Committee for the Evaluation of Medical and Biomedical Engineering Study Programs

Tel Aviv University

Evaluation Report

January 2017

Contents

Chapter 1- Background

The Council for Higher Education (CHE) decided to evaluate study programs in the field of Medical and Biomedical Engineering during the academic year of 2016.

Following the decision of the CHE, Vice Chair of the Council of Higher Education on behalf of the Minister of Education, appointed a Committee consisting of:

- Prof. C. Ross Ethier- Department of Biomedical Engineering at Georgia Institute of Technology & Emory University School of Medicine, USA committee Chair
- Prof. James Moore- Faculty of Engineering, Department of Bioengineering, London Imperial College, UK
- Prof. Milica Radisic- Faculty of Applied Sciences and Engineering, University of Toronto, Canada
- Prof. Amit Gefen[1]- Department of Biomedical Engineering, Tel Aviv University, Israel

Ms. Alex Buslovich Bilik was the coordinator of the Committee on behalf of the CHE.

Within the framework of its activity, the Committee was requested to:[2]

1. Examine the self-evaluation reports, submitted by the institutions that provide study programs in Medical and Biomedical Engineering and to conduct on-site visits at those institutions.
2. Submit to the CHE an individual report on each of the evaluated academic units and study programs, including the Committee's findings and recommendations.
3. Submit to the CHE a general report regarding the examined field of study within the Israeli system of higher education including recommendations for standards in the evaluated field of study.

The entire process was conducted in accordance with the CHE's Guidelines for Self-Evaluation (of October 2015).

[1] 1In accordance with CHE policy, Prof. Amit Gefen did not participate in the evaluation in order to avoid the appearance of any conflict of interest.

[2] The Committee's letter of appointment is attached as **Appendix 1**.

Chapter 2-Committee Procedures

The Committee held its first meetings on November 27th during which it discussed fundamental issues concerning higher education in Israel, the quality assessment activity, as well as Medical and Biomedical programs in Israel.

During Novemebr and December 2016, the Committee held its visits of evaluation, and visited, Tel Aviv University, Ben Gurion University, the Technion and Afeka academic college. During the visits, the Committee met with various stakeholders at the institutions, including management, faculty, staff, and students.

The schedule of the visit is attached as **Appendix 2**.

The Committee thanks the management of Tel Aviv University and the Department of Biomedical Engineering for their self-evaluation report and for their hospitality towards the committee during its visit at the institution.

Chapter 3: Evaluation of Medical and Biomedical Engineering Study Programs at Tel Aviv University

This Report relates to the situation current at the time of the visit to the institution, and does not take account of any subsequent changes. The Report records the conclusions reached by the Evaluation Committee based on the documentation provided by the institution, information gained through interviews, discussion and observation as well as other information available to the Committee.

1. Executive Summary

The Committee finds that students in the BME Department are well-qualified and that faculty members are conducting research in important areas. TAU BME has a unique strategic advantage related to its central position and proximity to 17 hospitals. However, the committee finds that the Department is not realizing its full potential yet, mostly due to the highly-varying levels of performance amongst faculty members. The committee recommends that the Department must :

- Remain within the Faculty of Engineering.
- Collaboratively develop a mission statement, improve Departmental cohesion, and foster a culture of excellence through workshops with external consultants and by improving communication amongst faculty.
- Replace imminent retirements and add several faculty to reach a complement of at least 15 faculty members. One area that should be strengthened for both teaching and research missions is biomaterials/tissue engineering.
- Identify the next Department Head promptly. Should appropriate leadership not be identified, and a broadly-supported mission statement not be reached, then faculty hiring should be put on hold.
- The committee was impressed with the BioMedTech Innovation Program and Sylvan Adams Sports Excellence Institute, and thus these programs should continue to develop and grow.
- The number of PhD students (22 in 2015-2016) is dangerously low and does not support the research mission appropriately. This must increase; a target total number of students is 30-37 over the next 3 years.
- Increase the amount of research funding. All faculty should hold competitive research funding. A mechanism of internal grant peer review before submission should be instituted so that more experienced faculty should coach less experienced faculty in grant writing.
- Establish learning outcomes at all departmental levels, in all courses and all syllabi.

- Increase the number of support staff in the Department to reach a staff: faculty ratio of 0.5:1. WE do not have a specific prescription of how to get to this target, but note that at present the number of support staff is extremely low by the standards of internationally competitive BME departments.

