August 18, 2014

Technion ISE Evaluation Report 2013

We are grateful to the committee members for the time and effort put into the professional and thorough evaluation of our program and the writing of this report, as well as the general report. Below we respond to the comments and specific recommendations of the committee, pertaining to our ISE programme. With regards to the general report, the upshot is that, in the committee's opinion, "radical change is required of all Israeli programmes", and it is recommended that the institutions meet and work together in revising their programmes accordingly. Although we do not object to cooperation between institutions, after many years of experience we believe that our programme is very well-suited to the unique nature of the Technion and are opposed to radical changes. We elaborate on our point of view in the detailed response that follows.

1. Organizational Structure

1.1. Observation and findings

At the Technion, the Information Systems Engineering study programme is jointly administered by the Faculty of Computer Science and the Faculty of Industrial Engineering and Management.

The committee believes that the two-faculty organization is working well at the moment. However, we were repeatedly told that conflicts were easily resolved because the two Deans have good relations and compatible views. We do have some concern about what could happen if the normal cycle of rotation and retirement were to change this fortunate fact.

We note that both faculties have professors with a computer science background and that they occasionally offer competing courses. There are also potential disagreements about admission requirements.

We would like to express our gratitude and appreciation to the committee members for the time and effort put into the professional and thorough evaluation of our program, and the writing of this report. Below we respond to the comments and recommendation of the committee.

The Technion is a highly regarded institute of science and technology. The Information Systems Engineering track was established in the spirit of the Technion as a combined effort of the faculty of Industrial Engineering & Management and the faculty of Computer Science, and it provides a strong education in the relevant aspects of both science and engineering. The track has been designed and is continuously adapted based on both timely and foreseen IT needs of the Israeli industry. Unlike the graduates of (non-engineering) Management Information Systems programs, ISE graduates are nowadays expected to have a substantial knowledge in various aspects of computer science and IT engineering, while being capable to apply this knowledge in the context of business specifics of their organizations. This is what our program aims to accomplish.

Regarding the execution of the program, we note that it has been administered jointly by the two faculties for many years already, and there are well defined, working administrative mechanisms for controlling the execution, such as the inter-faculty committee for the ISE program, the Technion's committee for undergraduate studies, dialogues between the deans, and other means of joint management. We should note that the Technion has much successful experience with programs that are administered by more than one faculty.

The committee noted that both faculties have professors with a computer science background. This is indeed the case, and is true for other faculties in the Technion as well. This is natural for technology institutes nowadays, given the major role computers play in all aspects of technology. The two faculties (and the Technion as a whole) see that as an important advantage for the program. First, the communication amongst professors with a common interest from both faculties allows for better coordination and shaping of the program. Second, the fact that core courses of the program can be given by multiple professors improves the stability of the curriculum. It is important to note here that courses across the Technion may compete, but each of the courses has to be unique enough to be approved by the relevant Technion committees. Finally, we note that running the ISE program in a joint effort of two faculties rather than establishing a separate department for ISE greatly reduces redundancy between the courses given by the professors across the campus.

1.2. Recommendations:
1.2.1. Short term/immediate (~ within 1 year)

We recommend that the current Deans document their mutual understandings in a document that binds future Deans. We are particularly concerned about potential conflicts about who teaches a shared course and how those courses are taught. We recommend that such potential disagreements be resolved in a formal agreement that governs the administration of the programme.

We believe that the Annual Catalogue contains the required documentation for the program. Regarding "shared courses", note that each course in the track is under the full responsibility of exactly one faculty, and the responsible faculty is the one that decides who will teach the course and how it will be taught. The course number indicates whether a course is an IE&M course or a CS course. Please note that the program also includes courses given by other Technion departments, such as mathematical courses that are under the responsibility of the Math department. So, although the track is shared by the two departments, there are no shared courses in the track, and there is no ambiguity regarding which department is responsible for each course. Changes in the program always require the agreement of the two departments.

