Systems, Design, and Management and the Educational and Research Mission of Today’s Universities
SDM Conference

Thomas Magnanti, President, SUTD
24 October 2012
US National Academy of Engineering’s Greatest Achievements of the 20th Century
Observations

• Engineering has changed the very fabric of society
• Innovation occurs through a pipeline
  ▪ Research
  ▪ Inventors/entrepreneurs
  ▪ Companies/government
• Multiple disciplines have contributed to most achievements
• Most of these accomplishments involved complex engineering systems
Happy 15th SDM
March 12, 1994

Memorandum

To: John Guttag, John Little, Joel Moses, Earll Murman, Ed Roberts, Warren Seering

From: Torn Magnanti

Subject: Summary and Next Steps

This note summarizes the discussion at our last meeting, highlights a few points on which we seem to agree, outlines a few issues to be resolved, and sets out our next steps. Let's start with our next task, as we defined it our last meeting.

Next Steps

The engineering faculty (John G., Joel, Earll, Warren) and the Sloan faculty (John L., Ed, and Tom), will each create a list of topics/core knowledge (at the level of courses or major components of a course) that they feel the students in the new program should receive. So that we can best draw upon our respective backgrounds and not duplicate efforts, the first group will focus on engineering content and the second group of management content (the list are likely to overlap and eventually we would like to develop an integrated set of material). I will coordinate preparation of the management material and the group volunteered John G. to coordinate the preparation of the engineering material (sorry John!).
Enterprise Prospectus

System Design and Management

A New Industry-Government-MIT Collaborative Program

Leading to a

Degree of Master of Science
in
Engineering and Management

Offered by the
Massachusetts Institute of Technology
School of Engineering and Sloan School of Management
January, 1996

Executive Summary
1. Scope and Objectives
2. Student Audience
3. Core Program Content
4. Degree Program Format
5. Non-Degree Option
6. Sustaining Enterprise Members
7. Program Costs
8. Summary: Program Benefits
Big Questions

If you wanted to create a world class university from scratch for these and future times, what would you do?

• What would you select as your intellectual and programmatic footprint?

• How would you go about ensuring that the university was world class
  • In education, in research, and in societal impact? Its path to greatness?

• What would you choose as
  • Organizational structure, facilities, and even an academic year calendar
  • What and how to teach
  • Approach to research
  • Use of modern technology

• What you seek in
  • Kind of faculty, staff and students
  • In culture, including incentives, rewards, evaluations
Guiding Premises

- Technology and design are pervasive and essential for a vibrant society
- Common design knowledge, principles, practice and skills cut across many fields
- **Successful technology-based design requires**
  - strong foundations in basic mathematics, sciences and technology
  - grounding in the arts, humanities and social sciences
  - coupled effectively with hands-on experiential learning
- Technology leaders (innovators, engineers) are in short supply
SUTD
Building a world-class university
to advance knowledge and
educate technically-grounded
leaders and innovators
SUTD Strategy

• Be distinctive
  • Focus on technology and (Big-D) design
  • Novel curriculum and degrees
  • Innovative teaching methods
  • Academic calendar for these times
  • Research intensive and entrepreneurial
  • Both teaching AND research intensive

• Be strategic catalyst
  • Blending the best western and eastern innovation cultures
    (from MIT and Zhejiang University)

• Be deeply engaged in the world of ideas and the world of practice and entrepreneurship
Important Collaborators

• **MIT**
  - Developing and helping to launch curriculum
  - Helping to assess and nurture faculty and students (teach-the-teacher program)
  - Joint research center
  - Student exchanges and contests

• **Zhejiang University**
  - Developing “Asian” elective courses
  - Collaborative research program
  - Faculty and student exchanges
  - Student design contest
SUTD Mission

• Advance knowledge
• Nurture technically grounded leaders to serve vital societal needs of the world
• Focus on Design
• Anchored in the foundations of science, technology and other areas of scholarship
Big ‘D’ – The Art & Science of Design