2. Mission and Goals

Observations and findings

The Departmental mission was not included in the written Self-Evaluation report, but was included in slides provided to the Committee during the visit. We found the mission statement to be somewhat lacking: it was generic and included a number of strategic goals (e.g. increase faculty numbers) that should not be part of a mission statement. It was stated that when the Department was founded, there was a mission statement developed, but that it had become obsolete over time. Further, faculty members did not express clear consensus on the Departmental mission statement when asked. The Committee feels strongly that best practices should include development of a clearly articulated mission statement that can be used to drive marketing of the Department and will help guide faculty recruitment (see below).

The Department has several strategic advantages: its location in Tel Aviv makes it attractive for faculty and student recruitment. Further, there are many TAU-affiliated medical centers which are natural collaborative partners for the BME Department. Some, but not all, of these advantages are being realized and the general impression of the Committee was that the Department was not realizing its full potential. The Committee did not form a favorable view of faculty collegiality within the Department, and there was a sense that it was a challenge to manage the Department. The Committee further felt that this culture was an impediment to the Department realizing its full potential and that cultural change is an important and necessary step going forward. The question then becomes: how best to effect this? The current Chair stated that he had invited an external advisor to visit the Department and provide coaching to faculty, and that this was effective. The Committee was impressed by this but finds that more work on developing a collaborative culture is required.

Closely related to the above comments is the fact that one of the stated goals of the Department is to increase faculty numbers. This is driven by several factors: 3 upcoming retirements, a stasis in faculty hiring for several years in the past, a stated lack of critical mass in some technical areas within the Department, and a desire to establish the

Department as a School within the new TAU structure. The Committee understands the desire to enlarge the faculty complement and particularly appreciates the difficulty of running a teaching track when there is only one faculty member working in the track area: this presents major logistical challenges if, for example, the relevant faculty member is on sabbatical.

The Committee feels that, if the University wishes to increase the impact of the Department, it is important that a more co-operative and collegial culture be established within the Department. One way to change the culture in the Department is through new hiring. For example, if the 3 faculty members who are approaching retirement were replaced, and several additional faculty were hired to help create critical mass in selected areas (see below), then there could be 5 new hires over the next several years. Although this would not bring the faculty complement to 20, it would represent 8 new faculty members (including 2 recent hires and one faculty member about to join). This bolus of new hires could be a strong positive force for change within the Department.

It is important that new hiring be underpinned by strong Departmental leadership. The Committee finds that Prof. Scheinowitz has been very effective as Departmental Chair, and had the clear impression that his leadership was supported and appreciated by the faculty members. However, his second term will be finishing shortly and a successor has not been named. If a strong successor as Department chair cannot be identified, and cannot get "buy-in" for improving the culture of the Department, then we have reservations about enlargement of faculty numbers.

It is useful to consider various scenarios for faculty recruitment

- Option 1: do not replace retirements, i.e. allow total faculty numbers to decline. The Committee is strongly against this option, as we feel it would imperil the existence of the Department and its ability to fulfill its teaching mission. Due to the importance and future growth of BME as a discipline, this would be a very unwise course of action.

- Option 2: only replace retirements, i.e. keep faculty numbers stable. The Committee does not favor this option as it means that some teaching areas will lack critical mass and be vulnerable.

- Option 3: replace retirements and add several faculty to reach a complement of 15 or 16 faculty members. This would provide robustness for the teaching

program and create some critical mass in associated research areas. The Committee favors this approach.

- Option 4: replace retirements and add faculty members to reach 20 faculty total. This may be a viable approach in the medium term but the Committee does not favor this option at present. We feel there is too much uncertainty about the incoming Department chair and Departmental culture. If, over time, these areas can be addressed then Option 4 would become the preferred option: it would improve the profile of the Department, which in turn would generate improved grant income and attract more and better students.

Medical and Biomedical Engineering, by its nature, is a highly interdisciplinary discipline that potentially interacts with many parts of the university. Here too, TAU has a strategic advantage: the university includes exact sciences, engineering, and medicine. The question then arises as to the best way to facilitate collaboration across these disciplines. The Committee views the Department as central to this activity: it uniquely brings together engineering, medicine and life sciences and can serve as a central hub for collaboration. A model that works extremely well is to ensure that multidisciplinary collaborations are grounded in strong departments and facilitated by cross-cutting institutes. The exciting developments leading to the establishment of the Sylvan Adams Sports Excellence Institute are an example of how this can work extremely well. We understand that the formation of such entities requires external fundraising and is therefore somewhat opportunistic. Another activity that the Committee was impressed by was the BioMedTech Innovation Program, which is somewhat more "virtual" but appeared effective and useful.

