The Value of The Modern Research University: MIT As a Case Study

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Massachusetts Institute of Technology
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The Value of the Higher Education

- Education has served throughout history to **elevate humanity** by enabling social, economic, ecological, medical and intellectual advancement and prosperity.

- **Today’s generation of students is focused on impact:** interest in “grand challenge” research areas is flourishing; e.g. health, energy, environment, security, poverty, food, water; as well as participation in service learning, international projects, educational outreach, entrepreneurship, professional development, political advocacy.

- **We are experiencing a time of transformational possibilities:** distributed tools of technology, hyperconnection, globalization and generational changes are increasing the impact of universities in magnitude, speed and scope.

- Graduate education goes beyond foundational to **advanced knowledge, developing critical thinking, multidimensional skills, broad context, application of knowledge in creative and innovative ways.** *(CGS Pathways Report)*
MIT: Hand and Mind

The mission of MIT is to advance knowledge and educate students in science, technology, and other areas of scholarship that will best serve the nation and the world in the 21st century.

Facts

> Private institution founded in 1861
> 1,018 faculty members
> 76 Nobel Prize winners
> 10,775 employees
> 10,894 students
> Budget: $2.57 billion
> ½ budget for research
> 53% research funded by federal government
> 1853 doctoral research assistantships (51% of doctoral)
The Modern Research University

**Key Characteristics**

- Fundamental scholarship and research must be equal with applied research and innovation.
- Teaching and research are intertwined.
- Quality is determined by the quality of its faculty and students.
- Must have an open environment for research to flourish.
- Young faculty must be free to study and teach what they believe is important.
- Competition engenders excellence.

**Value**

- Generating, disseminating and applying new knowledge to solve the world’s grand challenges:
  - Measures of scholarly productivity
  - Research and curricula addressing the world’s grand challenges: health, energy, environment, security, poverty, food, water, etc.
- Stories are important → **Students are the backbone**

**Economic**

- Providing skilled human capital to sustain national and global workforce
- Generation of companies and jobs

**Fundamental Exploration: Pursuing the Frontiers of Humanity**

- Elevating & inspiring the human spirit and the next generation

**Globalization: Universities as Ambassadors to the World**

*From Charles Vest, “Lessons from the American Research University: What we have learned; what should be preserved; what needs to change,” December 8, 2008*
MIT: Boundary-crossing research

5 Academic Schools
25 Academic Departments
10 Interdisciplinary Graduate Programs

More than 65 major research labs, centers, and programs

MIT Energy Initiative
Center for Energy & Environmental Policy Research
Koch Institute for Integrative Cancer Research
Microsystems Technology Labs
Center for Biomedical Engineering
MIT Entrepreneurship Center
Industrial Performance Center

→ Interconnected and integrated physical infrastructure
→ Incentivizing policies (co-advising, joint faculty appointments, etc.)
→ Extensive co-curricular opportunities
MIT’s “Infinite Corridor”

○ Departments, Labs, Classrooms terminate in infinite corridor; physically interconnected infrastructure

○ “Academic Village” model: classroom “porches,” food, encourage faculty-student, peer-peer informal learning
MIT Graduate Student Professional Development Environment
(*Support at all levels; empowering Student/Department/School/Institute: Embedded in the fabric and culture of the campus)

Selected examples

-career path & transferable skills
  -Teaching & Learning Lab
  -Global Ed/Career Office
  -Academic Depts.
  -Vice President Research

-global ed/office of student life
  -Imperial-MIT Global Fellows
  -Seminars Workshops Path of Professorship
  -Ethics Training

-interinternational
  -Workshops
  -Internships
  -Conferences
  -Research Exchanges

-curricular
  -Sloan School of Management
  -Academic Depts.

