

FINAL ASSESSMENT REPORT

Institutional Quality Assurance Program (IQAP) Review

Computational Science and Engineering

Date of Review: March 2nd and 3rd 2015

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 graduate programs delivered by the Computational Science and 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.

This Final Assessment Report includes an Implementation Plan that identifies who will be responsible leading the follow up for the proposed recommendations; any changes in organization, policy or governance that will be necessary to meet the recommendations; and timelines for acting on and monitoring the implementation of those recommendations.

Executive Summary of the Computational Science and Engineering Cyclical Program Review

The Computational Science and Engineering Program submitted a self-study to **the School of Graduate Studies** February 2015. The self-study presented the program descriptions and learning outcomes, an analytical assessment of the graduate programs offered, and program data including the data collected from a student survey along with the standard data package prepared by the Office of Institutional Research and Analysis. Appended were the CVs for each full-time faculty member in the Department.

Two external reviewers and one internal reviewer examined the materials and completed a site visit in March 2015. The visit included interviews with the Provost and Vice-President (Academic); Deans of the Faculty of Science and of Engineering; Dean of School of Graduate Studies; Chair of the Department, and meetings with groups of current students, full-time and part-time faculty and support staff.

The reviewers praised a number of aspects of the Computational Science and Engineering program, including its uniquely broad and interdisciplinary character, efficient use of available resources and students' academic achievements. They did also identify a number of opportunities for improvement and enhancement, especially concerning administrative matters and how the program should evolve in future.

The following program strengths and areas for enhancement/improvement were also noted:

- **Strengths**

- McMaster’s CSE Program was recognized as pioneering in Canada where it is distinguished by its breadth (spanning the Faculties of Science and Engineering, with participation of the School of Business and the Faculty of Health Sciences)
- the Program was found to be well aligned with the University’s mission, especially as regards promotion of interdisciplinary education and scholarship
- the solutions offered by the Program in regard to research environment, coursework and comprehensive examination, which bridge different academic cultures and traditions, are well designed and based on good models; as such are appreciated by its key stakeholders
- the Program has a well-developed sequence of High-Performance Computing (HPC) courses taught by SHARCNET staff
- the Program’s operation is efficient in terms of its use of both human and financial resources

- **Areas for Enhancement/Improvement**

- Lack of a memorandum of understanding between the Faculties of Science and Engineering unambiguously specifying their responsibilities with respect to the Program
- core courses (CSE 700, 701 and 702) taught by sessional instructors rather than by full-time faculty
- lack of transparency in regard to funding offered to students supervised by faculty from different departments
- lack of common space available to students in the Program
- vacant position of Associate Program Director (who should come from a faculty other than the Program Director)

Summary of the Reviewers’ Recommendations with the Department’s and Dean’s Responses

Recommendation	Proposed Follow-Up	Responsibility for Leading Follow-Up	Timeline for Addressing Recommendation
Full-time faculty to teach core courses (CSE 700, 701, 702)	Faculties of Science and Engineering each assign one teaching slot to teach these courses	Deans of Science and Engineering	Academic Year 2016-17
Guaranteed minimum support available to all students admitted to the Program	Introduce more transparency regarding access to financial resources (TAs, bursaries, TAships)	Program Director and Program Administrator	Academic Year 2015-16

	etc.) for both in-program and incoming students		
Availability of common space to students	Stipulation in the Memorandum of Understanding	Deans of Science and Engineering	Academic Year 2015-16
Access to office space and other facilities in the supervisor's home department	Stipulation in the Memorandum of Understanding	Deans of Science and Engineering	Academic Year 2015-16
Create an "Avenue to Learn" shell for students in the Program	Direct implementation	Program Director	Summer 2015
Orientation meeting involving students' supervisors and administrative staff	Direct implementation	Program Director	September 2015
Establish SIAM Chapter	Direct implementation	Program Director and selected CSE students	Fall 2015
Escape clause for core courses (allowing students who can demonstrate adequate training to replace a core course with a different course)	Propose a change to Program requirements	Program Director, School of Graduate Studies	Academic Year 2015-16
Reinstate the position of the Associate Program Director	Stipulation in the Memorandum of Understanding; initiate search for a suitable candidate	Deans of Science and Engineering	Academic Year 2015-16
Discontinue the currently inactive coursework-only Master's program	Propose a change to Program description	Program Director, School of Graduate Studies	Academic Year 2015-16
Ensure CSE-affiliated faculty receive full credit for their contributions to the Program	Stipulation in the Memorandum of Understanding	Deans of Science and Engineering, Chairs of participating departments	Academic Year 2015-16
Improve Program's visibility through better advertising	Prepare a new advertising brochure, improve website and overall web presence	Program Director, School of Graduate Studies	Ongoing effort
Create a new stream	Expand the Program's	Program Director,	Academic Year 2016-

focused on “data science and big data” (this initiative will allow us to probe the demand for a professional-degree program mentioned below)	curriculum in areas related to data science	CSE-affiliated statistics faculty, School of Graduate Studies	17
Support the creation of an undergraduate Program focused on scientific computing	Support creation of a “task-force” with suitable mandate	Dean of Science	???
Consider creation of a professional Master’s program in “Computational and Data Science”	Support creation of a “task-force” with suitable mandate	Dean of Science, School of Graduate Studies	???