Recommendations

Essential:

- The Department develop a mission statement and a set of goals within 8 months. These goals specifically include consideration of hiring areas under Option 3 above. The mission statement will only be useful if it is broadly supported by faculty members, and thus the Department should involve an external facilitator as part of this process to help create support. If a broadly-supported mission statement cannot be agreed, then faculty hiring be suspended.

- Senior TAU administration work rapidly to identify and announce a new Department chair, ideally by March 2017.

Important:

- The current or future Department chair consider re-inviting the external consultant (former head of Oracle Israel) to further interact with faculty members with the goal of further improving departmental culture.
- The Department and senior TAU leadership continue to identify opportunities for interdisciplinary collaborations in which the Department can play a central role. In particular, in view of the importance of the medical device industry in Israel, enlarge the BioMedTech Innovation Program. This could be done by offering academic credit for courses in this program and involving more hospital/industrial partners (see also Section 6).
- The Department establish an external advisory board to monitor the progress towards the departmental strategic goals and hiring plans. The Committee recognizes that this has a financial implication and that it is unusual for Israeli universities to establish such boards. However, if the Department at TAU wants to increase its international stature, we view this as an important step. Costs could be controlled by holding Advisory Board meetings as a satellite activity at, for example, the annual BMES Meeting.

3. Organizational Structure

Observations and findings

The Department is a part of the Faculty of Engineering, falling under the leadership of the Dean of Engineering. The organizational structure is relatively standard and generally consistent with TAU practice.

In the past there was consideration of moving the Department to the Faculty of Medicine, although this was recently abandoned. In case this idea resurfaces, the Committee is not in favor of such a move. Association with Medicine would be a very poor fit for delivering the teaching mission, and seems to confer little net benefit to TAU.

Recommendations

Essential:

- No further consideration be given to the idea of moving the Department into the Faculty of Medicine.

4. Study Programs

Observations and findings

The number of students in the traditional undergraduate program has been flat in the past few years, while the new (established 2012) BSc program in neurobiology is attracting a growing number of students who graduate with BSc degrees in biomedical engineering and neurobiology. This program is singly responsible for the growth in overall student numbers for the department. The numbers of students following the MSc/project program is decreasing steadily. Numbers of PhD students are dangerously low, at 22, which is less than 2 per faculty member.

Currently, tracks are offered in Signals and Systems in Biomedical Engineering, as well as in Biomechanics, Biomaterials and Tissue Engineering. Other track topics have arisen and faded away since the program began over 10 years ago. The neurobiology program is considered another track in some Department documents. The Department wishes to develop new courses in bioinformatics, wearables, and sports biomechanics (aligned with the new Sylvan Adams Center).

There is good interaction with industry, with opportunities for students at all levels to do industry-associated projects. The direct-to-Masters program appears to be designed well and appreciated by the students.

Cell and molecular biology is currently taught by Dr. Binderman, who is providing an excellent training environment, including some supervision of 4th year projects.

Teaching of soft skills, as well as important BME-specific topics such as regulatory affairs, is irregular or absent. The department had a regulatory class that was required in the fourth year, but this was eliminated when the university changed its requirements for interdisciplinary studies ("Kelim Shluvim").

Students at all levels had limited knowledge of intellectual property practices and policies. This is a particular concern at the PhD level.

Recommendations

Essential:

- Institute procedures within the Department for peer review of teaching skills within eight months, and continue other strategies to improve teaching, such as the annual teaching seminar.
- Target one biomaterials/tissue engineering hire toward the cell/molecular level to account for the possibility that Dr. Binderman may soon choose to retire from teaching.
- Within one year, provide training in basic intellectual property concepts and regulatory affairs to all students as part of initial student orientation activities, or as part of a course on MedTech business/entrepreneurship.
- Continue to foster relationships with industry, particularly with MedTech startups.
- The Department double the size of the curriculum committee (currently three faculty), and consider carefully the composition of any new tracks to ensure that student demand is present and that appropriate teaching resources can be devoted to any new tracks.