- Include architectural design, product design, software design, systems design and basically all technically grounded design
- Design through conception, development, prototyping, manufacturing, operation, and maintenance – the full value chain
- Practice (Art) and theory (Science)
Curriculum Content
When hunting reindeer, bring a bow and arrow (gun, ...)
Interdisciplinary Curriculum and Technically Grounded Education

- Science
- Technology
- Design
- Arts
- Social Sciences
- Humanities
Curricular Framework

- **Architecture & Sustainable Design**
- **Engineering Product Development**
- **Engineering Systems & Design**
- **Information Systems Technology & Design**

<table>
<thead>
<tr>
<th>Year</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshmore</td>
<td>Information, Computation, Materials and Systems</td>
</tr>
<tr>
<td>Sophomore</td>
<td>Statistical Reasoning and Optimization</td>
</tr>
<tr>
<td>Junior</td>
<td>Entrepreneurship, Management, Social Science, Economics, Humanities, Arts</td>
</tr>
<tr>
<td>Senior</td>
<td>Capstone: Integrated Design Experience</td>
</tr>
</tbody>
</table>

- **Design projects**
- **Electives**
Curricular Structure

- Four 12-unit subjects per semester (x 8 semesters)
- Total of **thirty-two** 12-unit subjects will be as follows:
  - 6 Sciences and Mathematics (shared freshman year)
  - 4 Engineering (first shared semester of sophomore year)
  - 15 Four Pillars (sophomore, junior, senior years)
  - 7 Social Sciences, Humanities and Arts subjects (starts in freshman year)
The Fifth Row (co-curricular activities)

- Writing activities
- Machining and fabrication
  - A hobby shop to make anything from a chair to a new invention
  - The line between creative and crazy is vanishingly thin
- Public service
- Public speaking
- Business activities
  - Contracts, P&L’s, Taxes, Startups
- Clubs
  - Solar car, electric car, rockets, electronics
- UROP’s
- UPOP’s
- UTOP’s
- Mentorship activities
Curriculum
Pedagogy
Postdocs Can Be Trained to Be More Effective Than Senior Instructors, Study Finds

By Tushar Rae

Trained but inexperienced postdoctoral students can teach a college class as well as or better than longtime professors who rely on lectures, if the postdocs learn to incorporate a method of teaching that relies on having students interact with the material they are learning through discussions and assignments synthesizing new and old information and experiences.
Pedagogy

- Cohort-based learning communities
- Project-based and hands-on learning throughout the curriculum
- Learning objectives and measurable outcomes for ALL courses
- Lecturelettes and videos
- OpenCourseWare
- Khan Academy type material and learning
entrepreneur

entreprendre: see ENTERPRISE

adolescent: a business undertaking, assag
profit —entrepreneur'ial adj.

entrepreneurship n.

entrepreneurial adj.
International and Local Internships

- SUTD offers opportunities to work in the real world for world-class organizations
Evolution Engineering Education

Knowledge  |  Attitudes  |  Skills

Early to mid 20th century
Late 20th century
Research
IDC Research Activities

Design “Grand Challenges”

Sustainable Built Environment
Engineering for the Developing World
ICT-enabled Devices for Better Living

Information
Computation
Visualization
Fostering Creativity
Concept Selection
Global Hub

Design Research Thrusts
### Compact Education

- First semester starts in **April**

- **Degree programmes**
  - 8 semesters in **3.5** years for Bachelor Degree
  - 10 semester for Master of Architecture

- Graduate **8** months earlier than cohort in other local engineering programmes

- Graduate by August 2015 for the first intake (**April 2012**)
The Vision

- Creating a world class university in short order
- Attracting top faculty and students and having sufficient faculty (and faculty expertise) at start up
- Research intensive
- A novel vision for interdisciplinary education
- Strong ties to industry and entrepreneurship
- Developing technically grounded leaders
- Preparation for many paths (professional practice or graduate school)
- A focus on design to serve the needs of Singapore, the region, and the world
Engineering Systems is a Key Component of SUTD!
In preparing for battle I have always found that plans are useless, but planning is indispensable.

— Dwight D. Eisenhower
Thank You

Established in collaboration with MIT