Dean’s Response:

Engineering -

The Faculty of Engineering will endeavour to work with the home faculty of Science and CSE to develop a MOU that addresses the points of teaching/credit, TAs and space; the faculty is building collaborative space in ITB which would be accessible to the students in CSE. The matter regarding minimum funding level brought up in the report is readily addressed within CSE itself and the program has full authority to make such a change. The suggested appointment of an Associate Program Director will be reviewed with CSE based on need and fiscal constraints. The only part of the report which the Faculty of Engineering challenges is the need to develop an undergraduate program for CSE, as there exists a well-established Computing and Software program in Engineering that already provides education in computer science and software development. Instead, it would be beneficial for these undergraduate and graduate programs to develop interactions that might result in higher domestic admissions into CSE and better offer that feeling of integration sought in the reviewers’ comments.

Science –

Some of these suggestions fall under the direct control of the program director, and the Dean is pleased to see that they are currently being implemented or are planned for the near future. In particular, the issue of cohort-building through an orientation meeting and an Avenue to Learn course shall will be addressed for the next incoming class, and the professional development of the students through creation of a local SIAM chapter should also be in place this academic year. The program has also outlined a plan to help even out the funding discrepancies for students across the program. The Dean of Science has asked the Associate Dean for Graduate Studies to work with the Program Director to help with recruitment activities and to investigate the idea of a possible Professional MSc program connected with Big Data. Some of the other

suggestions, such as more flexibility in the core courses and the removal of the coursework MSc option will be addressed during this fall's curriculum cycle.

Since this is an interdisciplinary program, many of the staffing and governance issues must be addressed through a Memorandum of Understanding with the Faculty of Engineering. Such an MOU is currently under discussion, and the Dean of Engineering and the Dean of Science do not foresee any difficulties. The MOU will address the financial and other resource issues, including the teaching of core courses, common room space, and appropriate administrative support.

While it will be very important to not duplicate existing Computer Science programs, the Faculty of Science supports the consideration of an enhanced undergraduate experience in computational science. The Faculty's recent academic planning process brought to light the need for guided projects in computational biophysics, biochemistry, psychology, etc. to meet the needs of UG students from a diverse array of programs. The Faculty is also interested in the development of courses on the use and analysis of database archives or large data sets in genomics, climate, astrophysics, etc. Whether such an experience could form the basis of a new, stand-alone undergraduate degree program in CS&E would need to be investigated with the help of the Associate Deans (Academic) from both faculties.

Quality Assurance Committee Recommendations

- The review team was very impressed with the programs: **“the McMaster CSE program has succeeded remarkably in establishing a well-functioning and sustainable interfaculty program that scores very highly in terms of the metrics of graduate education and research”**
- The team commented that the program is strong, the admission standards are appropriate and aligned with similar programs at the university, the curriculum is creative and in line with leading edge programs in this area, the administration of the program is efficient and effective, and the graduates are successful and positive about the program
- Recommendations:
 - to enhance the success of the program and permit it to reach its full potential, an MOU should be established between the Faculty of Science and the Faculty of Engineering. The IQAP committee feels that once in place a well documented MOU will address many of the minor areas of improvement
 - core courses should be taught by tenure-stream faculty
 - establish minimum support packages for students
 - provide a common room for students
- Other Areas for Improvement
 - Better inclusion of students – provide desks and include on distributions lists for academic and social activities
 - Avenue 2 Learn provided for students to communicate and network
 - Enhanced intake meeting for incoming students to provide a plan
 - Encourage students to start a SIAM chapter at McMaster
 - Escape clause for core courses (if have covered material previously)
 - Re-instate Associate Program Director from the opposite faculty of Program Director
 - Discontinue the current coursework master's program due to lack of interest and recruitment

- Provide full academic credit for faculty supervisors
 - Increase recruitment of domestic students
- Areas for Enhancement
 - expand aspects of the curriculum related to data science, including algorithms for computational statistics, large-scale optimization, and high-end parallel and distributed computing for big data problems
 - create a professional master's (the reviewers were informed that a new undergraduate program had already been considered, but was not an option at this time)

Quality Assurance Committee Recommendations

McMaster's Quality Assurance Committee (QAC) reviewed the above documentation and the committee recommended that the program should follow the regular course of action with an 18-month progress report and a subsequent full external cyclical review to be conducted no later than 8 years after the start of the last review.