Important/advisable:

- Within eight months, set up a departmental web page that contains useful information for current and prospective students, including availability of funding sources (travel, fellowships, etc.), university policies on intellectual property, laboratory safety, etc.

Desirable:

- Consider alternative teaching methods such as flipped classroom, where appropriate.

5. Human Resources / Faculty

Observations and findings

Faculty members were performing at a variety of levels: some were extremely strong while others were frankly weak. This is discussed in more detail in the Research Section of the Report (Section 8).

The Committee was surprised to learn that there are only 3 FTE staff members paid by the Department: 2.0 FTE members of technical staff and 1.0 FTE support staff member. This is an extremely low ratio and certainly must be holding back the efficient operation

of the Department. Leading institutions that we are aware of have staff:faculty ratios of 0.5:1 to 0.8:1.

Recommendations

Essential:

- The Department hire more support staff to reach a staff: faculty ratio of 0.5:1. We understand that this has a financial implication and regret that we do not have sufficient understanding of the internal TAU budget model to recommend exactly how this would be achieved. However, we strongly believe that this matter is limiting the efficiency of the Department.

6. Students

Observations and findings

Students at all levels exhibited excellent communication skills in English. They commented that they only receive soft skills application training in the 3rd and 4th years. They nonetheless appear to function well in this regard. They exhibited excellent command of both engineering and biomedical concepts. The committee was impressed by the quality of all students and alumni.

Students at all levels voiced appreciation for the amount of industry interaction available. One alumnus noted that they were employed by the company for which they had done their 4th year project.

None of the students expressed concerns over employability, although there was some slight concern expressed over the specific type of job they would get.

The newly established BioMedTech program is excellent, and off to a good start with monetary support from industry and the university. The oversight committee contains several leaders from academia and institutional investment organizations. Participation from the Department's students appears to be limited so far, but should grow. It was noted that the web site for this program does not indicate that it is led by the Department. Also, it does not appear that any academic credit is granted for participation in this program. The fact that many students work during the 3rd and 4th years may limit participation.

It was noted that the Departmental seminar series was weak and not well attended by faculty. A strong seminar program would benefit the quality of education of all students, and the Committee feels that it is important to strengthen the seminar series. This would also provide an important boost to the Departmental culture, but this goal will only be reached if the faculty and students commit to suitable participation. The Committee feels that the minimal time required of each individual would be of great benefit to the Department.

Students expressed concern that there was little interaction amongst the research groups. This limits their ability to broaden their research skills. Students noted that Departmental faculty members do not have a harmonious working relationship.

Students had no knowledge of program learning outcomes (addressed below). Some PhD students were not familiar with the availability of travel funding for attending conferences.

Recommendations

Essential:

- Within three months, align and identify BioMedTech as being a Biomedical Engineering-led program on the web site and in all associated literature. The Department has put considerable resources into establishing this program, and should benefit from the reputational benefits it brings.
- Rejuvenate the seminar experience in a manner that increases faculty and student participation, including mechanisms that encourage graduate student interaction.
- Continue to encourage students at all levels to interact with industry.

Important/advisable:

- Within one year, identify mechanisms to give students academic credit for BioMedTech participation.

7. Teaching and Learning Outcomes

Observations and findings

The committee was astounded by the lack of learning outcomes from the program level all the way down to the course syllabi. The lack of learning outcomes was also noted by the students.

Recommendations

Essential:

Within 8 months, establish learning outcomes at the Departmental level. Learning outcomes must also be specified for each program, track and course.

8. Research

Observations and findings

The committee found that the research areas represented in the Department are important and current, but that "the department was punching below its weight". More specifically, given the unique environment at Tel Aviv University and the surrounding areas, with a high concentration of outstanding students and top researchers in many areas, as well as the presence of 17 hospitals in the greater Tel Aviv area, the department could be stronger in research, and in fact could be a research powerhouse. For this to happen, it is necessary to foster a culture of research excellence in an appropriate manner.

The committee also found that there was uneven performance amongst faculty members in terms of research funding, the number of PhD students supervised and the number of publications. While some faculty members were able to maintain impressive levels of research funding, and supervise greater than 7 students in the past three years, many other professors exhibited a substandard performance.

