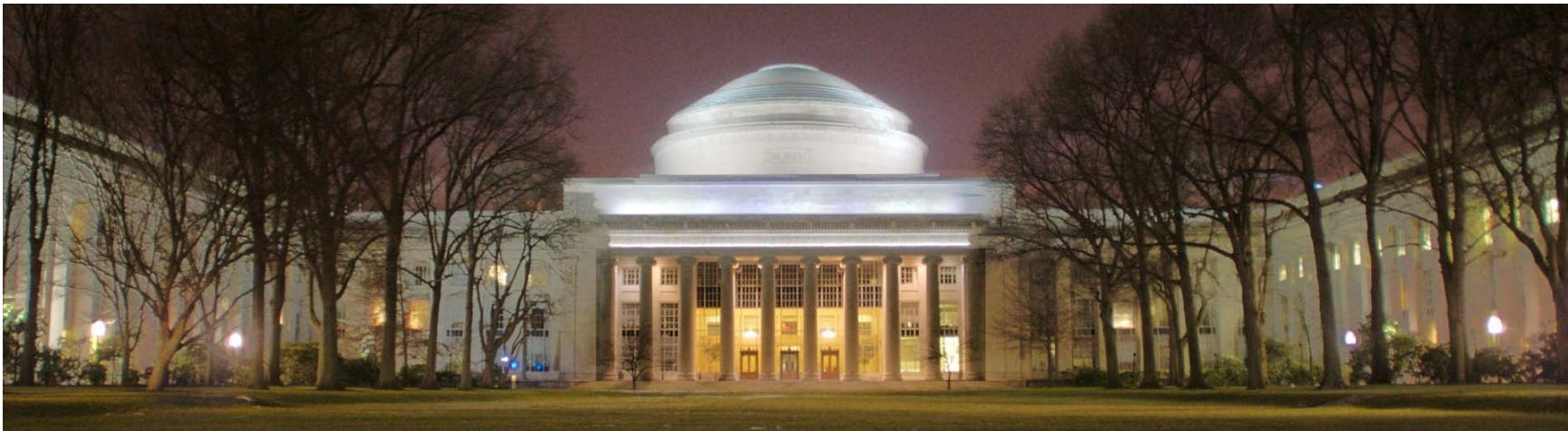


# The Value of The Modern Research University: MIT As a Case Study

*Christine Ortiz, Dean for Graduate Education  
Massachusetts Institute of Technology*

October 1<sup>st</sup>, 2012

AAU AGS Deans 63<sup>rd</sup> Annual Meeting



# 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

From Charles Vest, "Lessons from the American Research University: *What we have learned; what should be preserved; what needs to change,*" December 8, 2008

## Value

Local → National → Global

**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

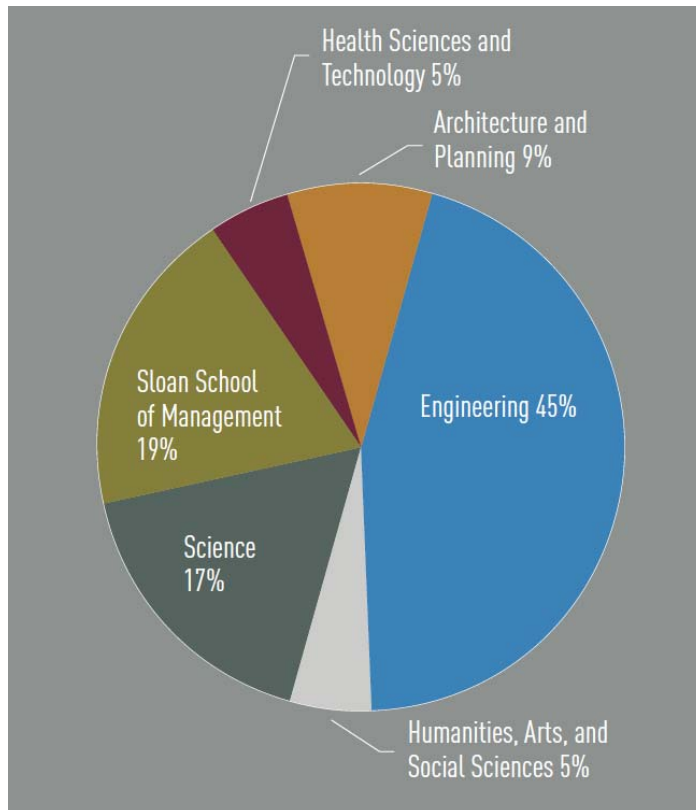
**Globalization: Universities as Ambassadors to the World**



