



Technion – Israel Institute of Technology
The William Davidson Faculty of Industrial Engineering and Management

Professor Boaz Golany, Dean
The Samuel Gorney Chair in Engineering

פרופסור בועז גולני, דיקן
הקתדרה להנדסה ע"ש שמואל גורני

28.04.2011

To: Michal Neuman
Head, the Quality Assessment Unit
The Council for Higher Education

Re: Response to the recommendations of the CHE evaluation report on the IE&M programs

Dear Michal,

We were happy to receive the report of the international evaluation committee that was authorised by the CHE to evaluate the IE&M programs in Israel during 2009. Their overall assessment of our program as expressed in the executive summary stated:

The IEM programs at the Technion are excellent, with outstanding faculty, dedicated staff, and very good students. There is a very high demand by prospective students for admission to IEM programs, and the IEM program graduates are in very high demand by business and industry. The faculty members are research active, they publish in the top tier journals of their subfields, and many of them hold editorial positions in a variety of journals. In some subdisciplines the international reputation of the faculty is in the top ten in the world. Through its graduates and research, this IEM program is having an important impact on the productivity and competitiveness of Israeli companies and the security and future of the nation

Naturally, we are very proud to have received such an evaluation. Nevertheless, we are aware of the need to continue our on-going efforts to improve our programs and bring them to new heights.

This effort is reflected in the detailed responses to specific comments and recommendations made by the committee (appended to this letter).

With best regards,

Boaz Golany

cc: Prof. Paul Feigin – Senior VP, Technion
Prof. Daniel Rittel – Deputy to the Senior VP



**CHE International Evaluation of the IE&M Programs in Israel
Response to the Committee's recommendations regarding the Technion's Program**

Thursday, April 28, 2011

1. Advisory Boards

p. 5: *"The faculty is strongly encouraged to implement its plans to create an external advisory board composed of industry leaders to advise on the relevance and adequacy of the program offerings."*

The IE&M Faculty established in 2006 two Advisory Boards whose purpose is to provide external guidance and feedbacks to the Dean. The International Advisory Board is composed of several world-renown scientists from leading universities abroad and the Industrial Advisory Board is composed of key figures (mostly CEOs of leading corporations) in the Israeli economy.

While both of these boards do not have a formal role in the running of the faculty, their members provide it with valuable advice and support.

The two advisory boards are presented in the faculty's website. This site is currently undergoing a design change. As part of this change, we intend to make the two advisory boards even more prominent so as to demonstrate our ongoing commitment to high academic standards and our responsiveness to the changing needs of the Israeli industry.

2. Class sizes and student-faculty ratios:

p. 5: *"Another key concern is unsustainable program loading, characterized by unacceptably large obligatory undergraduate class sizes, a large proportion of obligatory undergraduate courses taught by external adjunct faculty, extremely high student-faculty ratios, and the loss of critical faculty mass in specific sub-disciplines. The outstanding faculty research expectations and productivity are unsustainable given the overwhelming faculty workloads."*

p. 8: *"Class sizes are extremely and unacceptably large for key undergraduate required courses. The evaluation committee was shocked to find 483 students in a section of an introductory economics class, 387 students in deterministic models in operations research, 256 students in introduction to statistics, 228 in introduction to industrial engineering, etc. For the 2008-2009 academic year, the committee counted 12 sections with over 200 students and another 18 sections with 100 to 200 students. This is a severe threat to the quality and reputation of the program."*

p.10: *"The junior faculty are impacted by the large section sizes and are concerned about the Teaching Assistant tutorial load and grader impact."*

p.11: *"After weighing many aspects of the program, one of the most serious concerns raised by the committee is the very large undergraduate class sizes reported for many of the key required courses. The committee understands that the current budget climate has generated the pressure for larger classes, creating a dilemma that the committee feels is threatening the quality of the undergraduate program."*



Technion – Israel Institute of Technology
The William Davidson Faculty of Industrial Engineering and Management

Professor Boaz Golany, Dean
The Samuel Gorney Chair in Engineering

פרופסור בועז גולני, דיקן
הקתדרה להנדסה ע"ש שמואל גורני

p.14: "*Class sizes are extremely and unacceptably large for key undergraduate required courses. This is a severe threat to the quality and reputation of the program. The evaluation committee recommends that class sizes be capped at a reasonable size that assures student learning quality.*"

Following the report, we have initiated a discussion in our Undergraduate Teaching Committee regarding class sizes. We aim at a resolution that would limit class size to no more than 120 students. Also, our teaching assignment process takes into account the teaching capabilities of instructors, adapting class size based on instructor skills.

