courses with significant engineering science and design content.

Summary of Key Findings from the External Reviewers

Reviewers stated the following "The overall assessment of the management sciences programs including the undergraduate, graduate (online and in-person), as well as the MSCI option is positive. The program has a healthy intake of students. In addition, the retention rates and graduation rates and times are in line with comparable programs at other institutions. The department consists of outstanding faculty members, dedicated staff and thriving students, which is seen as the department's major strength. The department benefits from an interdisciplinary mix of expertise at the intersection of management of technology, operations research and information systems, which distinguishes it from other engineering programs. The students seem to enjoy the interdisciplinary nature of the program, which counts among one of the decisive factors for them to join this department."

Response to External Reviewers' Recommendations

1. Teaching space considerations especially with regards to courses offered in RCH

Program Response

The Department of Management Sciences uses i) two department classrooms; ii) Registrar's classrooms in RCH; and iii) Registrar's classrooms located in other buildings, for teaching undergraduate and graduate courses. The department needs strong support from the Faculty of Engineering and the university for new space for teaching and learning.

i) The two department classrooms are well equipped and in good condition but have insufficient capacity to support further enrolment growth. The department needs more such designated classrooms to accommodate expected enrolment increases in both undergraduate and graduate programs.
ii) The department will continue to collaborate with the Registrar's Office to ensure that all classrooms are better equipped, in the proper size, and in a good environment for teaching MSCI courses. On the other hand, Scheduling has a limited supply of rooms, and assigns classrooms based on enrolment.
iii) Registrar's classrooms in other building (e.g., M3) may be better equipped and have larger seating capacity. However, the walk between classes/buildings will be longer, which might be a concern especially in winter terms.

Proposed Actions:

- The department will engage in the new Engineering Building 8 (E8) in order to secure additional department space for teaching and learning.
- The department is renovating department classrooms to serve teaching and learning better.

Responsibility for Leading and Resourcing (if applicable) the Actions:

- The department space committee, led by the department chair, will work with the Faculty of Engineering to review existing spaces, determine department needs, and secure the necessary spaces, potentially in E8.
- An ad-hoc committee was formed to design new teaching and learning space. The department space committee and the Office of the Dean of Engineering implemented the plan.

Timeline for addressing Recommendations:

- The department classroom renovation was completed in the winter 2022 term.
- E8 is the next space project of the Faculty of Engineering, which has started. This may be complete in five years (2027).

Dean's Response
E8 may take many years to come to fruition. In the shorter term we are looking at the feasibility of renovating further space in Carl Pollack Hall (CPH) to expand and improve the classrooms there. The department has come to an agreement with the faculty to exchange space with MME to be able to expand the size of its current classroom into an adjacent classroom and increase its capacity to 120-150 (enough for our current cohorts, plus growth of the program). We have begun discussions with the Dean's office and will be obtaining a quote for costs in 2024 to determine funds used to make these renovations.

2. **Develop a common departmental integration strategy bringing the three streams together.**

   Program Response
   In general, the department encourages collaboration among faculty members from different research streams (OR, IS, and MOT). For example, WATMIMS, a research group housed in the Department of Management Sciences, has researchers from both OR and MOT. Recently, data analytics has been one of the focus research areas of the department. The department has hired three new faculty members in the area of data analytics, one in each of the three research streams.

   Proposed Action:
   - Jointly organize research conferences/workshops in data analytics;
   - Collaboration in research; and
   - Co-supervise research students.

   Responsibility for Leading and Resourcing (if applicable) the Actions:
   - Faculty members, hired in recent years, in the data analytics area will be the main driving force for the integration initiative.

   Timeline for addressing Recommendations:
   - The department is expecting to see increased research collaboration and research student co-supervision by 2027.

Dean's Response
I support the department's approach to help further integrate the three research areas.

3. **Facilitate small yet interdisciplinary research projects/programs across department research streams.**

Program Response
The department always encourages interdisciplinary research and has been financially supporting faculty members from different research areas who are interested in co-supervising graduate students.