-entrepreneurship
  -Sloan Action Learning Labs
  -J-Pal
  -D-Lab
  -Minor

/MIT ODGE PRO-DEPOT

-ODGE Grad Student Council/GWAMIT
-Boot Camps

-MISTI Global Ed/Career Office
-Workshops
-Lemelson Prize
-MIT China Entrepreneurship Forum

-IDEAS Global Challenge

-Martin Trust Center
-Deshpande Center
-Venture Mentoring Service
Scholarly Impact, Knowledge Generation and Career Impact

<table>
<thead>
<tr>
<th>Knowledge Generation</th>
<th>• Publication and citation data</th>
</tr>
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<tbody>
<tr>
<td>Student and Faculty Diversity</td>
<td>• Timely publication of data</td>
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<td></td>
<td>• Flexibility afforded through use detailed discipline taxonomy</td>
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<tr>
<td>PhD Cohort Analysis Time-to-Degree and Completion</td>
<td>• Timely publication of data</td>
</tr>
<tr>
<td></td>
<td>• Flexibility afforded through use detailed discipline taxonomy</td>
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<tr>
<td>5-10-15-20 Alumni Survey</td>
<td>• Career Trajectories and Professional Development</td>
</tr>
</tbody>
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**Overall Publications for MIT: (NRC Data 2005-2009)**

- Number of Publications Per Faculty Member: 2.61
- Number of Citations Per Faculty Member 52.56

Global Research Report United States, NOVEMBER 2010, Jonathan Adams, David Pendlebury, Thomas Reuters
Human Capital: MIT Graduate Degrees Awarded, Job Placement and Career Trajectories


89% received at least one job offer
79% report having a job at graduation
86% will stay in U.S. after graduation, 51% in Massachusetts
75% of internationals stay in U.S. after graduation

5-10-15-20 Year Grad Alumni Survey on Career Trajectories and Professional Development Skills
MIT Entrepreneurial and Economic Impact

○ **25,800** currently active companies founded by MIT alumni employ about **3.3 million** people (1 million MA) and generate annual world sales of **$2 trillion**, producing the equivalent of the 11th largest economy in the world.

○ **Technology drawn from MIT** and other universities generated 1.7 million of those jobs and about **$1 trillion** of the total revenues.

○ There are more than **6,900** active MIT alumni-founded companies headquartered in **Massachusetts**, estimated sales **$164 Billion**, 26% of the sales of all Massachusetts companies.

○ These leading companies provide a substantial part of the **Massachusetts high-tech environment**, helping to **attract highly skilled professionals and other firms to the state**.
MIT Examples of Student-Engaged in Entrepreneurship

- MIT 100K Business Plan Competition
  - Has helped launch more than a dozen companies currently valued at more than $100 million, with at least two more than $1Billion

- MIT Ideas Global Challenge

- MIT Entrepreneurs Club

- i-Teams

- MIT TechLink

- Sloan Global Entrepreneurship Lab

- MIT China Innovation and Entrepreneurship Form

++++ MANY MORE  At least 120 companies have been started by participants in student-run competitions.
95 Kendall Square Life Sciences companies, by the year 2001, 21 were either were founded by MIT alumni or faculty, or had MIT-licensed technology; their revenues were $2.5 billion. Source: *Entrepreneurial Impact: The Role of MIT* (2009).
The Emerging Energy Cluster in Greater Boston Area

- 22 energy companies in Cambridge and 25 more in Boston. A high percentage of the new energy firms are MIT-related in terms of their founders and/or technology sources.

MIT Impact on Health: OmniGuide

- Fundamental research on materials science, optics and manufacturing funded by US Army/DoD led by MIT Professor Yoel Fink, Materials Science and Engineering
- 140 employees
- 50,000 surgeries to date; Used in >650 hospitals in the U.S.
MIT Impact on National Security

**FIDO**: Explosive detection devices for airports and battlefields: the most sensitive detectors ever produced

*The Research*
1960’s – 1990’s
- Fundamental investments in polymers
- Potential broad use in sensing, power & energy

1998
- Research lead to breakthrough development of amplifying fluorescent polymers (AFP) – T. Swager
- MIT Department of Chemistry
- First molecular wire with in-series receptors for signal amplification

*The Result*
2005
- Breakthrough leads to development of Fido® XT Explosives Detector (FLIR Systems, Inc.) Collaborative Research Programs between DARPA, NVL, and ARO
- Employed in Afghanistan and Iraq
- Won Army’s Greatest Invention Award for 2005 and 2007.

• 2009
  - TSA airport version deployed

*Fido is currently in use by the TSA at 70 airports nationwide*
○ Ambri’s liquid metal battery technology is distinct from other storage options on the market today. Each cell consists of three self-separating liquid layers — two metals and a salt — that float on top of each other based on density differences and immiscibility. The system operates at elevated temperature maintained by self-heating during charging and discharging — a low-cost and efficient storage system.