1.2.2. Intermediate (~ within 2-3 year)
None

1.2.3. Long term (until the next cycle of evaluation)
None

2. Missions and Goals
2.1. Observation and findings

We found two "mission statements" that differ substantively. The CS department's document includes reference to human aspects of information systems that are missing in the statement provided by Industrial Engineering. The Industrial Engineering and Management version added the internet, big data, and other technology topics.

Both mission statements say that the concept of "information system" has changed. The committee agrees that the changes discussed are real and important but is concerned that the new definition no longer includes topics that were classically understood as information systems. The mission statements provide justification for the additional topics but not for deleting the missing topics. The deleted topics are still very relevant to the use of IT in organizations. [See section 3.1 below for more detail.] This newly revised programme is not consistent with the CHE document defining "Information Systems" programmes, which was approved by the C.H.E on June 14, 2011.

The term "Information Systems" is being used in different academic programs in Israel, for example, "Management Information Systems (MIS)" (מערכות מידע ניהוליות), "Managing Information Systems", (ניהול מערכות מידע), etc. It is important to emphasize that our program teaches "Information Systems Engineering" not "Information Systems", and the focus is on the engineering, mathematical, scientific and technical aspects of information systems, with the objective of training engineers. This has been the focus of the program also prior to the revision and it is different from the focus of Information Systems tracks in other institutes that do not train engineers. The compliance with CHE document is addressed in clause 2.2.2 below.

2.2. Recommendations
2.2.1. Short term/immediate (~ within 1 year)

The two faculties should agree on a single mission statement that is consistent with the CHE definition approved by the C.H.E on June 14, 2011.

We will create a unified mission statement by the two faculties, and it will replace the current mission statements in the Technion's catalog of academic programs. The statement will be consistent with the CHE definition, while emphasizing the specifics and uniqueness of the mission chosen by the Technion.

2.2.2. Intermediate (~ within 2-3 years)

Make sure that the programme covers all "classical" Information Systems Engineering topics and is consistent with the requirements for an ISE program as specified in the C.H.E document approved by the C.H.E on June 14, 2011. We are concerned that the use of the old title for a truly new concept may lead to confusion. We suggest that this problem be reviewed by the Council and the Technion and that steps be taken to avoid any such confusion.

The Information Systems Engineering program of the Technion does in fact comply with the specifications defined in the CHE document of June 14, 2011, and it covers all the areas mentioned in this document. The program includes all the courses mentioned in the area of Computer Science and Information Systems. It provides a wider coverage than what the CHE document recommends in the areas of mathematics, statistics and engineering. Its coverage of the area of management and organization is slightly less than what is recommended in the CHE document, but the differences are minor. The only significant difference between the program of the

Technion and recommendation in the CHE document is that the Technion program also includes many courses in the area of Operations Research, while this area is not mentioned in the CHE document.

2.2.3. Long term (until the next cycle of evaluation)

None

3. Study Programmes

3.1. Observation and findings

The following topics/courses could not be found.

- ***Introduction to Information Systems***

  The students learn about systems in “Introduction to System Programming” (234122) and about information systems in the course “Specification and Analysis of Information Systems” (094222). These courses are given as early as possible, contingent upon pre-requisites in mathematics and in programming. Adding a separate early introductory course to the curriculum of the first year of studies has been discussed in the past by the joint academic committee of the track. Based on these discussions, our position is that the specifics of Information Systems engineering, and in particular its breadth and reliance on other disciplines, preclude an introductory course of sufficient academic quality. We note that IS engineering is not unique in that respect, and other broad engineering programs in the Technion also do not have an introductory course.

- ***Human Computer Interface Design***

  Currently, both faculties are offering courses on the subject. Moreover, the IE&M faculty has recently recruited a faculty member in the area of human-computer interaction, and both faculties are attempting to recruit a second faculty member with interest in this area.

- ***Managerial/organizational decision making***

  The specialization tracks of the program include two courses that focus on psychological, sociological, and mathematical foundations of decision making and decision analysis, namely 096617 (Decision Making) and 096570 (Game Theory and Economic Behavior).