Proposed Actions:
- Small funds are available in the department to support interdisciplinary research (e.g., publication fees, data collection fees).
- The department provides partial financial support to graduate students co-supervised by faculty members from different research streams, if they do not have adequate and uncommitted funding.
- The department will set up a new committee, in consultation with all three research groups, to develop strategies and plans for interdisciplinary research.

Responsibility for Leading and Resourcing (if applicable) the Actions:
- The department chair and the associate chair for graduate studies and research are responsible to provide partial financial support for interdisciplinary research and to setup the committee for strategies and plans.

Timeline for addressing Recommendations:

- The actions will be implemented starting in 2022 and will continue in the next five years (2022 – 2027). The committee for strategies will be setup in 2022 and is expected to conclude its work within two years (2022 – 2023).

Dean's Response
I support the department's approach and proposed actions to address this recommendation.

4. Through support from the Dean, receive portions of university envelope to apply for large grants such as CFI JELF and IF, as well as NSERC CREATE in interdisciplinary areas where the department has substantial strength.

Program Response
The department always encourages and supports faculty members to apply for research grants. In 2021, the Dean of Engineering and the department of Management Sciences launched a new research support for MOT faculty members provided that they apply for a NSERC, SSHRC, CIHR, or other grants in the next two years.

Proposed Actions:

- To encourage faculty members to apply for major research grants.
- To collaborate with the Engineering Research office to encourage faculty members to work with industries, especially in data science and data analytics.

Responsibility for Leading and Resourcing (if applicable) the Actions:

- The department chair will work with the associate Dean for research to implement related plans. The department will provide matching fund.

Timeline for addressing Recommendations:

- The joint fund from the Dean's Office and the department was established in 2021. The collaboration with the Engineering Research Office will be implemented in the next five years (2022 – 2027).

Dean's Response

I support the department's proposed actions to address this recommendation and in particular we have been working with the Chair to find ways to encourage research especially in the Management of Technology (MOT) group.

5. Revitalize the MMSc-MOT Online program through pedagogical innovation, better integration within the department and updated course material.

Program Response

Management Science agrees in principle with the recommendation. However, they plan on taking a measured and systematic approach to address the MMSc-MOT online program. Specifically, we are already attempting to increase the enrollment of the current program using a targeted recruiting and advertising approach, which has already seen some success. We think this program has significant potential to improve further and are considering more significant changes, such as a renaming of the degree and reimagining of the courses offered. Before making these more significant changes, we are waiting on an analysis of the effects of our recruiting efforts. Given the course content change lead time, the department must be forward-looking and set content that will be of interest to future students. In the immediate term, it will help to have the Graduate Diploma in Data Analytics (GDDA) available to online students. Currently, the diploma is not available to online students. Of the informal feedback received so far, there is some interest from incoming and current students in acquiring the GDDA. The GDDA may be difficult given the course requirements of the current online program.

With respect to pedagogical innovation, the program already delivers courses that are different to those currently taught in the department. With smaller class sizes, instructors can tailor courses to appeal to the nature of the students. Specifically, it is their

understanding that instructors already have more applied deliverables such that students can address issues in their workplace.

Responsibility for Leading and Resourcing (if applicable) the Actions:
As the online program grows, it will help to have a dedicated staff member to help manage the program. This staff member will be responsible for advertising, keeping in touch with students, and addressing students' questions. At this point in time, a staff member is not necessary, but once enrollment doubles, something possible within a few years, they may become a necessity for the online program. In addition, the staff member can help supervise the program. Specifically, it will help to have online instructors take training on designing and delivering online courses through the center of teaching excellence. This training will ensure instructors are up-to-date on evidence based best-known methods for teaching online. The staff member can arrange for training and keep the department aware of which instructors have taken the training.

