FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

MECHATRONICS ENGINEERING (UG) PROGRAM

Date of Review: March 28 – 29, 2023

In accordance with the University Institutional Quality Assurance Process (IQAP), this final assessment report provides a synthesis of the external evaluation and the internal response, and assessments of the undergraduate program delivered by the Mechatronics Engineering program. This report identifies the significant strengths of the program, together with opportunities for program improvement and enhancement, and it sets out and prioritizes the recommendations that have been selected for implementation.

The report includes an Implementation Plan that identifies who will be responsible for approving the recommendations set out in the Final Assessment Report; who will be responsible for providing any resources entailed by those recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations and who will be responsible for acting on those recommendations; and timelines for acting on and monitoring the implementation of those recommendations.

Executive Summary of the Review

In accordance with the Institutional Quality Assurance Process (IQAP), the Faculty of Engineering submitted a self-study in February 2023 to the Vice-Provost (Teaching and Learning) to initiate the cyclical program review of the Mechatronics Engineering undergraduate program. The approved self-study presented program descriptions, learning outcomes, and analyses of data provided by the Office of Institutional Research and Analysis.

Two arm's length external reviewers and one internal reviewer were endorsed by the Dean, Faculty of Engineering and selected by the Vice-Provost (Teaching and Learning). The review team reviewed the self-study documentation and then conducted a virtual site visit on March 28 – 29, 2023. The visit included interviews with the Vice-Provost (Teaching and Learning), Deputy Provost, Dean of the Faculty of Engineering, Chair of the Department, Director of Engineering & Society and Engineering & Management programs, and Acting Associate Dean (Academic) and meetings with groups of current students, full-time faculty, and support staff.

The Dean of the Faculty of Engineering, Chair of the Department, Associate Chair and Acting Associate Chair (Undergraduate) submitted responses to the Reviewers' Report. The initial response was prepared by the program in May 2023, and finalized by the Dean in May 2024. Specific recommendations were

discussed, and clarifications and corrections were presented. Follow-up actions and timelines were included.

Strengths

The mechatronics program at McMaster is a unique program in that it emphasizes software, as opposed to the same program in other universities. This uniqueness has made the program attractive among the students and allows for the program to have a successful competition with other universities offering the mechatronics program in the region. It also builds on existing strength in software engineering that is already within the department.

Students from the program because of their software strength are well sought both during their education and after graduation. Finding co-op and summer job opportunities is straightforward for the students enrolled in the mechatronics program.

The participation of female students in the department of Software Engineering and the mechatronics program is about 40%, which is excellent compared to other engineering department and programs at large.

Opportunities for Improvement and Enhancement, Including Appropriateness of Resources

The reviewers stated:

The department of software engineering and mechatronics program are the top two choices among the 1-st year engineering students, choosing their discipline when entering year 2. This has encouraged the university to allow the program to grow at a rapid rate and naturally the allocation of resources including faculty members, teaching assistantship with proper training, space, equipment, and staff support could trail behind the rapid growth. In turn, the faculty and students have difference of opinion on this rapid growth to a certain degree that could affect the existing enthusiasm toward the program in the long term. Hence, the administration and particularly the faculty can be more communicative about the need for the growth and short- and long-term plan for provision of support and resources.

Students lacking in Math skills. This is an issue that is facing all universities in Canada, and is not unique to McMaster. Synchronizing offering of courses – introductory courses such as Math, design, and circuits should be offered earlier in the program to prepare students with adequate background prior to more advanced courses.

A large percentage of the students enrolled in the mechatronics program seek co-op option and benefit with industry experience during their education. After speaking with the students, we feel that the students' enthusiasm is not commensurately met by the co-op office, and broader support is expected.

$400 co-op fees is excessive considering the services it provides. The co-op office offers resume reviews and coaching. However, it does not provide much in terms of connecting students with potential employers.

Summary of the Reviewers' Recommendations with the Program's and Dean's Responses

Recommendation #1: Prepare and present to the faculty members involved in the program, a brief and clear document describing the rationale and short- and long-term resource allocation plan for the program.
Department's Response and Actions to be Taken: We agree. There should be a strategic plan for our Mechatronics program, concerning its future, size, and resources needed. Initial discussions have been held with the Associate Dean Academic on the program and the intention is to perform a review of the program in the coming year that will produce these documents. In the meantime the original Mechatronics program proposal that describes the program design and philosophy will be made available to all instructors of the program.
Dean's Response: The Associate Dean (undergraduate) has had initial discussions with the Chair of CAS about the Mechatronics program and will be undertaking a more formal review in the 2024/25 academic year.

Recommendation #2: Adjust the role, scope, responsibilities of the co-op office and staff according to the scale of the co-op program.
Department's Response and Actions to be Taken: The co-op programs and their administration are in the responsibility of the Faculty. Engineering Career and Coop Services has recently hired additional staff to support the growth in demand for coop placements.
Dean's Response: Since July 2021, the ECCS team has prioritized and delivered on the following: • A full departmental reorganization and structural redesign. • 66% growth in team size including specialized roles for both industry partnership and student support. • A student needs assessment which collected feedback from more than 1700 undergraduate and graduate students. • Implementation of co-op policies and procedures to create consistency and transparency of processes and strengthen the integrity of the program. • A system audit of OSCARplus followed by a thorough clean-up of back-end data and implementation of new functions to improve user experience, operational efficiencies and reporting capabilities. • Development of a career curriculum and redesign of career and co-op courses.

Recommendation #3: Design and implement a technical and admin support for the faculty in view of the past and upcoming rapid growth.

Department's Response and Actions to be Taken: An additional staff position Team Lead, Academic has been added to the department bring the office staff to 5 full time positions.
Dean's Response: We agree that that additional capacity for program administration is needed, which is why we added this role.

