Educating Technology Leaders for Design-Driven Innovation

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BIG Questions
Designing A World Class Innovation University

Intellectual and Programmatic Footprint?
Organization? Staffing?
Culture? Research?
Degrees? Societal impact?
Curricula? Facilities?
Pedagogy? Technology?

Path to Greatness?
Design Thinking in Business

Bloomberg Businessweek

"DESIGN THINKING" IN HARVARD BUSINESS REVIEW
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

How did we get to where we are
Timeline MIT Engineering Departments

1865
- Majors in C and Topographical E*
- ME
- Geology and Mining**

1865
- 1865
- 1870
- 1890s
- 1900s
- 1910s
- 1920s
- 1930s
- 1940s
- 1950s
- 1960s
- 1970s
- 1980s
- 1990s
- 2000s
- 2010s

1983
- Naval Architecture

1902
- EE

1920
- Chem E

1958
- Nuclear E****

1998
- Eng Systems

1914
- Business & Eng Admin***

1939
- AA

1975
- EECS

2005
- BE

* Now Civil and Environmental Eng
** Now Material Science and Eng
*** Now Sloan School of Management
**** Now Nuclear Science and Eng

US University Research (Millions)

MIT Research Expenditures (FY1940-2006)

US University Patents

Bayh-Dole Act 1980

PRE 1992
- All Unis = 12,123
- MIT = 1,210

1992
- All Unis = 12,123
- MIT = 1,210

TOTAL (to 2012)
- All Unis = 75,353
- MIT = 4,017
US University Patents 1925-1980

Source: Mowery and Sampat

Entrepreneurship Programs and Groups at MIT

Lemelson-MIT Program
Enterprise Forum
Deshpande Center
Catalyst Program/I-Teams
VC/PE; SWIM et al
Global E-Lab & E-Lab
TIE Program
SEBC; TechLink et al
Venture Mentoring Service
UPOP
MITE2S; WTP
SEED
STEM

$100K Competition
Undergraduate Management minor

Innovators & Entrepreneurs
Ph.D. Students
Professional Grad. Students
Undergraduates
Pre-College
Age/Stage
Engineering Schools MIT Sloan

Venture Mentoring Service
$100K Competition
Undergraduate Management minor

Entrepreneurship Programs and Groups at MIT
Masters Eng & Management

MIT to the Marketplace

TLO 2012
Invention Disclosures 694
U.S. Patents Filed 305
U.S. Patents Issued 199
Licenses 81
Trademark Licenses 139
Options 26
Companies Started 16

Living MIT Alumni
Companies Founded 25,000
Number Employees 3.3 million
Annual Revenue ($) 1.1 trillion

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Undergraduate education

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Path to Greatness?
Singapore Public R&D Expenditures

8 Fold Growth over 25 Years

- National Technology Plan (1991-1995) $2 billion
- National Science & Technology Plan (1996-2000) $8 billion

Patents 2005-2010
Population and GDP data from World Bank; Patent data from OECD
SUTD’s Unique Value Proposition

**Mission**
- To advance knowledge and nurture technically grounded leaders and innovators to improve lives
- Focus on Design through integrated multi-disciplinary curriculum and multi-disciplinary research

**Values**
- Leadership • Integrity • Passion
- Collaboration • Creativity

**Distinctiveness**
- Innovative education for science & engineering talents
- Emphasis on Technology, Innovation, Entrepreneurship
- Develop graduates with ideas and solutions that have real-world impact and use

**Strategic Collaborations**
- MIT
- Zhejiang University
- SMU
Collaboration with partner universities

- Curriculum development (87 courses) and co-teaching
- Recruitment and training of SUTD’s faculty
- Student exchange
- Research collaboration
- SUTD-MIT International Design Centre

- Development of 5 elective courses
- Research collaboration
- Student exchange

- Co-development of 5 elective courses
- Research collaboration
- Student exchange
- Advanced placement for graduate school
- Dual degree undergraduate program

Evolution of Engineering Education

- Attitudes
  - Early to mid 20th century
  - Late 20th century

- Knowledge

- Skills
How is SUTD DISTINCTIVE?

Degree Structure
Outside-in approach

Grounding on Technology and Design
# Undergraduate Curriculum

<table>
<thead>
<tr>
<th>PILLAR</th>
<th>ARCHITECTURE AND SUSTAINABLE DESIGN (ASD)</th>
<th>ENGINEERING PRODUCT DEVELOPMENT (EPD)</th>
<th>ENGINEERING SYSTEMS AND DESIGN (ESD)</th>
<th>INFORMATION SYSTEMS TECHNOLOGY AND DESIGN (ISTD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terms 4 to 8</td>
<td>Capstone Integrated Design Experience</td>
<td>Technical Application Electives</td>
<td>Probability and Statistics</td>
<td>Entrepreneurship, Management, Social Sciences, Humanities, Arts</td>
</tr>
<tr>
<td>□ □ Architecture Core</td>
<td>□ □ Engineering Product Core</td>
<td>□ □ Engineering Systems Core</td>
<td>□ □ Information Systems Core</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FRESHMORE</th>
<th>Term 3</th>
<th>Modeling the Systems World, Engineering the Physical World, Digital World, Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term 2</td>
<td>Advanced Mathematics II, Physics II, Design, World Civilizations and Texts</td>
<td></td>
</tr>
<tr>
<td>Term 1</td>
<td>Advanced Mathematics I, Physics I, Chemistry, World Civilizations and Texts</td>
<td></td>
</tr>
</tbody>
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**11:1 student-faculty ratio. Cohort-based. Dedicated classroom.**

Not in big and impersonal lecture halls.
Pedagogy

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

Library Extension Project

SUTD students developed the design concept for the Chinese New Year light-up for 3 years

Chinese New Year Horse

Easy Ring

Leveraged Freedom Wheelchair

SUTD’s maturing clusters and emerging centres

SUTD-MIT INTERNATIONAL DESIGN CENTRE (IDC)

Materiality Design

Digital Design & Manufacturing

Health and Medical Engineering

Big Data

Smart Energy

Robotics

iTrust

Center for Research in Cyber Security

Temasek Labs @SUTD

SUTD Game Lab
The IDC intends to become the world’s premier scholarly hub for technologically intensive design research and practice.

### Project Snapshots

- **Innovative structures thru computation**
- **MICA cube**
- **Pavilion: Gridshell structure**

### Design Grand Challenges

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

### Achievements

- 267 persons engaged in the IDC
- 115 research projects
- 50 leveraged grants
- 410 conference publications/presentations
- 232 book/journal publications
- 63 accolades
- 24 IP

### Research Highlights

- Experimental Design
- Visualization and Prototyping
- Designing Creativity
- Decision Making
- Global Collaboration
Campus

Ready by end 2014

Progress

Curriculum
- MIT, ZJU, SMU
- Freshmore Courses
- Pillars
- Postgraduate Programs

Research
- IDC
- LKY CIC
- iTRUST
- Game Lab
- Temasek Labs
- Faculty Driven Research

Human Resources
- Top Flight Faculty (135)
- Top Flight Students (921)
- MIT Collaborators (>100)

Culture
- Cohort Based Learning
- Entrepreneurship
- Experimentation
- Autonomy

Infrastructure
- Interim Campus
- Permanent Campus
- Equipment and Labs
- Financial resources
- Systems
SUTD Needs the Help and Support of the MOT Community

Thank You