The most recent data supplied to the committee at the time of the visit indicate that there were 22 PhD students in the Department in the year 2015-2016. Taking into account the fact that there were 12 professors (a new hire and an emeritus professor were not counted) this represents about 1.8 students per faculty member on average. This is an alarmingly low number of PhD students, since they are the ones who really drive the research intensity in the unit, given that the number of post-doctoral fellows and research associates is extremely low. The committee understands that there were also 42 MSc students in the department in 2015-2016 who were doing a thesis (~3.5/per professor); however, the scope of Masters projects is usually smaller and in most cases these students do not publish as many papers as PhD students. Thus, it would be advisable to increase the enrollment of PhD students.

On average, at the time of writing of the report, the level of research funding per professor was ~$100,000/year; updated data provided at the time of the visit showed that this value had increased to ~$160,000/ year. In addition, at the time the self-evaluation

report was written, there were three faculty members in the department who appeared to have no competitive research funding; this represents 25% of the faculty, a high percentage.

Although the trend of increasing research funding levels is encouraging, the total amounts of funding are still low for a research-intensive University, even when the funding climate in Israel is taken into account. It is necessary to have a more uniform performance amongst the faculty members in terms of the ability to win competitive research funding.

The committee finds that it is necessary to increase the intensity of overall research activity, to encourage faculty members to apply for more research grants, and to establish a system where more experienced grant writers can coach those with less experience. The committee understands that one person in the department has an ERC grant now. It would be important to coach other investigators on how to obtain those. If other departments and schools within Engineering have better success on ERC grants, those investigators could lend some advice to the BME Department about obtaining these larger amounts of funding and could consider sharing grant proposals for the purpose of learning how to write in the most effective manner.

The committee wishes to emphasize that due to the unique position of BME research areas at the intersection between human health, engineering and life sciences, BME researchers should be able to get research funding from agencies that support both human health research as well as science/engineering research. As a result, many BME departments around the world are the top grossing units in their respective faculties and universities in terms of the amount of research funding per faculty member. This is clearly possible at TAU as well, with proper planning.

In terms of publication records, the data in the self-evaluation report indicate that on average, the department produced between 4-5 papers per faculty member per year, in solid specialized journals. Although this is a respectable number, the real data are highly non-homogeneous. Whereas some faculty produced 11 or 16 papers per year, others were barely able to write 1 paper per year. This performance is also reflected in citation indices: while some faculty had impressive citation records (e.g. over 8000 citations, h-index=42), this level of productivity was not reflected in all senior faculty and some had citation records that are substandard for the field. Newer faculty hires had very promising records for their career stage (between 1300 and 2600 citations, h-indices between 23

and 26). The committee feels that a more homogeneous performance is needed in publications as well.

In addition to enhancing the number of journal publications, the faculty should strive towards publishing in general science journals. We noted that there was one publication in Nature Communications listed in the self-evaluation appendix, and one PNAS publication coming out of the department in 2014. Given the research excellence of the TAU environment, this profile could be further enhanced.

In terms of research areas, the committee feels that the area of biomaterials/tissue engineering should be strengthened since there is only one faculty member in the Department with research in this area. This expertise is critical for the teaching program as well, since biomaterials/tissue engineering/cell biology is one of the key competencies of the modern BME curriculum.

The committee was impressed with a clever way the Department was dealing with the lack of space by creating core facilities with shared equipment. This practice should continue in order to enable efficient use of both space and money for infrastructure. This should also make hiring easier.

Overall, the committee feels the BME area is important and undergoing expansion around the world. This department could become amongst the best at Tel Aviv University by fostering a culture of research excellence. This can be achieved by increasing the number of students at the PhD level, by enhancing the amount of research funding in the department, creating a dynamic research seminar series that is attended by all, and by ultimately producing more and better-quality research publications.

<u>Recommendations</u>

Essential:

Enhance the levels of research funding per faculty. The first step is to demonstrate a larger number of grant applications per faculty member within 2 years.

Within 6 months, set-up an internal peer review mechanism for grant proposal submissions

Within 1 year, establish a system where more experienced grant writers will coach those with less experience.

Within 1 year, establish a system where more experienced researchers or external consultants will coach the less experienced ones on publishing in high impact journals.

To enhance research intensity, increase the number of PhD students in the department within 3 years to 30-37, as it was in the past.

Strengthen the biomaterials/tissue engineering areas through faculty recruitment (see Section 2).

Ensure that research seminars are well attended by all and that they provide a platform for constructive exchange of information and seeding of new collaborations.