- ***Advanced system analysis (e.g. business modelling, process modelling)***

  The topics of business modeling, process modeling, as well as numerous other related topics on modeling information systems, are given in the scope of the mandatory course 094222 (Specification and Analysis of Information System). The latter de facto serves as an advanced system analysis course, with the introductory topics on system analysis (such as use case analysis, object oriented system analysis, and object oriented programming) being taught in the scope of the mandatory course 234122 (Introduction to System Programming).

- ***A fourth year capstone project in Information Systems Engineering.***

The program does in fact include a capstone project, which is given by the IE&M faculty in two successive and inter-dependent parts: 094189 and 094195. These projects are performed by students working in small teams, with each project involving analysis of a concrete industrial-use case, specification of the IS components and of the overall IS system addressing the needs of the use case, and implementation of the IS system. This industrial project is then followed by a project course given by the CS faculty, in which the students practice implementation of comprehensive IT solutions using state of the art IT engineering tools and technologies. Having three such mandatory project courses in our program is demanding and, to the best of our knowledge, provides students with practical experience beyond what is typically required in equivalent programs of other institutes.

The committee also perceives a need for a course on the semantic web.

At the moment, we don't favor giving a standalone course on semantic web. Instead, the foundations of the semantic web technologies are given in the scope of the courses 236369 (Internet Information Management) and 096230 (Collaborative Information Systems), both of which are offered within the specialization tracks of the program. In particular, the course Internet Information Management covers the principles of the Semantic Web and the vision that drives the Semantic Web, and it presents some of the main tools in this domain. These subjects are taught at a level that allows students to use the tools and integrate them with systems they implement. In particular, using these tools and handling Semantic Web standards and technologies are included in the final project of the course.

The role and content of the File Systems course was not completely clear.

The File Systems course actually teaches core principles in the implementation of data-management systems, such as external sort, concurrency control, recovery from system failures, indexes, query evaluation, etc. These topics are very relevant and important for Information-Systems Engineers. We plan to conduct revisions in the course in the coming years, in parallel to changes in the Database Systems course, and we intend to change the name of the course to better reflect its content.

Data provenance and security get little attention. The curriculum requirements appear to allow a student to graduate from the program without taking any course covering computer security directly. The security specialization has only one mandatory course, "Computer Security".

Many of the courses in the information security specialization have titles that reflect advanced technical and mathematical content (e.g., non-cooperative games, cryptography and complexity) but it is unclear where fundamental topics such as data provenance and protection, privacy, security modelling, security architectures for large scale and distributed systems, and security operations monitoring and management are taught.

We agree that the topics of security in information systems are important to the program and are currently underrepresented. We will consider revising the program and adding relevant available courses.

3.2. Recommendations

3.2.1. Short term/immediate (~ within 1 year)

Review the curriculum taking these observations and Chapter 4 into account. Submit a response that includes a detailed plan to correct any faults to the CHE for review.

Please see the passage on the projects above.

3.2.2. Intermediate term (~ within 2-3 year)

The committee believes that a 4th year "capstone" project that includes systems analysis, design, documentation, implementation, testing and dealing with user feedback, is needed as discussed in Chapter 4 of this report. The projects should provide students with experience in fitting an Information System to a host enterprise.

See above.

We recommend that the project should have the following properties:

- *All projects should have milestones with firmly specified deliverables including professional documentation for both maintainers and users.*
- *Projects should include feedback from users and customer(s) and someone taking the role of an external (outside the team) maintainer.*
- *In an ISE project, all documents should conform to departmentally specified documentation standards, be dated, and properly identified.*
- *Minutes should be kept during all project meetings.*
- *Projects should be retained (in electronic form) for future use by the department; students should be advised to include them in a "portfolio" for future job interviews.*
- *There should be firm course prerequisites for each project. The stress of each project should be on learning how to apply previously taught material. No new material should come up in a projects course.*
- *There should be a departmental project supervisory committee that works to assure consistency from year to year; it must meet to approve projects before they are given to students.*
- *See Chapter 4 for a more detailed discussion of projects.*

3.2.3. Long term (until the next cycle of evaluation)

None

4. Human Resources / Faculty

4.1. Observation and findings

The committee was very positively impressed with the achievements and energy of the faculty members that we met. However, most of the Faculty would be considered "core" Computer Science and are not specialists in the area of Information Systems Engineering. We are concerned that many would not be prepared to deliver courses or advise graduate students in some of the areas that we identified as not adequately covered.