Clearly, limiting class sizes must be accompanied with more academic positions. Otherwise, the ratio of adjunct to regular faculty would grow even further.

Junior faculty members have been generally shielded from the impact of high student-faculty ratios. However, this changes dramatically at the levels of Associate and Full Professorship. To reduce the workload, more faculty positions should be created and filled, without compromising the academic standards of our hiring process.

3. Language of teaching

p.8: "*The evaluation committee also encourages the faculty to consider a broader curricular inclusion of English usage, both spoken and written by instructors and students. The committee believes that this will enhance the long term career success of the program graduates.*"

The faculty works within the Technion charter that states clearly that Hebrew is the official teaching language of the Technion. However, we encourage our students to develop their English proficiency in many ways including:

- Occasionally we invite a foreign professor to teach an elective undergraduate course. When that happens, we submit a request to the Dean of Undergraduate Studies to approve the teaching of the course in English. These requests have thus far been approved.
- We encourage instructors to use textbooks, class notes and other teaching materials in English.
- Every week during the academic year we have at least 2-3 seminar talks by foreign researchers. All of these talks are given in English and we invite students to attend.

4. Professional Networks:

p.8: "*The evaluation committee would like to encourage the department to expose students to professional networks and opportunities for IEM students. For example, there are IEM communities on Facebook, Twitter, and LinkedIn with active IEM student interactions. Additionally, students would enjoy participating in international IEM student competitions like The IIE/Rockwell Student Simulation Competition, The IIE Student Paper Competition, The Lean Student Paper Competition*"

We certainly intend to follow-up on this recommendation and encourage our students to register and participate in these competitions.



5. Examination Periods:

p.8: *"The evaluation committee learned of the disruptive nature of the timing of the second and third examination periods that can result in student focus on previous semester course material during the beginning of a new semester. The students get behind in the new courses, struggle for the semester, and then the cycle repeats. There is an opportunity to examine alternative exam timing to improve the learning experience of the students and associated workload requirements for the faculty."*

The faculty is bound by the Technion's general policy on these matters. A few initiatives have recently surfaced at different Technion level committees regarding this matter and we will participate in these discussions.

6. Disconnect between first two years and the rest of the program

p.9: *"Some of the interviewed alumni experienced a disconnect between the first two years of basic math and science courses and the engineering content in last two years. They feel that it is important early on in the program to provide an introductory course to motivate and create a perspective on what the students will be learning in the program and why it is important. This is a universal challenge for all IE programs. One potential approach to address this challenge is to introduce more engineering course material in the first two years of the program of study."*

In the academic year of 2010 we have revamped our "Intro to IE" course. It's academic weight was upgraded from 2.5 to 3 credit points and a project component was added to the course. This way, first year students now experience actual industrial engineering practice in a supervised fashion.

This revised course provides an understanding of the spectrum of topics (including basic math skills) that students should acquire to face the challenges that await them after graduation.

7. Shortage of faculty:

p.9: *"Brain drain and competition for faculty from universities in other countries that pay higher salaries is a pressing threat."*

"There is a shortage of industrial engineering (IE) faculty to cover teaching needs in the IE area."

p.10: *"The computer integrated autonomous systems needs to recruit faculty to support and build this area, which has a fine laboratory infrastructure but needs faculty leadership."*

We concur with the observations of the committee and are doing our best to recruit suitable candidates. During the last year, we have invited 20+ candidates (some from abroad) for job talks and interviews. Five of these candidates received offers but only one responded positively. The others have preferred to accept offers made by US universities (motivated by both salary / compensation package considerations and the fact that in most cases the expected time and effort it will take them to reach tenure and promotion in a US university are shorter than those expected at home.

8. The area of Operations Research:

p.10: *"The Operations Research (OR) area faculty levels are declining to the point of raising a concern that it could slip below the critical mass needed for research and advanced level courses."*



Technion – Israel Institute of Technology
The William Davidson Faculty of Industrial Engineering and Management

Professor Boaz Golany, Dean
The Samuel Gorney Chair in Engineering

פרופסור בועז גולני, דיקן
הקתדרה להנדסה ע"ש שמואל גורני

"The third concern has surfaced the potential innovation of OR resource sharing: the strategy of creating a National Operations Research Collective / Coalition to share expertise across institutions and allow graduate students to learn from the world class faculty among several Israeli universities and programs. The committee strongly encourages the exploration of this strategy and thinks that the Technion can play a major leadership role in its development."

p.14: *"The size of the faculty and students of the OR program may be slipping below critical mass. The committee strongly recommends that the program explore the potential innovation of OR resource sharing by creating a National Operations Research Collective/Coalition to share expertise across institutions and allow graduate students to learn from the world class faculty among several Israeli universities and programs. This process should be initiated over the next 1-2 years."*

We have started exploring the idea of creating a consortium of Israeli OR departments that will offer a joint PhD program (following a successful example in The Netherlands). Initial discussions with colleagues in Israel are already under way. In parallel, we have coordinated a summer school in Israel for OR students from Erasmus School of Economics (ESE) and Technion OR students that will be held in Israel in the Fall of 2011. The summer school will also be opened to OR students from other universities in Israel and we hope that this will serve as the first step towards a joint program.