Recommendation #4: The committee identified the need for a Mechatronic Program Director position to lead the management of the program. It later learnt that one such position presently exists. The recommendation is to make sure this is widely communicated to the students.
Department's Response and Actions to be Taken: This has already been done, it is part of the new Mechatronics students' orientation.
Dean's Response: As part of our review in 2024/25, we plan to revisit the program's governance structure. Given its interdisciplinary nature, the Director should lead an active committee with representation from Mechanical Engineering, Electrical and Computer Engineering, and Engineering Physics. Additionally, leadership roles are typically term appointments to ensure cyclical changes.

Recommendation #5: Direct entry to the software engineering and mechatronics programs may further help McMaster be the first choice of high school graduates, who have particular interest in these disciplines.
Department's Response and Actions to be Taken: This is a recommendation at the Faculty level.
Dean's Response: We recognize the potential benefits of direct entry and are currently exploring several direct entry schemes for all B.Eng. programs. This represents a significant change from our current admissions process and could impact our budget. Therefore, we are modeling a range of scenarios to determine the potential outcomes. If implemented, direct entry will be done thoughtfully and carefully.

Recommendation #6: The faculty may also consider increasing the number of "free choice" students entering the second year to allow more students choose their desired programs, although a study may be required as this may have implications on the other engineering programs.
Department's Response and Actions to be Taken: This is a recommendation at the Faculty level.
Dean's Response: We cannot increase the number of free choice students. Free choice guarantees students their discipline of choice in the second year, provided they are in good standing. However, each program

has limited space. If we issued additional free choice offers, we would likely exceed enrollment caps in Software and Mechatronics, and potentially in Electrical and Computer Engineering.

Recommendation #7: There is a desire to include more robotics and hardware related contents in the program, from both the students and the instructor of the specific mechatronics courses. More electives as well as greater specialization choices was another topic discussed with the students. The mechatronics program can consider allowing the students to adopt different specialization path in the upper years, as long as the fundamental of software, mechanical and electrical engineering are covered in the lower years. There is a need to synchronize the offering of courses such as math and design before more advanced robotics and mechatronics courses.

Department's Response and Actions to be Taken:
There has been on-going hiring of new Mechatronics faculty in robotics, with also emphasis on the hardware component. The Mechatronics curriculum has been recently updated to adapt to this new reality, and we hope that with the integration of new faculty and new electives the students will soon be able to choose their own specialization path.

Dean's Response:
We are eager to see how the updated curriculum is received by the Mechatronics students. The 2024/25 review will assess whether these updates are sufficient or if further changes are needed.

McMaster University

Implementation Plan

In the chart below, please outline the recommendations made by reviewers, briefly outline the actions you plan to take, who will be responsible for leading the action, and a timeline for completion.

Recommendation	**Action(s) to be Taken**	**Responsibility for Leading Action** (specify the role(s) that will be responsible for each action item e.g. Program Chair.)	**Timeline for Completing Action** (indicate specific timelines (e.g. not 'ongoing') for action)
Prepare and present to the faculty members involved in the program, a brief and clear document describing the rationale and short- and long-term resource allocation plan for the program.	We agree. There should be a strategic plan for our Mechatronics program, concerning its future, size, and resources needed.	Department Chair Mechatronics Coordinator and Undergraduate Advisor for Mechatronics Engineering	Academic year 2023/24
Adjust the role, scope, responsibilities of the co-op office and staff according to the scale of the co-op program.	The co-op programs and their administration is the responsibility of the Faculty.		
Design and implement a technical and admin support for the faculty in view of the past and upcoming rapid growth.	An additional office staff was hired.	Department Chair	Academic year 2023/24
The committee identified the need for a Mechatronic Program Director position to lead the management of the program. It later learnt that one such	This has already been done, it is part of the new Mechatronics students' orientation.	Department Chair	Academic year 2023/24

position presently exists. The recommendation is to make sure this is widely communicated to the students.			
Direct entry to the software engineering and mechatronics programs may further help McMaster be the first choice of high school graduates, who have particular interest in these disciplines.	This is a recommendation at the Faculty level.	Associate Dean Academic	Academic year 2025/26
The faculty may also consider increasing the number of "free choice" students entering the second year to allow more students choose their desired programs, although a study may be required as this may have implications on the other engineering programs.	This is a recommendation at the Faculty level.	Associate Dean Academic	Academic year 2025/26
There is a desire to include more robotics and hardware related contents in the program, from both the students and the instructor of the specific mechatronics courses. **More electives as well as greater specialization choices was another topic discussed with the students. The mechatronics program can consider allowing the students to adopt different specialization path in the upper**	There has been on-going hiring of new Mechatronics faculty in robotics, with also emphasis on the hardware component. The Mechatronics curriculum has been recently updated to adapt to this new reality, and we hope that with the integration of new faculty and new electives the students will soon be able to choose their own specialization path.		

years, as long as the fundamental of software, mechanical and electrical engineering are covered in the lower years. There is a need to synchronize the offering of courses such as math and design before more advanced robotics and mechatronics courses.			
When and where possible, the instructor may consider increasing the weight of term and final projects, individual presentations to not only assess the students learning more fairly but also promote their soft skills including preparation of technical reports, public speaking, and presentations.	This is the responsibility of the individual instructor. Many of our courses already contain the soft-skills components suggested by the reviewers.		

Quality Assurance Committee Recommendation:

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation at the June 19, 2024, meeting. The committee recommends that the **Mechatronics Engineering** program should follow the regular course of action with an 18-month progress report and subsequent full external cyclical review to be conducted no later than eight years after the start of the last review.