# 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

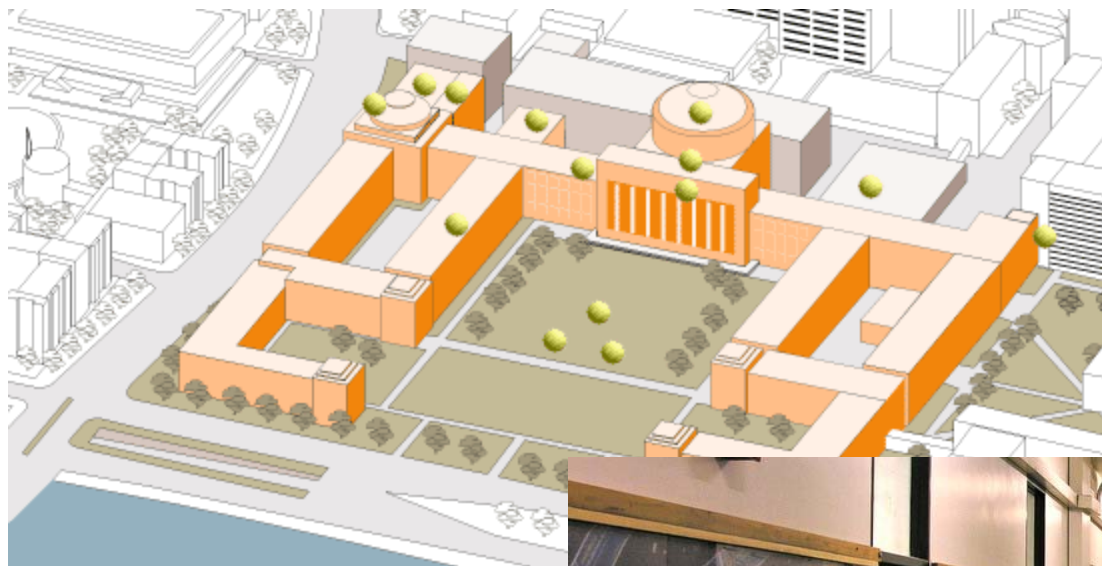
Center for Biomedical Engineering

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"