9. IE integration with physical systems:

p.10: *"The faculty and students can benefit from expanding and strengthening the research and teaching in the core IE area of integration with physical systems, such as high-tech (nano-, bio-, laser-based, etc.) manufacturing processing and robotics. While it will require adding faculty members, such areas can be developed jointly and enriched by effective collaboration with related faculty colleagues and labs, e.g., in Mechanical, Chemical, and Biomedical engineering, and in Chemistry and Biology."*

"Another core industrial engineering area which would fit well the existing faculty areas of excellence is the area of human-robot interaction and multi-robot collaboration. Again, jointly with several related faculties and labs, there are valuable extensions of OR, statistics, human factors, information and communication systems, etc. that can benefit the program and the students, both undergraduate and graduate."

The faculty is looking for ways to broaden the students' exposure to other engineering disciplines. In particular, we encourage faculty and students to get involved in the new multi-disciplinary centers that the Technion has launched in recent years (specifically, the Autonomous Systems, Science & Technology of Security, Bio-Life Engineering, Systems Engineering; and Energy). As a result, an undergraduate student received this year first award from the Center for the Science & Technology of Security; A faculty member with two graduate students received research support from the Center for Autonomous Systems; several faculty members and their students received support from the Center for Systems Engineering, and more.



Technion – Israel Institute of Technology
The William Davidson Faculty of Industrial Engineering and Management

Professor Boaz Golany, Dean
The Samuel Gorney Chair in Engineering

פרופסור בועז גולני, דיקן
הקתדרה להנדסה ע"ש שמואל גורני

10. Separate the MBA program from IE&M:

p.10: *"Developments across the institution have led to discussion of a separate MBA program. The committee encourages the further exploration of this option given differences in the culture and structure of leading MBA and IEM programs, with a strong consideration not to deplete critical resources from this already overloaded program staff. Also, careful consideration should be given to potential negative impact on industrial engineering and management student enrollment."*

p.14: *"The Technion administration is considering the separation of the MBA program from this faculty in the next five years. This option should be studied carefully, balancing the benefits of an IEM focus against the potential detrimental impact on existing programs and faculty due to budget pressures."*

The Technion management has already made a strategic decision to establish a stand-alone academic unit which will be dedicated to management education and particularly to MBA. Implementation of this decision was put on hold until a suitable source will be found to support this activity.

11. Research guidance:

p.11: *"Undergraduate students would benefit from guidance on research opportunities within the profession as they prepare for next career steps, especially for the high proportion who seek advanced degrees."*

The faculty assigns a faculty member (currently Prof. Avishai Mandelbaum) as the head of the IE& Excellent Students Program. These students, our main pool for graduate degrees, are encouraged in various ways to participate in the research activities of faculty members.

12. Tracking students' achievements:

p.11: *"The way the university collects data makes it very difficult to track students who are falling through the cracks -- those who have not been failed or have chosen to drop out, but are not actively making progress."*

This is a relatively easy fix that need to be done in our data base management system. Such data is now available to us each time we send a query on this matter.

13. Supply of elective courses:

p.11: *"The committee encourages the program to address two key findings reported in the Undergraduate Student Survey of the program self-evaluation. Current budget limitations may be the reason that a large portion of the students do not feel that they can choose from a variety of interesting course options each semester."*

We feel that our elective list is satisfactory in terms of size and variety. We work, together with the student body, to encourage students to take electives that require efforts in terms of mathematical understanding yet are rewarding in their ability to differentiate students based on their knowledge. For example, two courses in Financial Engineering which were offered this semester and attracted 30+ students each.



14. Feedback on home assignments:

p.11: *"An acute problem that the committee feels must be addressed, is that students need to receive feedback on homework to help them learn and prepare for final exams."*

We work within the Technion's budgetary constraints to make an effective use of grading budget. In cases where grading is reduced to random grading, students discuss solutions in class; students are also encouraged to respond to other's solution via forums on our Moodle system.

