

Two-Year Progress Report

Systems Design Engineering

(MAsc/PhD/MEng)

July 2020

Background

The review team examined the self-study documentation and conducted a site visit at the University of Waterloo on June 11-12, 2015. The visit included interviews with the Vice President, Academic & Provost, Associate Provost, Graduate Studies¹, the Dean and Associate Dean, Graduate Studies, of the Faculty of Engineering, Chair and Associate Chair, Graduate Studies, of the Department, faculty members, administrative and technical staff and a group of six current graduate students and support staff. The reviewers also had an opportunity to visit three research laboratories.

Summary of strengths, challenges and weaknesses based on self-study:

Strengths

- Systems Design Engineering (SDE) is unique in Canada, providing an engineering program that focuses on both design as well as systems analysis, two areas that are typically in separate programs.
- The program boasts leading edge research in emerging areas, such as Biomedical engineering, intelligent systems & signals, human factors engineering as well as societal & environmental engineering.

Challenges

- SDE is a diverse department, which is reflected in the diverse areas of research topics and they continually question what can unify their program. In the undergraduate program the unification is via design & system modelling which is not as explicit in the graduate program.
- There is a difficulty in attracting excellent domestic students to the Department's graduate programs, especially their own undergraduates who are highly desirable in the work force. This problem is also shared by other engineering departments at Waterloo and in Canada in general. A working group at the faculty level is addressing this issue.

¹ The Associate Provost, Graduate Studies title changed to Associate Vice-President, Graduate Studies and Postdoctoral Affairs as of June 2017.

- Struggles with graduate course offerings chiefly due to the lack of teaching resources available, i.e., a lack of faculty.

Weaknesses

- Many of the faculty collaborate with other departments and faculties, but comparatively few collaborate with each other. Collaboration is an opportunity to unify the program and attract more domestic graduate students. We anticipate that space consolidation in EC4 (former RIM / Blackberry space) and the opening of E7 will partially address this weakness.

Summary of key findings from the external reviewers

The external reviewers report was positive and noted “The general environment in the department is open, receptive, inclusive and collaborative.” It also reported that the graduate students “value the interdisciplinary, collaboration and freedom that the SDE philosophy facilitates and see it as allowing them to see the big picture and transcend traditional engineering boundaries”.

Faculty members are seen as supportive, personable and compassionate and ‘very special’ people who go beyond what is expected by graduates. In addition, the program’s retention rates and times to completion are good, and overall student numbers are reasonably healthy and growing.

Reviewers identified a few challenges which included a shortage of graduate courses to serve the broad interests of graduate students and a continuing shortage of lab space.

Progress on Implementation Plan

Recommendations

1. A “systems level philosophy to problem solving” is implicitly found in the general environment in the department, but has not been developed and articulated at the graduate level in a formal manner.
 - a. **Status:** We are introducing core courses to the graduate program that addresses this. Initially the core courses will only be core for the MEng students however other graduate students in Systems Design will be able to take these courses. The Department approved these courses at a departmental meeting on July 19, 2017.
 - b. **Details:** The proposed new core courses include SYDE600 Systems Theory, Models, Research & Design; SYDE 660 Systems Design Graduate Workshop 1; & SYDE 662 Systems Design Graduate Workshop 2. These courses are available to MASc, MEng and PhD students in our department as well as within the Faculty of Engineering.

2.

- a. Graduate students in the course based MEng program will benefit greatly from guidance to navigate their course selections.
 - i. **Status:** The Associate Graduate chair has met with students on a regular basis to assist MEng students. We are also introducing core grad courses for MEng students (see above) as well as a variety of five specializations which will provide direction for MEng students as well as providing them with a focus.
 - ii. **Details:** The specializations were approved at Senate in April 2019 with the intention to have these available for students beginning in the Fall 2019 term. The specializations being introduced are: Artificial Intelligence and Machine Learning; Biomedical Systems; Human Factors; Mechatronic & Physical Systems; and Vision, Image & Signal Processing. Concurrently, 5 additional variants of SYDE660 (Systems Design Graduate Workshop 1) were created SYDE660A, SYDE660B, SYDE660C, SYDE660D, and SYDE660E to allow the students to gain design experience specific to their specialization. Those variants are being offered for the first time in Spring 2020.
- b. The mechanism for graduate student body feedback and involvement in matters related to the graduate program should be more formalized.
 - i. **Status:** A Graduate student representative was chosen to act as an intermediary the past two years. We have decided that a formal GSA is necessary and in September elections will be held for its executive.
 - ii. **Details:** The SDE GSA constitution has been approved at the university GSA level in July 2017. A faculty mentor is also working with the SDE GSA leadership.
- c. The average funding for thesis-based students in the department seems good, however, the minimum funding levels could be improved.
 - i. **Status:** The reviewers report suggested looking into offering funded TA-ships at the time of admission; this could certainly make an offer letter more attractive, but carries a risk of offering a TA position to a student with unknown pedagogical skills. We would point out that our average income for funded graduate students is \$31,857, compared to the Faculty of Engineering average income of \$30,295. Similarly, 27.5% of SDE graduate students have external scholarship support, compared to 20.3% across the faculty of Engineering. These two statistics are evidence, in fact, that Systems Design Engineering funding support is competitive relative to the rest of the faculty. The minimum level of funding for full-time research Masters students is set by the Faculty of Engineering and as of May 2019 is \$18,000/year. The minimum level of funding for full-time doctoral