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

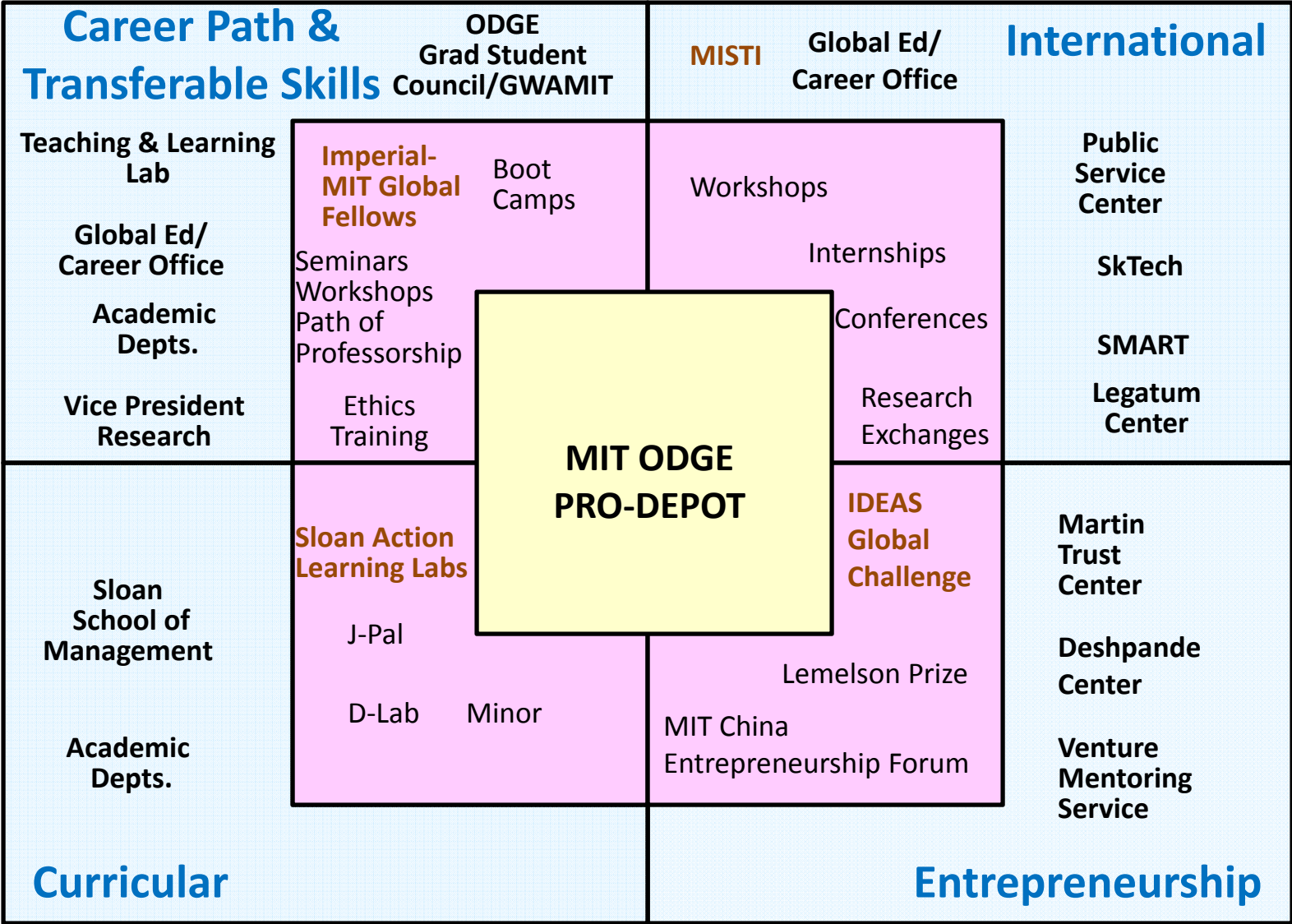


o "Academic Village" model: classroom "porches," food, encourage faculty-student, peer-peer informal learning

# 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*



# Scholarly Impact, Knowledge Generation and Career Impact

<b>Knowledge Generation</b>	<ul style="list-style-type: none"> <li>• Publication and citation data</li> </ul>
<b>Student and Faculty Diversity</b>	<ul style="list-style-type: none"> <li>• Timely publication of data</li> <li>• Flexibility afforded through use detailed discipline taxonomy</li> </ul>
<b>PhD Cohort Analysis Time-to-Degree and Completion</b>	<ul style="list-style-type: none"> <li>• Timely publication of data</li> <li>• Flexibility afforded through use detailed discipline taxonomy</li> </ul>
<b>5-10-15-20 Alumni Survey</b>	<ul style="list-style-type: none"> <li>• Career Trajectories and Professional Development</li> </ul>

**Overall Publications for MIT: (NRC Data 2005-2009)**  
 Number of Publications Per Faculty Member: 2.61  
 Number of Citations Per Faculty Member 52.56

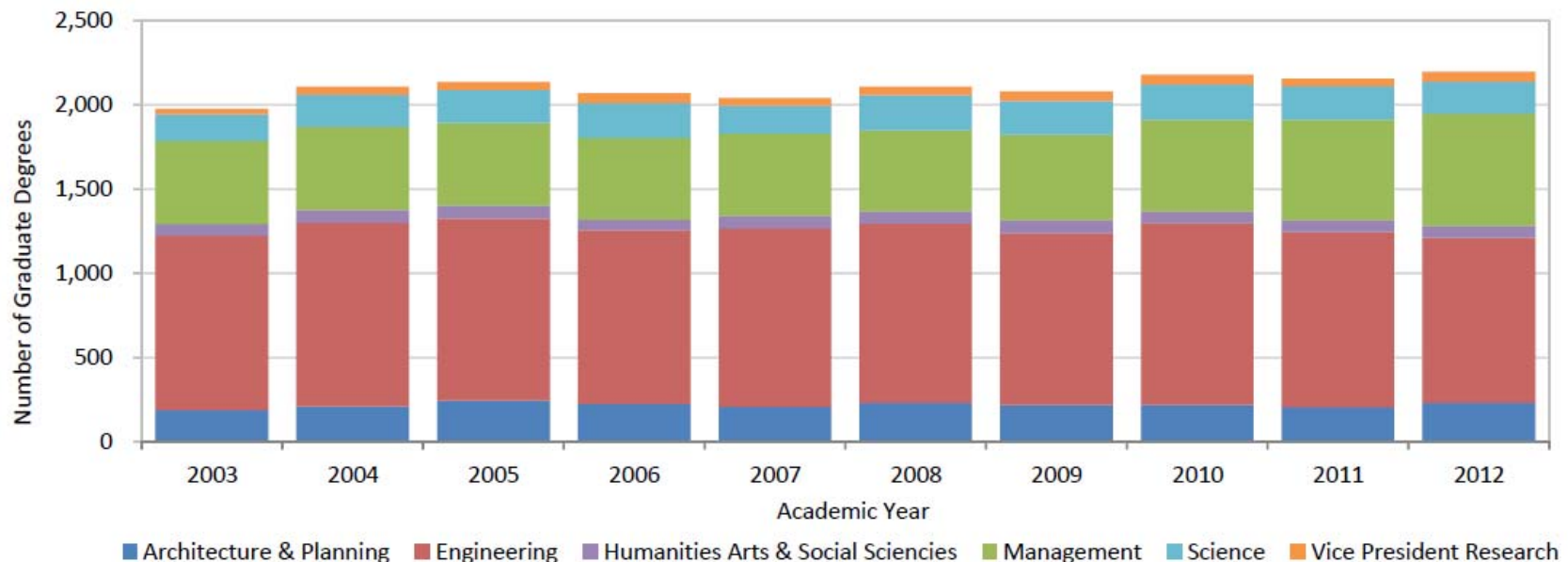
Global Research Report United States,  
 NOVEMBER 2010, Jonathan Adams, David  
 Pendlebury, Thomas Reuters