Important/advisable:
Enhance the number of publications in general science journals.

Desirable:
Continue with the practice of establishing and strengthening the core facilities.

9. Infrastructure

Observations and findings

We appreciated receiving a tour of the Engineering and Exact Sciences library. The Committee was surprised to see that it appeared outdated and under-utilized. It is puzzling to see such a large amount of underused space in an institution where space is clearly at a premium. We understand that this is an issue that goes well beyond the Department but feel that senior TAU administration are missing an opportunity to convert this space into something that is more useful, e.g. student study space, maker space, and/or group study rooms (fishtanks).

The space available to the Department is of good quality but is extremely limited. The Department has been smart: for example, they have converted some lobby space into student seating carrels. It is clear that if there is going to be faculty hiring, particularly as less research-intensive faculty are replaced by more research-active faculty, there will need to be more lab space made available to the Department.

The number of support staff within the Department is far too small. This point is discussed in more detail within the Human Resources section (Section 5).

The Technology Transfer arm of the university (Ramot) was spoken of favorably and seems to be working effectively. This cannot be said to be true at all universities and TAU seems to be doing something right here.

Recommendations

Essential:

Within 18 months, TAU senior leadership develop a plan to better use the space within the Engineering and Exact Sciences library.

- As part of the hiring of new faculty members, additional lab space must be identified. This is a critical matter for the Department Chair and Faculty Dean. This of course is dependent on whether approval to hire new faculty is forthcoming (see Section 2).
- Continue to encourage faculty members with suitable IP to engage with Ramot for their tech transfer activities. Immediately incorporate consideration of IP in hiring, promotion and tenure processes.

10. Self-Evaluation Process and implementation of previous recommendations

Observations and findings

The committee found that there were appropriate mechanisms of self-evaluation in place at the level of individual professors at the Department of Biomedical Engineering at TAU.

At the individual level, each faculty member undergoes an annual performance review based on the data submitted to the Department Head using a dedicated form, which includes a table that provides information at-a-glance about how much progress there was in terms of publications, grants, etc. since the previous review or a promotion. This is followed by a 1:1 meeting with the Department Head to discuss performance.

Overall, this committee did not find any deficiencies in the self-evaluation of individual professors on research; the issue of teaching review is covered in Section 4. However, the evaluation mechanisms for the Department as a whole are not fully developed. Specifically, it appears that there are no structured internal review mechanisms in place.

This Department is clearly going through a transition; hence it would be beneficial to closely monitor progress towards implementing a culture of excellence in the Department. Thus, the committee recommends that the Department Head and the Dean of Engineering create of an External Advisory Board that would provide recommendations and advice to the Department on their progression towards becoming a top unit within Tel Aviv University. For example, the oversight committee for the BioMedTech is stellar and a similar Board could be established to help the department reach the goal of becoming a top research-intensive unit. The Board's size, composition, the timing of meetings (e.g. annual) and location can all be tuned to optimize cost and efficiency.

Recommendations

Important Recommendations:

- Create an External Advisory Board that would provide recommendations and advice to the Department of Biomedical Engineering on their progression towards becoming a top unit within Tel Aviv University. The External Advisory Board should be composed of top academics (ideally external to Tel Aviv University) and industry leaders who would be able to provide constructive advice and oversight in the Department's transformation processes.
- Continue with the self-evaluation process for individual professor's performance as described.

Chapter 4: Summary of Recommendations and Timetable

Essential recommendations:

- The Department develop a mission statement and a set of goals within 8 months. These goals specifically include consideration of hiring areas under Option 3 above. The mission statement will only be useful if it is broadly supported by faculty members, and thus the Department should involve an external facilitator as part of this process to help create support. If a broadly-supported mission statement cannot be agreed, then faculty hiring be suspended.
- Senior TAU administration work rapidly to identify and announce a new Department chair, ideally by March 2017.
- No further consideration be given to the idea of moving the Department into the Faculty of Medicine.
- Institute procedures within the Department for peer review of teaching skills within eight months, and continue other strategies to improve teaching, such as the annual teaching seminar.
- Target one biomaterials/tissue engineering hire toward the cell/molecular level to account for the possibility that Dr. Binderman may soon choose to retire from teaching.
- Within one year, provide training in basic intellectual property concepts and regulatory affairs to all students as part of initial student orientation activities, or as part of a course on MedTech business/entrepreneurship.
- Continue to foster relationships with industry, particularly with MedTech startups.
- The Department double the size of the curriculum committee (currently three faculty), and consider carefully the composition of any new tracks to ensure that student demand is present and that appropriate teaching resources can be devoted to any new tracks.
- The Department hire more support staff to reach a staff: faculty ratio of 0.5:1. We understand that this has a financial implication and regret that we do not have sufficient understanding of the internal TAU budget model to recommend exactly how this would be achieved. However, we strongly believe that this matter is limiting the efficiency of the Department.
- Within three months, align and identify BioMedTech as being a Biomedical Engineering-led program on the web site and in all associated literature. The

