

## History of the 5 year combined SB/SM degree

In 2013, the Visiting Committee report specifically recommended that the department “Push forward the concept of a five-year combined BS / M-ENG degree.”. The report did not identify the source of this recommendation, but in January 2015, the department charged Nick Roy with determining if an MEng degree were feasible and worthwhile.

This is not the first time the department has had an MEng degree. There is no documentation left in HQ, with any of the sector heads or in the Academic Program Administrator’s office that records the history of that degree. Marie Stuppard was able to find an announcement in the 1995 MIT Course Catalogue that an announcement of an MEng program in Course 16 in 1995-96. That degree last appeared in the Course Catalogue in 2000-2001. Discussion with different faculty present at the time indicate that the degree did not attract high quality students and was not considered a success.

## Process

Nick met with the Deans of Undergraduate and Graduate Education at the time, Denny Freeman and Christine Ortiz. Nick did a survey of the other SoE departments to determine which other departments offered a 5 year combined degree, as well as our top 4 competitor Aero departments around the US. Nick also met with the Undergraduate Advisor and Undergraduate Officer in EECS, Anne Hunter and Albert Meyer in EECS, as they administer the largest 5 year combined degree at MIT, the EECS MEng. Nick also met with the Academic Program Administrator and Graduate Program Administrators, Marie and Beth, in our department.

## Summary of Findings

- Most of our competitor departments and SoE departments offer a 5 year combined SB/SM degree. There are good reasons to offer a 5 year combined degree in general, beyond the recommendation of the Visiting Committee.
- Starting a new degree is a great deal of work, but it is already possible to complete a regular SM in our department in a single year, by taking additional courses before completing the SB. Some students do this already.
- We can create an easier path to getting our existing SM degree in 5 years, with all of the advantages of a new combined degree, with relatively little work by admitting our students to the SM program earlier.

## Outcome

- Nick shared his findings with the Department Head and Associate Department Head, Jaime and Eytan, in May 2015.
- Eytan presented a version of this to the faculty at the May 2015 departmental retreat.
- At the sector heads meeting on June 24th, the decision was made to create a trial program where our best students would be invited by Eytan at the end of May 2016 to apply by July 1st, 2016 to see if there would be issues running this.

- Following the NSE example, the decision was made to run the application process essentially the same as the in-cycle application process, with standard reviews by the GAC. However, the decisions of who to invite and who to admit remained with HQ.
- Three students applied in summer 2016, and students have been invited in subsequent years.

## Detailed Findings:

- Why would we propose an MEng degree?
  - The purpose would be to give our undergraduates a path to a graduate degree in 5 years.
  - Our students anecdotally appear to want it. If we allowed a large fraction of our undergraduate population to complete an MEng, our undergraduate population will likely be better educated.
  - Even if we accept into the MEng only the very same undergrads we would accept into the SM now, there may be advantages.

The NSE graduate program guide discusses their 5 year combined SB/SM program (<http://web.mit.edu/nse/education/grad/fiveyear.html>):

- “It is an attractive alternative to dual SB degree programs, and requires fewer subject credit hours; also, many employers appear to place a higher value on the SM than on an additional SB degree.
  - The student is given earlier assurance of admission to graduate school (typically in the junior rather than the senior year), and is consequently better equipped to plan for the senior and graduate years.
  - Contacts can be established to cultivate a better selection of financial aid opportunities during the graduate year.
  - An earlier and more informed start on the SM thesis project can be arranged, leading to a less hectic pace during the graduate year.
  - The five-year student can often, by an informed choice of electives and advance planning, proceed further in his or her area of specialization than the normal SM candidate, and thus be better prepared for either immediate employment or accelerated pursuit of the ScD/PhD.”
  - If we restrict the combined degree to our own students, we avoid what we think are the problems with the MEng degree from the late 90s.
  - If we admit our best students to the program early, we probably lock them into our department, and reduce attrition to other schools. We don’t have statistics on how many students we have lost to other schools, and while faculty are enthusiastic about this, it’s not clear it’s a good reason for doing this.
- How would a new MEng in Aero/Astro envisioned to be different to the previous MEng?
    - The previous MEng was a professional degree, taking students both from within our department and outside. The previous MEng was similar to the MEng degrees offered by ChemE, CEE and MechE.