# Human Capital: MIT Graduate Degrees Awarded, Job Placement and Career Trajectories

[https://web.mit.edu/ir/analysis/Degrees\\_Awarded\\_2003-2012.pdf](https://web.mit.edu/ir/analysis/Degrees_Awarded_2003-2012.pdf)



**MIT 2012 Doctoral Exit Survey: First Placement** <http://web.mit.edu/ir/surveys/grad/index.html>

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

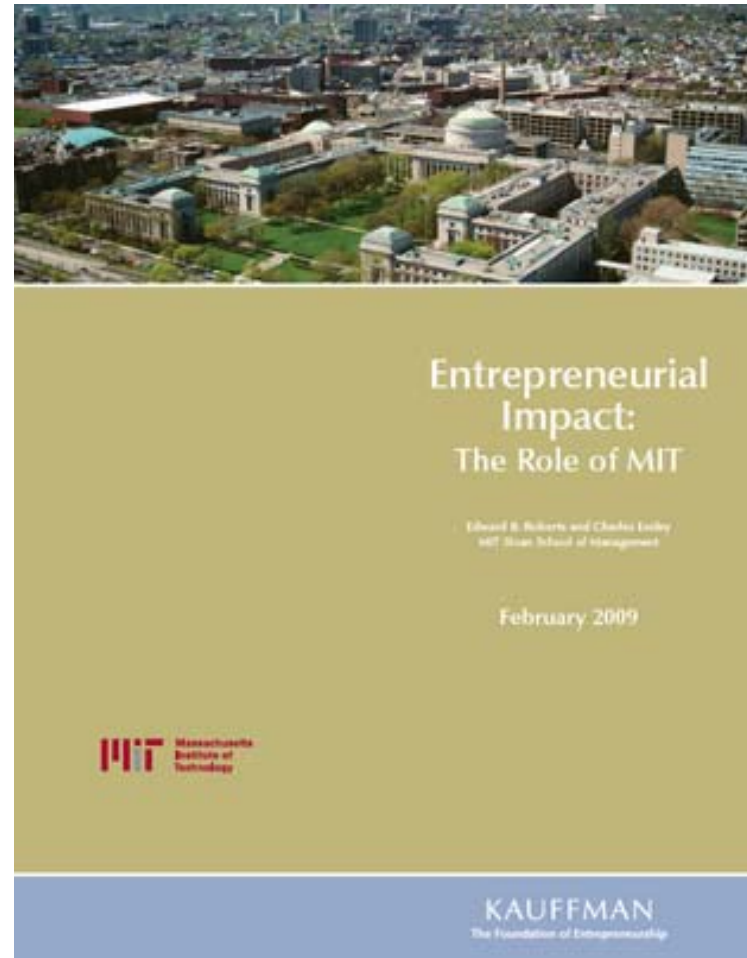
75% of internationals stay in U.S. after graduation