○ MITEI has produced a series of major integrative technology/policy studies - The Future of Natural Gas and the Future of the Nuclear Fuel Cycle, both published last year, have had substantial policy impact.
MIT Impact on Local Communities

Prof. Larry Sass – MIT Architecture
Digitally Fabricated House for New Orleans to replace trailers
MIT: Impact on Poverty
J-Pal: Abdul Latif Jameel Poverty Action Lab

- Network of 55 affiliated professors around the world who utilize randomized evaluations answer questions critical to poverty alleviation.

- Doctoral students in Department of Economics conduct field research for 8-10 weeks in summer, after the first year of the program, prior to which they have taken a course in development economics.

- Students work as part of a team with J-PAL associated faculty from MIT and abroad

- Experience often inspires dissertation work, can lead to additional international visits later in the student’s academic career

Photos: J-Pal website: http://www.povertyactionlab.org/
MIT: Impact on Human Discovery

Maria Zuber, a professor of geophysics at MIT, is one of the first two women to lead a major planetary mission for NASA. That mission, which launches in 2011, will shoot two remote-controlled spacecraft to orbit the moon, where they will study its gravity for clues to the moon's origins. Zuber is a pioneer in space exploration who has made seminal breakthroughs in understanding solar system planets and their evolution.

- Localized Crustal Magnetic Depth Estimations of Earth and Mars
- Digital Field Geology System
- Mars Convective Core Stability Models
- Assessment of future Mars landing sites
- The Shape of near-Earth asteroid 433 Eros
- The Relationship Between Elevation and Atmospheric Pressure on Mars from Radio Occultations
- Assessing Mercury’s Core State
- Viscoelastic Relaxation of Earth and Planetary Topography
- Lunar Gravity and Topography
A regional focus on sub-Saharan Africa. Broadly, she studies the evolution of markets and various market failures in these economies. In particular, her main areas of focus are agriculture and formal and informal financial access. For example, she has worked on the adoption of seed technologies in Kenya and the extent of informal risk pooling mechanisms in rural Kenya.
The Global Impact of Our Graduate Students

About: Egypt’s first digital fabrication lab FABLAB Egypt is a non-profit open access makerspace, which gives everyone in the community from small children through to entrepreneurs and businesses, the capability to turn their ideas and concepts into reality. Fosters the culture of creation, invention and exploration in the Egyptian community by introducing the environment in which an individual or group can design whatever they can imagine, learn how to model it on computers and then fabricate this design physically.

Project led by Dina El-Zanfaly, Egyptian doctoral student in Architecture
Universities as Ambassadors to the World: MIT International Science & Technology Initiatives (MISTI)

**Mission:** Make hands-on international experiences available to MIT students as a part of a world-class science and technology education

**Cultural and Technical**

MISTI student internship placements
MIT: Curriculum Focusing on Benefits to Society

Interdisciplinary course that Focuses on Technology Innovation and International Development

- MIT Program offers 16 different courses in development, design, social entrepreneurship
- Provides project-based learning with real-world impact

D-Lab: Energy - offers hands-on, project-based approach that engages students in understanding and addressing the applications of alternative energy technology in developing countries

D-Lab: Waste - provides a multi-disciplinary approach to managing waste in low and middle-income countries

D-Lab: Mobility - focuses on improving wheelchair technology in developing countries
Empowering Minds: Traffic by Country – August 2012

<table>
<thead>
<tr>
<th>Country</th>
<th>Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>United States</td>
<td>841,538</td>
</tr>
<tr>
<td>India</td>
<td>170,360</td>
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<tr>
<td>China</td>
<td>66,656</td>
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<tr>
<td>Canada</td>
<td>55,783</td>
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<tr>
<td>United Kingdom</td>
<td>45,453</td>
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<tr>
<td>Brazil</td>
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<tr>
<td>South Korea</td>
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<tr>
<td>Australia</td>
<td>26,209</td>
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<tr>
<td>Germany</td>
<td>25,207</td>
</tr>
<tr>
<td>Turkey</td>
<td>22,051</td>
</tr>
</tbody>
</table>

- 33 academic departments, voluntary contributions from 78% of MIT faculty
MIT: Reinventing Residential Education and Benefits to Society

edX Cult Symbol?

6002X.BLOGSPOT.COM
External Impact: Developing World, STEM Pipeline, Community Colleges, etc.

Where is this?

A. Agarwal
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