- The envisioned MEng for Aero/Astro will only accept students who are completing SBs in Aero/Astro at MIT. The envisioned MEng is similar to the MEng degrees offered by EECS and BE, and somewhat similar to the 5 year combined SB/SM offered by NSE.
  - By taking only our own students, the baseline knowledge and quality of student should be higher.
- How would a new MEng in Aero/Astro envisioned to be different to our current SM?
    - The unit counts appear to be identical, as are the residency requirements. Since we already have a terminal SM, it is not clear how different the MEng would be. (Note: neither EECS nor BE have a terminal SM.)
    - Our current SM students typically take 4 semesters. The BE MEng takes 3-4 semesters for students funded under an RA or TA because of credit limits. We would expect ours to be of similar length.
    - The primary difference may be the timing of the admissions process (during junior year, rather than senior) and branding our department internally.
- How does an MEng fit in the School of Engineering?
    - There 10 SoE departments, 8 offering SB degrees ([ESD](#) and [IMES/HST](#) do not).
    - 2 SoE departments offer professional MEng degrees ([CEE](#) and [MechE](#)).
    - [ChemE](#) offers a 1-year professional-type SM degree (MSCEP) to internal students. The same degree is available to external applicants but requires an extra semester.
    - 2 SoE departments offer MEng degrees only to internal students ([EECS](#) and [BE](#))
    - [NSE](#) offers a 5 year SB/SM degree only to internal students from 6 departments (ChemE, CEE, EECS, MechE, NSE and Physics).
    - Aero/Astro and [DMSE](#) are the two engineering departments that offer an SB without a designated path to an accelerated graduate degree.
    - No science department appears to offer an accelerated graduate degree.
- Do other Aero departments have an accelerated SB/SM degree, or a one-year master's of any kind?
    - California Institute of Technology
      - One year MS, no research or thesis requirement. On-ramp to the PhD
      - No undergrad major in Aero, so no accelerated BS/MS
    - Stanford
      - One year MS, no research or thesis requirement. On-ramp to the PhD
      - One year professional Engineer's degree, research follow-on to MS.
      - Offers a coterminal program of a BS in any program and an MS in Aero.
    - University of Michigan
      - MSE is conventionally done in 2 years, but can be done in as fast as one year.
      - No research or thesis requirement, but can have a thesis through independent study course.
      - Sequential Graduate/Undergraduate Study allows Michigan undergrads to complete an MSE in one additional year

- Georgia Institute of Technology
  - Samples MS programs are 16 month long. Both with and without thesis options exist
  - AE Combined BS/MS Honors Program allows MS program to be finished 9-12 months after finishing BS degree, both with and without thesis.
  
- What would a new MEng degree program consist of?
  - Option 1: A free-form program, composed of 66 units from a long list of options, plus a thesis. The EECS program consists of 3 courses in a in-major concentration, a math requirement and a free elective.
  - Option 2: A focused program in a specific research area or areas, composed of 66 units from a small list of options per research area, plus a thesis. Most of the MEng programs in other departments are much more structured, with many fewer courses. For example, Bio engineering only offers an MEng in Biomedical Engineering, with 2 core courses from a choice of 3, and 2 more from a choice of 20, and electives.
  
- What are alternatives to a new MEng degree?
  - Option 1: Create a 5-year combined SB/SM program that gives a way for our undergraduates to enroll earlier in our existing SM program and complete both our SB and SM programs in 5 years.
    - Pros:
      - Creates an extra option for our students
      - Might lead to a better product from our department
      - Considerably less work than creating a whole new degree
    - Cons:
      - Creates some additional work over doing nothing
      - Not clear if it meets the visiting committee request
  
  - Option 2: Do nothing, but create roadmaps for our students to complete the existing SB and SM programs in 5 years.
    - Pros:
      - Much less work than the other options
    - Cons:
      - Not clear if it meets the visiting committee request
  
- What would a new MEng degree cost in terms of departmental and faculty resources?
  - Managing any 5 year program requires some additional advising support from the undergraduate and graduate program administrators. The combination of a joint graduate and undergraduate degree has pitfalls that can cause a student to inadvertently extend the time to completion of their degree, and also lose access to housing. The undergraduate and graduate program offices will probably require additional resources.
  - In terms of faculty resources:
    - Option 1:

- If the envisioned degree is solely a way to smooth the pipeline of our own graduate students into the SM program without changing who would be accepted, then the impact is limited to managing the overlap between the SB and MEng degree. The same admissions process and commitments to funding would exist at exactly the same point in time for the faculty, but students would be accepted to the program earlier.
- The MEng degree may also reduce our funding loads for the same graduate population. There is typically a burn-in period for new SM students, during which the student is still funded at an RA level. For an MEng, the burn-in could possibly occur during a senior-year UROP, with a productive 2 year RA beginning in the 5th year.

Option 2:

- If the envisioned degree is a way for more of our undergraduates to participate in the graduate program, we would either need to increase the size of our graduate program (and number of RAs offered), or reduce the number of SM/PhD students we admit each spring. In either case, we would be diluting the quality of our graduate student pool.
  - The advantage to our undergraduates needs to be balanced against either additional advising and fund-raising responsibilities, or fewer graduate students committed to in-depth research. We should decide as a department if we envision a 1-year thesis to be useful.
- What constraints exist on a proposed MEng degree?
  - The institute requires it to be 90 units total, with 42 H-level units, a thesis and 1 semester of residency.
  - If the degree is concurrent with the SB degree, then the student has to choose when they become a graduate student. This is not a trivial choice, affecting registration limits, time to completion of both degrees, funding and housing.
  - If the student is funded with an RA, the student is limited to 24 credits of coursework per semester, and cannot complete the degree in a single year. For a funded MEng, the coursework would need to either start in the senior year or take longer than one year.
- How would students be admitted to the program?
  - The EECS program admits all students above a 4.0 GPA with a 4.25 GPA in Course 6, 8 and 18 classes. The other MEng programs have a more formal admissions process.
  - To avoid the “wandering in the hall” problem, we should have a formal admissions process too. A good example is application to the NSE 5 year program, which uses the same gradapply website as we do.