**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

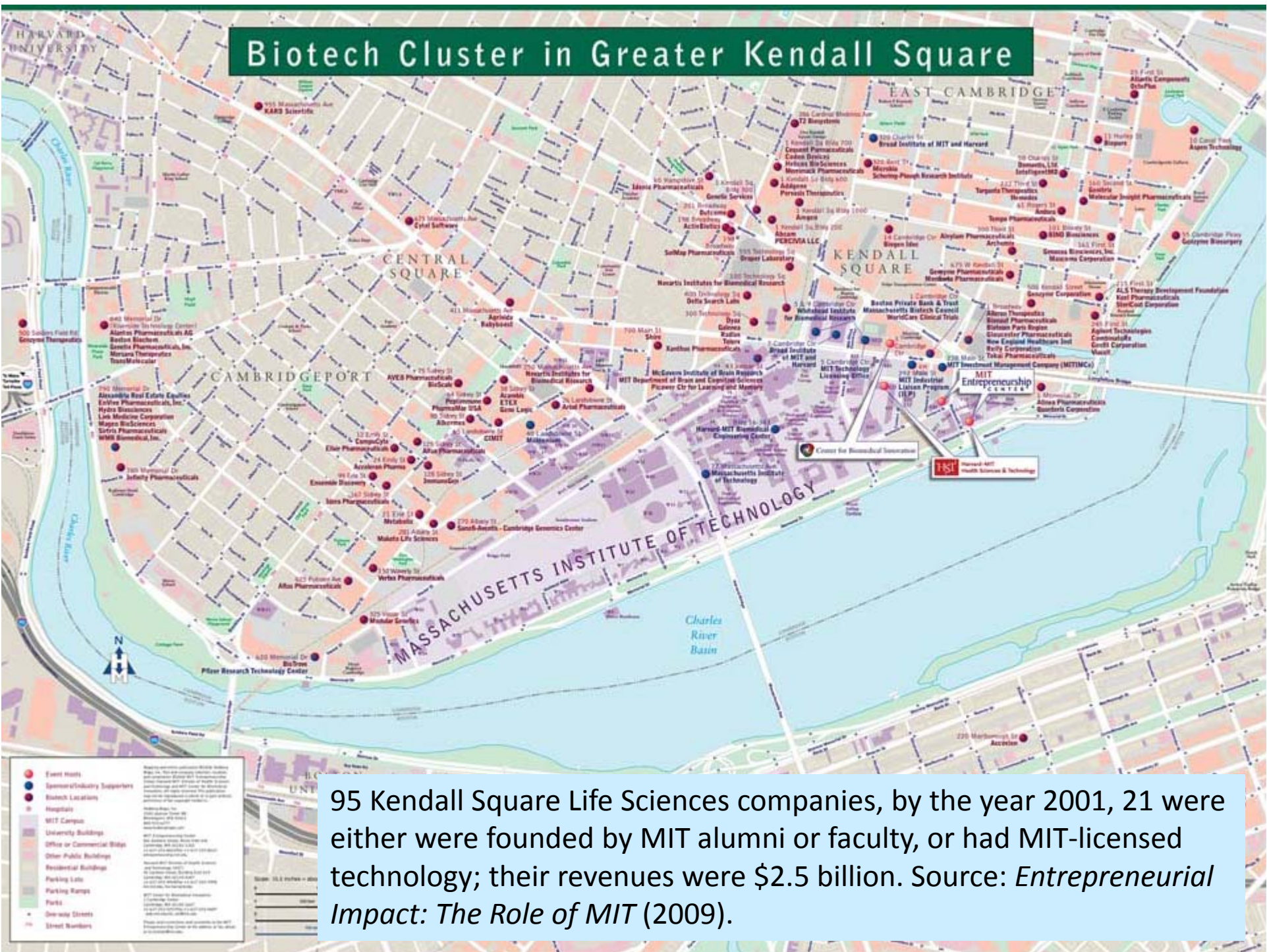


++++ MANY MORE

At least 120 companies have been started by participants in student-run competitions.



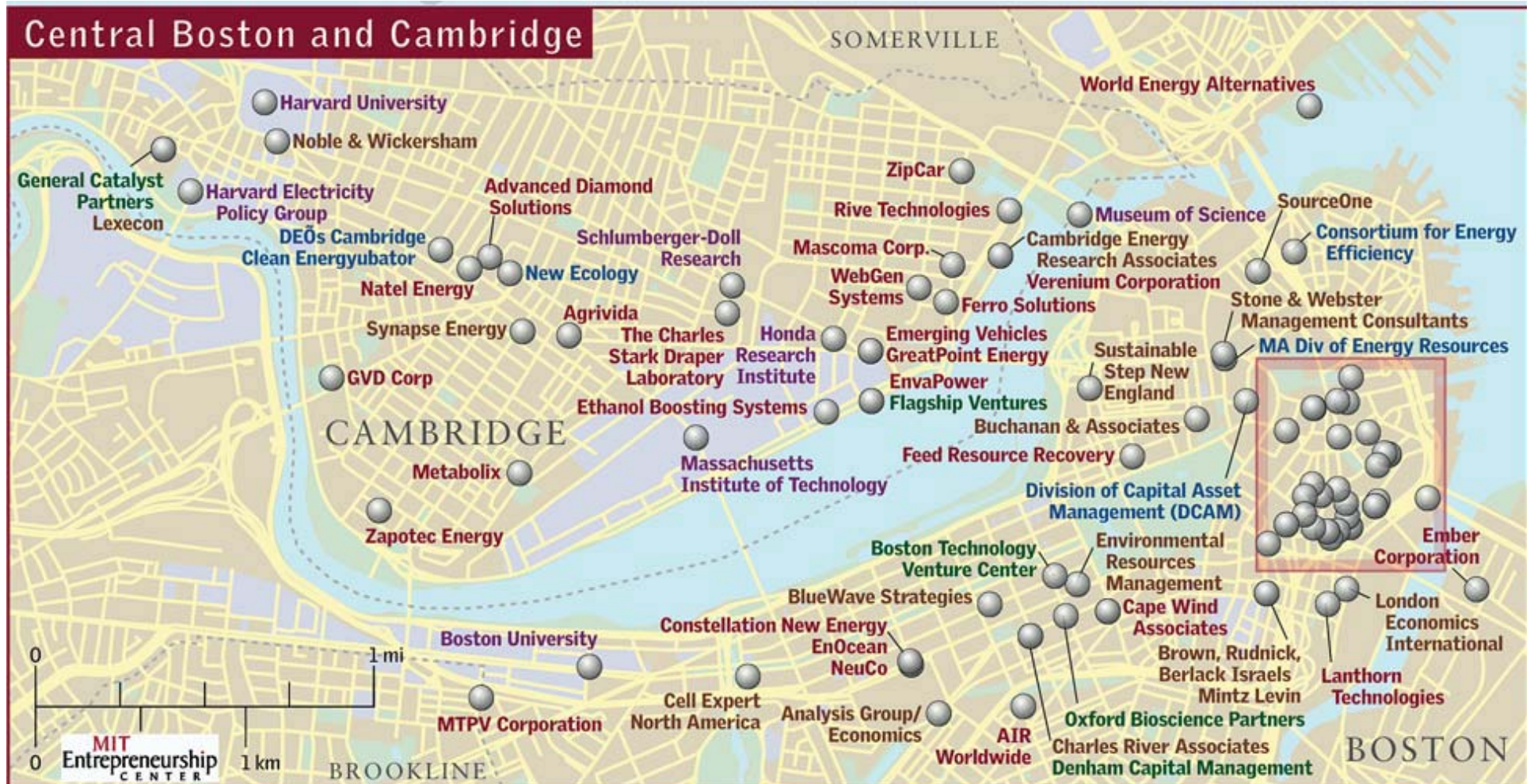
# Biotech Cluster in Greater Kendall Square