4.2. Recommendations

4.2.1. Short term/immediate (~ within 1 year)

Plan to add a cadre of people who have classical ISE training and research in core ISE areas to the teaching staff.

We believe we have faculty members who can supervise in all areas mentioned in the report. Additionally, we are targeting people with relevant interests, with some recent success, and will continue to do so.

4.2.2. Intermediate term (~ within 2-3 year)

Hire in accordance with the plan.

We agree.

4.2.3. Long term (until the next cycle of evaluation)

Have a balanced faculty with a core of members explicitly identified as serving the ISE programme.

5. Students
5.1. Observation and findings

The programme has excellent students, well prepared, smart, vocal, and focussed and enthusiastic. They appear to be well received by industry. The students are a major strength of the programme. However, the number of students graduated yearly (21 - 44) is low.

Students have no complaints except for one (made privately) about the infrastructure. We were not able to investigate that complaint.

5.2. Recommendations
5.2.1. Short term/immediate (~ within 1 year)
None

5.2.2. Intermediate term (~ within 2-3 year)

Consider revising the ISE programme so that it begins in the first year rather than have students begin in either Computer Science of Industrial Engineering and Management and then transfer to the programme. The programme could then be the responsibility of a single teaching unit and students would have a clear "home" department.

This procedure is in fact already in place for many years. The program is an "admission track". This means that students must enroll to the track before they begin their studies in the Technion.

5.2.3. Long term (until the next cycle of evaluation)
None

6. Teaching and Learning Outcomes
6.1. Observation and findings

The students all seemed happy and satisfied with the programme, but we found no formal effort to measure the outcomes.

The Technion has recently put in place a procedure that requires identifying concrete learning outcomes as part of the process of approving new courses. So this recommendation is already being enforced by the Technion.

6.2. Recommendations
6.2.1. Short term/immediate (~ within 1 year)

Introduce a formal evaluation of teaching and learning outcomes based on a revised mission statement and regular surveys of the students and graduates.

6.2.2. Intermediate term
None

6.2.3. Long term (until the next cycle of evaluation)
None

7. Research
7.1. Observation and findings

The faculty that we met all seem to be productive researchers who can communicate their findings very well. However, much of the research is typical of Computer Science rather than Information Systems Engineering.

7.2. Recommendations
7.2.1. Short term/immediate (~ within 1 year)

Faculty who teach in this programme should be encouraged to research in core ISE areas and to publish in ISE journals and conferences.

Actually, quite a few of our researchers work in core ISE areas. In general, encouragement of research in specific areas is done by research grants. It is the role of research foundations and of the relevant government offices to encourage research in areas they find appropriate, by providing targeted research grants.

7.2.2. Intermediate term (~ within 2-3 years)

Seek new faculty members who specialize in the field of ISE.

See above (item 4.2).

7.2.3. Long term (until the next cycle of evaluation)
None

8. Infrastructure
8.1. Observation and findings

The infrastructure that we were shown appears more than adequate though not outstanding.

8.2. Recommendations
8.2.1. Short term/immediate
None

8.2.2. Intermediate term (~ within 2-3 year)
None

8.2.3. Long term (until the next cycle of evaluation)

None

9. Self-Evaluation Process
9.1. Observation and findings

Note the comments on the two different mission statements in section 3.1.
In general, the institution included too much self-praise and praise from others (including pictures) that were irrelevant to our review. We needed facts about the programme so that we could evaluate it; we did not want to base our evaluation on evaluations by others.

9.2. Recommendations
9.2.1. Short term/immediate (~ within 1 year)
None

9.2.2. Intermediate term (~ within 2-3 year)
None

9.2.3. Long term (until the next cycle of evaluation)

Copies of the information given to students about the programme (translated if necessary) would have been helpful to our committee. We suggest that this be routinely required for future reviews.

We will be happy to comply and ask to be given specific instructions when the time comes.