15. Recruiting graduate students:

p.11: *"The faculty expressed a critical strategic need to recruit more top graduate students. Graduate students face uncertainty about scholarships and funding levels in future terms, which creates stress as they strive to complete their degree programs. To enhance the recruiting of the very best graduate students in the future, the committee encourages the program to consider guaranteeing financial support to graduate students as a part of their enhanced recruitment efforts."*

Special care is given to excelling undergrad students (average grade above 90). These students are invited to start their Master degree during the last semester of the undergrad degree and are guaranteed the maximum scholarship allowance. We make efforts to reach such excelling students, using both official and unofficial means. In addition, our faculty members accept invitations to give seminars in other Israeli universities and use these opportunities to recruit appropriate students. We also advertise our search for students through our website and through the website of the Technion Graduate School. We carry out two "open day" events every year. In these events we host potential applicants, offer them with transportation, refreshments, etc. and provide them with written and verbal information about our programs.

16. Health systems:

p.12: *"To extend their scholarship impact, there is an opportunity for research efforts in the health systems engineering area to be incorporated into the BioLife Science thrust at the Technion. The committee strongly recommends such leveraging of the Industrial Engineering & Management unique competencies, which would be in line with the top IE programs in the US."*

p.14: *"The evaluation committee encourages the institution to explore the opportunity to increase scholarly impact by extending health systems engineering research efforts into the BioLife Science thrust at the Technion."*

The faculty engage in various research activities that are related to life sciences. Our Statistics Lab collaborates with professors from the Technion Medical School in numerous projects. A group of faculty has just entered a multi-year research collaboration (supported by the FP7 program of the EU) with colleagues from France and Norway on Cancer research. Our Service Enterprise Engineering (SEE) Lab has conducted a 3-year project in collaboration with the IBM Haifa Research Lab and the Rambam hospital on improving healthcare provision. About 10 graduate theses were generated through this project along with a similar number of scholarly articles.

17. Assessing overall competency:



Technion – Israel Institute of Technology
The William Davidson Faculty of Industrial Engineering and Management

Professor Boaz Golany, Dean
The Samuel Gorney Chair in Engineering

פרופסור בועז גולני, דיקן
הקתדרה להנדסה ע"ש שמואל גורני

p.12: *"While the committee found appropriate measures of assessment for the mastery of course material, it encourages the program to consider the development of an assessment process directed at measuring overall programmatic competencies."*

We are considering a survey that will be distributed to students towards the end of their studies and then repeated in waves several times during the first few years of their graduation to provide us with a better feedback on the level of preparedness of these graduates vis-à-vis the expectations in the market.

18. Sharing of information:

p.12: *"The evaluation committee found that several faculty were unaware that the student survey reports dissatisfaction with lack of feedback on homework assignments and key insights from faculty and student surveys."*

Highlights of the surveys were shared with students during regular faculty meetings with the Vice Dean for Teaching. The Dean hosts the adjunct professors twice a year for a breakfast meeting where such surveys and the insights drawn from them are shared with these external lecturers.

19. Improvement opportunities:

p.12: *"The evaluation committee commends the surfacing of the following improvement opportunities:*

- * *Program adaptability to marketplace needs requires a process for improvement;*
- * *Relatively small number of students and faculty members that may be slipping below a critical mass;*
- * *Continual dependence on external lecturers; and*
- * *Insufficient alumni interaction via organized programs.*

The committee encourages the program to continue addressing these opportunities with improvement initiatives developed in an explicit action plan based upon the insights gained from this evaluation process."

The faculty implements a continuous improvement program that encompasses all aspects described above. In particular, we employ better IT-based methods to track the performance of students and we are actively encouraging our alumni to get more involved in our programs. However, we continue to depend on adjunct professors due to chronic shortage of staff in certain areas (a topic that was already discussed in response to comment #7 above).

20. Reliance on external staff:

p.14: *"External staff teaches nearly half of the undergraduate industrial engineering and management course offerings. This heavy reliance on external faculty may have a long-term detrimental impact on the quality and consistency of the students' educational preparation. The evaluation committee recommends that the senior faculty size be increased from the current level of 48 full time faculty members to at least 52 full time faculty in the next three years."*

See our response to comment #7 above.



21. Support staff:

p.14: "*Ongoing cuts of the technical and support staff have stressed their ability to meet the needs of students and faculty. The evaluation committee recommends that these staffing levels be examined closely based on student and program needs, and increased as appropriate.*"

The Technion has increased the faculty's technical support staff by one FTE last year. We have actually recruited two persons, each at a 50% position, to fill our needs in two technical areas.