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



o 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.

Source: *Entrepreneurial Impact: The Role of MIT* (2009).



# MIT Impact on Health: OmniGuide



**Shaping the future of minimally invasive surgery**

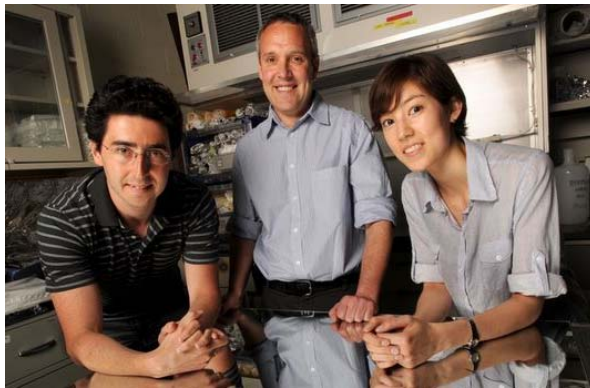
Improving surgical precision, access, and control with the innovative BeamPath™ flexible CO<sub>2</sub> laser delivery system.

[Learn More >](#)

Surgeons

Patients

Gynecology    Head & Neck    Laryngology & Airway    Otology & Neurotology    Neurosurgery & Spine



- 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**

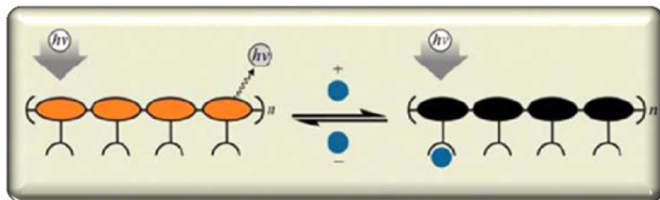
### The Research

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<sup>®</sup> 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***

# MIT Impact on Energy



MIT ENERGY INITIATIVE



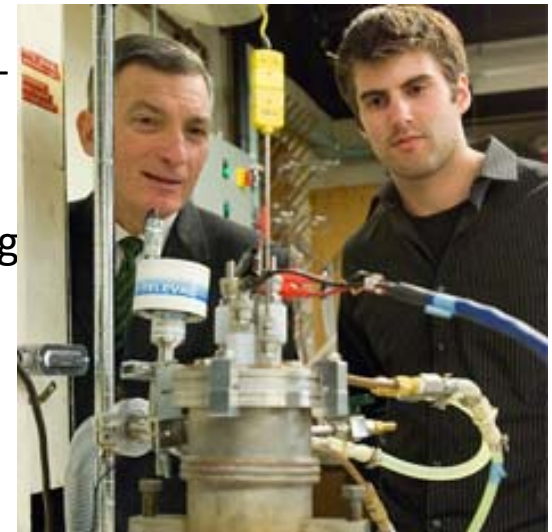
## It Will Change Everything

More renewable resources, less expensive power and a more reliable grid – with Ambri.