Timeline for addressing Recommendations:
As Management Science is growing enrollment through an awareness campaign, any additional changes to the program may start taking place at least 6 months from now.

Updated Timeline – Winter 2025:

- 1 year review - We opted for a continuous improvement strategy as opposed to a one-time review of offerings. We have been conducting annual reviews of the program offerings since 2022 and have made some adjustments.
- 1.5 year additional content + 2 years suggest changes to the program - We formed an Online Committee (Mark Hancock - Department Chair, Umair Shah - Director of Online Program, Samir Elhedhli and Sibel Alumur Alev) who review the curriculum regularly. We have already made minor adjustments (e.g., offering more relevant electives each term). We are planning a more significant curriculum change in the F2025 offering which we will present to the department in late W2025/early S2025 for approval.
- 0.5 year and 1 year CTE offerings - We now encourage all instructors to engage in CTE training; however, staff shortages have made it hard to track progress (see below)
- 1.5 year specific staff support -We will leverage current staff members (currently Brenna Costa) to support this program, as there is a hiring freeze. We are also not hiring a Marketing and Communications staff due to this same hiring freeze and instead must rely on the Faculty of Engineering support for this (Beth Cotter). Beth Cotter has helped us devise an online strategy and our marketing material has improved significantly.
- Future plans: (1) We are hiring a teaching-stream position in the current cycle who will be required to direct this program and lead the Online Committee and revitalization efforts. (2) We are investigating renaming the program to better reflect modern descriptors of its (refreshed) content. (3) We are adjusting the teaching model so that all instructors will be asked to teach these courses on overload, with compensation proportional to class size to

ensure affordability, recognize instructor efforts, and encourage instructors to deliver up-to-date, relevant content.

Dean's Response
I support the department's proposed actions to address this recommendation.

6. Plan for expanding department teaching outreach beyond the MSCI option to diplomas, certificate programs or customized options for non-engineering programs.

Program Response
The department will introduce a new direct entry graduate diploma for data analytics in 2023. The type-3 GDDA (graduate diploma in data analytics), which has been recently approved by the ministry, is a stand-alone GDDA with direct admission from all students and professionals outside of the Department of Management Sciences. On the other hand, the current faculty is not enough to cover Management Sciences option, GDDA, etc. Management Science hired a number of sessional instructors to teach courses for those programs. The current priority for the department is to increase the quality of existing programs, including the MSCI option.

Proposed Actions:
- Start to offer type-3 GDDA to students in the 2022-2023 academic year.
- The department is working with the associate Dean for Graduate Studies to expand the existing graduate student co-op program and increase the number of students in the co-op program.

Responsibility for Leading and Resourcing (if applicable) the Actions:
- The department chair and the associate chair for graduate studies and research will work on this issue.

Timeline for addressing Recommendations:
- The type-3 GDDA will be implemented in the winter 2023 term.

Update – Winter 2025:
- Our recent hiring has relieved some of the pressure from reliance on sessionals, though we still must rely on some sessionals. The FOE and our department have strategies for increasing teaching expectations of some faculty members, though this has not yet been confirmed/approved.
- We started accepting applicants for this program in Fall 2023, with an intake three times

a year. In the last four terms (Fall 2023, Winter 2024, Spring 2024, and Fall 2024), we received a total of 63 applications. Out of these, 7 were offered enrollment, and only one of those students accepted the offer but did not matriculate. We are working to increase awareness of the program for future offerings.

Dean's Response
I support the department's proposed actions to address this recommendation.

7. **Recruit faculty members that are able to bridge the three research streams and have the track record of interdisciplinary research and team building expertise.**

Program Response
Currently (2022), the department is searching for a new chair. It is an opportunity to recruit a faculty member with the capacity to bridge different research streams. The department has hired three new faculty members in data analytics. In a few years' time, the new hires will be established enough to promote collaboration in all three research streams and play a leadership role in interdisciplinary research.