Department has put considerable resources into establishing this program, and should benefit from the reputational benefits it brings.

- Rejuvenate the seminar experience in a manner that increases faculty and student participation, including mechanisms that encourage graduate student interaction.
- Continue to encourage students at all levels to interact with industry.
- Enhance the levels of research funding per faculty. The first step is to demonstrate a larger number of grant applications per faculty member within 2 years.
- Within 6 months, set-up an internal peer review mechanism for grant proposal submissions
- Within 1 year, establish a system where more experienced grant writers will coach those with less experience.
- Within 1 year, establish a system where more experienced researchers or external consultants will coach the less experienced ones on publishing in high impact journals.
- To enhance research intensity, increase the number of PhD students in the department within 3 years to 30-37, as it was in the past.
- Strengthen the biomaterials/tissue engineering areas through faculty recruitment (see Section 2).
- Ensure that research seminars are well attended by all and that they provide a platform for constructive exchange of information and seeding of new collaborations.
- Within 8 months, establish learning outcomes at the Departmental level. Learning outcomes must also be specified for each program, track and course.
- Within 18 months, TAU senior leadership develop a plan to better use the space within the Engineering and Exact Sciences library.
- As part of the hiring of new faculty members, additional lab space must be identified. This is a critical matter for the Department Chair and Faculty Dean. This of course is dependent on whether approval to hire new faculty is forthcoming (see Section 2).
- Continue to encourage faculty members with suitable IP to engage with Ramot for their tech transfer activities. Immediately incorporate consideration of IP in hiring, promotion and tenure processes.

- Create an External Advisory Board that would provide recommendations and advice to the Department of Biomedical Engineering on their progression towards becoming a top unit within Tel Aviv University. The External Advisory Board should be composed of top academics (ideally external to Tel Aviv University) and industry leaders who would be able to provide constructive advice and oversight in the Department's transformation processes.
- Continue with the self-evaluation process for individual professor's performance as described.

Important recommendations:

- The current or future Department chair consider re-inviting the external consultant (former head of Oracle Israel) to further interact with faculty members with the goal of further improving departmental culture.
- The Department and senior TAU leadership continue to identify opportunities for interdisciplinary collaborations in which the Department can play a central role. In particular, in view of the importance of the medical device industry in Israel, enlarge the BioMedTech Innovation Program. This could be done by offering academic credit for courses in this program and involving more hospital/industrial partners (see also Section 6).
- The Department establish an external advisory board to monitor the progress towards the departmental strategic goals and hiring plans. The Committee recognizes that this has a financial implication and that it is unusual for Israeli universities to establish such boards. However, if the Department at TAU wants to increase its international stature, we view this as an important step. Costs could be controlled by holding Advisory Board meetings as a satellite activity at, for example, the annual BMES Meeting.
- Within eight months, set up a departmental web page that contains useful information for current and prospective students, including availability of funding sources (travel, fellowships, etc.), university policies on intellectual property, laboratory safety, etc.
- Within one year, identify mechanisms to give students academic credit for BioMedTech participation.
- Enhance the number of publications in general science journals.

Desirable recommendations:

- Consider alternative teaching methods such as flipped classroom, where appropriate.
- Continue with the practice of establishing and strengthening the core facilities.

Signed by:

Prof. Ross Either, Committee Chair

Prof. Milica Radisic

Prof. Jimmy Moore

November 2016

Prof. C. Ross Ethier
Department of Biomedical Engineering
Georgia Institute of Technology & Emory University School of Medicine
USA

Dear Professor,

The Israeli Council for Higher Education (CHE) strives to ensure the continuing excellence and quality of Israeli higher education through a systematic evaluation process. By engaging upon this mission, the CHE seeks: to enhance and ensure the quality of academic studies, to provide the public with information regarding the quality of study programs in institutions of higher education throughout Israel, and to ensure the continued integration of the Israeli system of higher education in the international academic arena.