Today, it's hard to get enough electricity into certain areas, like big cities, leading to high prices and even blackouts. Renewable resources like wind and solar are not predictable – we can't control when the sun shines or the wind blows – which makes it hard to operate the grid. With Ambri, electricity can be delivered precisely where and when it is needed, cost-effectively.

○ 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 ENGINEERING



# 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

### Agriculture



### Education



### Health



### Labor Markets



### Environment & Energy



### Finance & Microfinance



### Political Economy & Governance



Photos: J-Pal website: <http://www.povertyactionlab.org/>



MIT SCHOOL OF HUMANITIES, ARTS, & SOCIAL SCIENCES

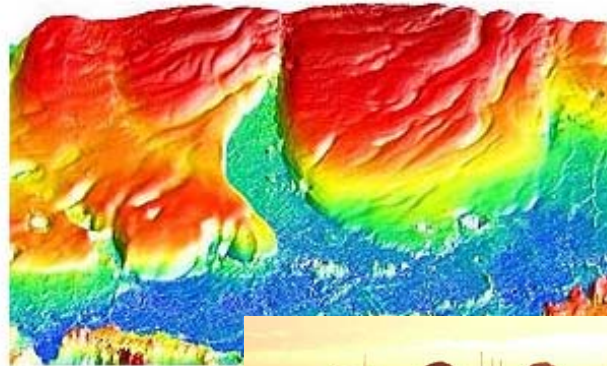
great ideas change the world

Office of the  
Dean for Graduate Education • oedge

# 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 large canyon, Chas south polar layered d Mars Orbiter Laser Al looking toward the s meridian. The canyon widest point; there is this scene