- students is set by the University. In Engineering, any income earned by students serving as TAs/CAs is on top of this minimum funding.
- ii. **Details:** No further progress required at departmental level.
- d. There is a general sense among the graduate students that the hours put in by the teaching assistants are significantly above the expected norms.
- i. **Status:** The program has, and will continue, to articulate to professors the expectation of 130 hours of total work for teaching assistants. This information has been and will continue to be annotated in the TA appointment letter. Instructors are also requested to submit a time allocation sheet for each TA, signed by both the graduate student and instructor, showing a distribution of duties within this time period. To the extent that this expectation is not met in certain courses, we would propose that the graduate student feedback representative or SYDE GSA, discussed in point 2b, should allow such cases to be communicated anonymously to the graduate chair and ensure that discrepancies are dealt with promptly.
 - ii. **Details:** No further details necessary.
3. The number of annual graduate course offerings seems low relative to the wide span of areas in the department.
- a. **Status:** In order to increase annual graduate course offerings, this problem will be addressed by the core courses introduced as well as the need for graduate courses for the specializations.
 - b. **Details:** Core courses are introduced and courses needed to support the specializations are being scheduled to be offered on a regular basis. Courses are also being added to ensure that each specialization has unique graduate courses, as required by the current University of Waterloo guidelines for specializations.
4. Current research space is fragmented and insufficient for the needs of the department.
- a. **Status:** When this review was undertaken in 2015, when the measures of space requirements per student etc. were accounted for, Systems Design was the furthest behind of any other department in Engineering at the University of Waterloo.
 - b. **Details:** Since the acquisition of space in EC4 and E7, Systems Design is now, arguably, further ahead in space than most other departments. However, since hiring for the new Biomedical Engineering undergraduate program in the department remain ongoing, our space allocation will revert to being closer to the faculty average over time.

Address any significant developments or initiatives that have arisen since the program review process, or that were not contemplated during the review

Fourteen faculty members joined the department in the last five years. Two more will be joining before the end of 2020. We are currently reorganizing the graduate course cohort to better serve the needs of our graduate students. As a part of this reorganization, we are planning a new joint graduate program in Biomedical Engineering.

One of the expressed concerns during the review was the number of domestic graduate students. We currently only have anecdotal evidence around the increase in domestic graduate students and the variation in distribution between domestic and international students at various levels (MAsc, MEng, PhD). As our cyclical review is upcoming, this analysis will be a key focus of the upcoming (2021-22) review. It will be helpful to identify any changes in graduate student numbers across the programs since the time of the 2015-16 review and any variation in distribution between domestic and International students.

Updated Implementation Plan

	Recommendations	Proposed Actions	Responsibility for Leading and Resourcing (if applicable) the Actions	Timeline for addressing Recommendations
1.	Systems level philosophy	New core courses	Associate Graduate Chair	Dept approval: July 2017 EGSO approval: Fall 2017 Effective Fall 2018
2.	MEng issues	New specializations	Associate Graduate Chair	Senate approval April 2019 – effective Fall 2019
3.	Shortage of annual graduate course offerings	Annual courses scheduled to support specialization will address this problem	Associate Graduate Chair	Senate approval April 2019 – effective Fall 2019
4.	Department research space fragmented & insufficient	New EC4 space added July 2016. E7 space added fall 2018.	Department Chair	Completed Fall 2018

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



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Date of next program review: _____ 2021
Date

Signatures of Approval:

Chair/Director Date April 29/19

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

Faculty Dean Date April 30/2019

Associate Vice-President, Academic (For undergraduate and augmented programs) Date

Associate Vice-President, Graduate Studies and Postdoctoral Affairs (For graduate and augmented programs) Date September 24, 2019

Checklist for SUC/SGRC Reviewer Feedback Quality Assurance Office

Two-Year Progress Report: Systems Design Engineering

Name of Reviewer: Rhona Hanning

Date: 3/9/2020

Does the Two-Year Progress Report:

- | | | |
|--|---|-----------------------------|
| 1. Clearly describe progress achieved on the various action items in the implementation plan? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 2. Explain convincingly any circumstances that would have altered the original implementation plan? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 3. For items that are behind schedule, propose an amended implementation schedule that is reasonable and credible? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 4. Address significant developments or initiatives that have arisen since the program review process, or that were not contemplated by the program review process? | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |

General Comments

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