As part of this important endeavor, we reach out to world-renowned academicians to help us meet the challenges that confront the Israeli higher education by accepting our invitation to participate in our international evaluation committees. This process establishes a structure for an ongoing consultative process around the globe on common academic dilemmas and prospects.

I therefore deeply appreciate your willingness to join us in this crucial enterprise.

It is with great pleasure that I hereby appoint you to serve as the Chair of the Council for Higher Education's Committee for the Evaluation of the study programs in Medical and Bio-Medical Engineering. In addition to yourself, the composition of the Committee will be as follows: Prof. James Moore, Prof. Milica Radisic and Prof. Amit Gefen.

Ms. Alex Buslovich-Bilik will be the coordinator of the Committee.

Details regarding the operation of the committee and its mandate are provided in the enclosed appendix.

I wish you much success in your role as the Chair of this most important committee.

Sincerely,

Dr. Rivka Wadmany
Vice Chair,
The Council for Higher Education (CHE)

Enclosures: Appendix to the Appointment Letter of Evaluation Committees

cc: Dr. Varda Ben-Shaul, Deputy Director-General for QA, CHE
Ms. Alex Buslovich-Bilik, committee coordinator

Schedule of site visit at the Medical and Biomedical Engineering Dept., TAU
Sunday, December 4th, 2016
The Multi Disciplinary Building, Room 307

Time	Subject	Participants
09:00-9:30	Opening session with the heads of the institution and the senior staff member appointed to deal with quality assessment	**Prof. Yaron Oz**- Rector **Prof. Eyal Zisser** – Vice Rector **Prof. David Horn** – Academic Quality Assessment
9:30-10:30	Meeting with the academic head of the Department of Biomedical Engineering	**Prof. Mickey Scheinowitz**
10:30-11:15	Meeting with Dean of Faculty Engineering	**Prof. Yossi Rosenwaks**
11:15-12:15	Meeting with senior academic staff with tenure	**Prof. Ofer Barnea**- Cardiovascular system modeling and simulation. **Prof. David Elad** – Respiratory Mechanics and Cell Biomechanics. **Prof. Shimon Abboud**- Signal processing and high-frequency ECG/ **Prof. Hayit Greenspan-** Medical image processing and analysis. **Prof. Natan Tzvi Shaked**- Optical Microscopy, Nanoscopy and Optical Interferometric Systems. **Prof. Tamir Tuller** - computational biology.
12:15-13:00	Lunch (in the same room)	Closed-door working meeting of the committee
13:00-14:00	Tour of labs (Prof. Meital Zilberman, Prof. Natan Shaked), teaching lab (Dr. Orna Yosef), classrooms, library, offices.	**Prof. Mickey Scheinowitz-**Head of the Department **Ilana Perry**- Director of the library of Exact Sciences and Engineering
14:00-14:30	Meeting with Adjunct academic staff	**Prof. Itzhak Binderman-** Dentistry **Dr. Gabriel Shavit -** Physiology pharmacology
14:30-15:30	Meeting with BSc students and MSc students	**Soffer Lior**- BSc student 2nd year. **Bishara Dima**- BSc student 2nd year ---------- **Lux Adar** - BSc student 3rd year **Nissim Noga** - BSc student 3rd year ---------- **Wolbromsky Lauren** - MSc student 1nd year with thesis.

		Radunsky Dvir- MSc direct track student 2nd year with thesis. **Slutzky Ronit** – MSc student without thesis.
15:30-16:15	Meeting with PhD students	**Dardikman Gili-** PhD direct track student **Wilczynski Ella-** PhD student 1th year **Diament Carmel Alon-** PhD student 3th year
16:15-17:00	Meeting with Alumni	**Ruth Caspi** **Frenklach Irena** **Mizrahi David**
17:00-17:30	Closed-door working meeting of the committee	
17:30-18:00	Summation meeting with heads of institution	**Prof. Yaron Oz**- Rector **Prof. Eyal Zisser** – Vice Rector **Prof. David Horn –** Academic Quality Assessment **Prof. Yossi Rosenwaks -** Dean **Prof. Mickey Scheinowitz –** Dept Head