Proposed Actions:
- The committee on interdisciplinary research will look into the need to hire faculty members, who are capable of leading interdisciplinary research in two or three areas. The recommendations of the committee will be implemented in the 2024-2027 academic years.

Responsibility for Leading and Resourcing (if applicable) the Actions:
- The department chair, the DACA, and the chair search committee led by the Dean of Engineering.

Timeline for addressing Recommendations:
- Recruiting can be done in two years (2022 and 2023). The Dean did commit to these hires and we are now interviewing for the last in this plan (with a new plan coming in the next Strategic Plan process).

Update – Winter 2025:

We have already recruited all but one of these hires, with an ongoing search in the final area happening in this cycle.

Dean's Response
I support the department's proposed actions to address this recommendation.

8. **Engage with other university units to be a part of the university space planning process for enhanced departmental spaces as well as expanded research labs.**

Program Response

The department plans to be part of the Engineering Building 8 (E8). The department has been engaging with other engineering departments for better space in teaching, learning, and research.

Proposed Actions:

- Work with Development & Alumni Affairs of the Faculty of Engineering to find endowments to fund the project related to E8.

Responsibility for Leading and Resourcing (if applicable) the Actions:

- The department chair and the department space committee.

Timeline for addressing Recommendations:

- This will be complete in five years (2022 – 2027).

Dean's Response

The Faculty is currently undergoing a detailed space audit and analysis to understand how well utilized our space is across all of our departments. Using this data along with data on the research activity of various research groups will provide us with tools to make evidence based decision of how best to allocate and use space in the future.

Recommendations Not Selected for Implementation

None

Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	Teaching space considerations especially with regards to courses offered in RCH	1) The department will engage in the new Engineering Building 8 (E8) in order to have more and better department space for teaching and learning. 2) The department is renovating department classrooms to serve teaching and learning better.	1) The department space committee, led by department chair, will work with the Faculty of Engineering. 2) An ad-hoc committee was formed to design the new teaching systems. The department space committee and the Dean of Engineering Office implemented the plan.	1) The department classroom renovation is undergoing and was completed in the winter 2022 term. 2) E8 is the next space project of the Faculty of Engineering, which has started. This may complete in five years (2027).
2.	Develop a common departmental integration strategy bringing the three streams together	1) Jointly organize research conferences/workshops in data analytics; 2) Collaboration in research; and 3) Co-supervise research students.	1) Faculty members, hired in recent years, in the data analytics area will be the main driving force for the integration initiative. 2) MSCI has two CRC chairs, who will play a leading role in this effort.	The department is expecting to see increased research collaboration and student co- supervision in 2027.

3.	Facilitate small yet interdisciplinary research projects/programs across department research streams	1) Small funds are available in the department to support interdisciplinary research (e.g., publication fees, data collection fees). 2) The department also provides partial financial support to graduate students co- supervised by faculty members from different research streams, if they do not have adequate, uncommitted funding.	The department chair and the associate chair for graduate studies and research are responsible to provide partial financial support for interdisciplinary research.	The plans will be implemented starting 2022 and will continue in the next five years (2022 – 2027).
4.	Through support from the Dean, receive portions of university envelope to apply for large grants such as CFI JELF and IF, as well as NSERC CREATE in interdisciplinary areas where the department has substantial strength	1) To encourage faculty members to apply for major research grants. 2) To collaborate with the Engineering Research office to encourage faculty members to work with industries, especially in data science and data analytics.	The department chair will work with the associate Dean for research to implement related plans. The department will provide matching fund.	The joint fund from the Dean's Office and the department has been established. The collaboration with the Engineering Research Office will be implemented in the next five years (2022 – 2027).

5.	Revitalize the MMSc-MOT Online program through pedagogical innovation, better integration within the department and updated course material	• 1 year review - We opted for a continuous improvement strategy as opposed to a one-time review of offerings. We have been conducting annual reviews of the program offerings since 2022 and have made some adjustments. • 1.5 year additional content + 2 years suggest changes to the program - We formed an Online Committee (Mark Hancock - Department Chair, Umair Shah - Director of Online Program, Samir Elhedhli and Sibel Alumur Alev) who review the curriculum regularly. We have already made minor adjustments (e.g., offering more relevant electives each term). We are planning a more significant curriculum change in the F2025 offering which we will present to the department in late W2025/early S2025 for approval. • 0.5 year and 1 year CTE offerings - We now encourage all instructors to engage in CTE training; however, staff shortages have made it hard to track progress (see below) • 1.5 year specific staff support -We will leverage current staff members (currently Brenna Costa) to support this program, as there is a hiring freeze. We are also not hiring a Marketing and Communications staff due to this same hiring freeze and instead must rely on the Faculty of Engineering support for this (Beth Cotter). Beth Cotter has helped us devise an online strategy and our marketing material has improved significantly.	As the online program grows, it will help to have a dedicated staff member to help manage the program. This staff member will be responsible for advertising, keeping in touch with students, and addressing students' questions. At this point in time, a staff member is not necessary, but once enrollment doubles, something possible within a few years, they may become a necessity for the online program. In addition, the staff member can help supervise the program. Specifically, it will help to have online instructors take training on designing and delivering online courses through the center of teaching excellence. This training will ensure instructors are up-to-date on evidence based best-known methods for teaching online. The staff member can arrange for training and keep the department aware of which instructors have taken the training.	*See timelines in proposed actions column.*

		• Future plans: (1) We are hiring a teaching-stream position in the current cycle who will be required to direct this program and lead the Online Committee and revitalization efforts. (2) We are investigating renaming the program to better reflect modern descriptors of its (refreshed) content. (3) We are adjusting the teaching model so that all instructors will be asked to teach these courses on overload, with compensation proportional to class size to ensure affordability, recognize instructor efforts, and encourage instructors to deliver up-to-date, relevant content.		
6.	Plan for expanding department teaching outreach beyond the MSCI option to diplomas, certificate programs or customized options for non-engineering programs	1) Start to offer type-3 GDDA to students in the 2022-2023 academic year. 2) The department is working with the associate Dean for Graduate Studies to expand the existing graduate student co-op program and increase the number of students in the co-op program.	The department associate chair for graduate studies and research will work with the associate Dean of Engineering on this issue.	We started accepting applicants for this program in Fall 2023, with an intake three times a year.
7.	Recruit faculty members that are able to bridge the three research streams and have the track record of interdisciplinary research and team building expertise	1) Hire 1 to 2 new faculty members, who is capable of leading interdisciplinary research in two or three areas, in the 2022-2023 and/or 2023-2024 academic year.	The department chair, the DACA, and the chair search committee led by the Dean of Engineering.	We have already recruited all but one of these hires, with an ongoing search in the final area happening in this cycle.
8.	Engage with other university units to be a part of the university space planning process for enhanced departmental spaces as well as expanded research labs	2) Work with Development & Alumni Affairs of the Faculty of Engineering to find endowments to fund the project related to E8.	The department chair and the department space committee.	This will be complete in five years (2022 – 2027).

The Department Chair/Director, in consultation with the Dean of the Faculty shall be responsible for the Implementation Plan.

Date of next program review **2028-2029**

Date

Signatures of Approval

Digitally signed by Mark Hancock
Date: 2024.02.28 15:12:34 -05'00'

Chair/Director Date

AFIW Administrative Dean/Head (*For AFIW programs only*) Date

Mary Wells Digitally signed by Mary Wells
Date: 2024.02.29 09:05:00 -05'00'

Faculty Dean Date

Note: AFIW programs fall under the Faculty of ARTS; however, the Dean does not have fiscal control nor authority over staffing and administration of the program.

July 11, 2023

Associate Vice-President, Graduate Studies and Postdoctoral Affairs Date
(For graduate and augmented programs)
On Behalf of the Associate Vice-President, Academic