# MIT Global Impact

## Tavneet Suri

**Professor of Sloan School of Management**



- Impact of Feeder Roads
- New rice varieties

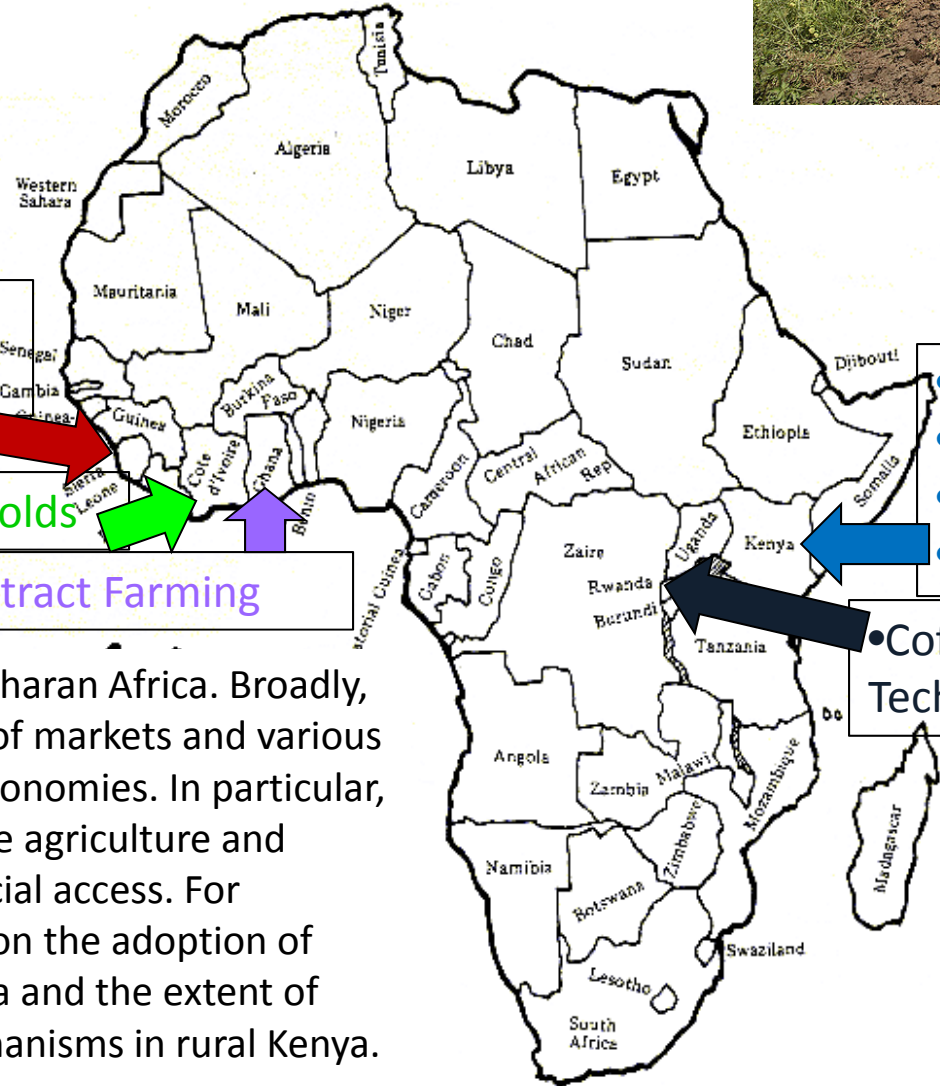
- Risk sharing across households

- Contract Farming

- Water storage tanks
- Hybrid Maize
- Mobile Money
- Harvest Insurance

- Coffee Farming Techniques

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

+ FABLAB EGYPT  
MINI MAKING FESTIVAL.  
3<sup>RD</sup> AUGUST 2012



Dina E El-Zanfaly



**Fab Lab Egypt**

1,410 likes · 102 talking about this · 89 were here



**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**

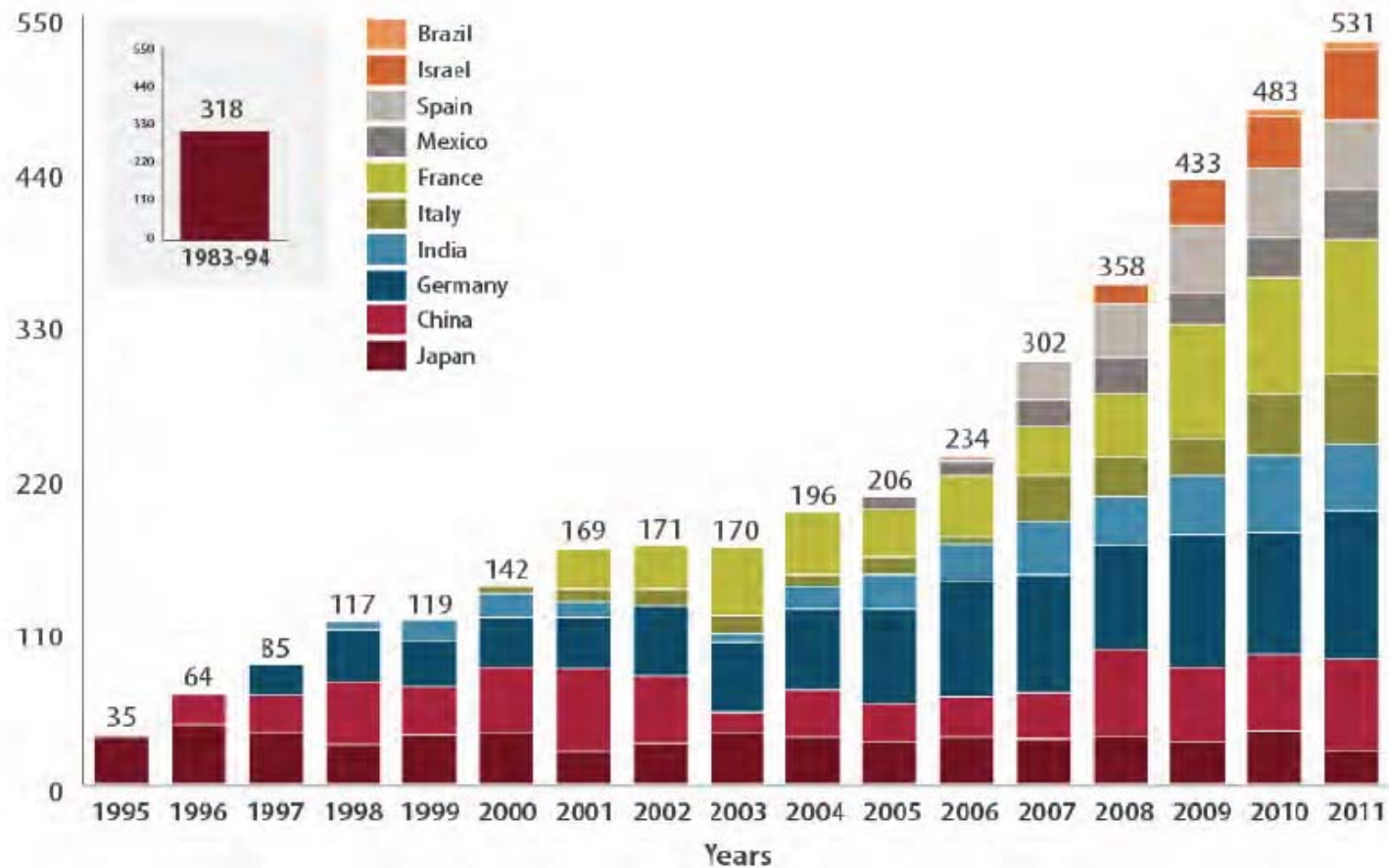


# Universities as Ambassadors to the World: MIT International Science & Technology Initiatives (MISTI)

**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

*D-Lab*

Development through Dialogue, Design & Dissemination

MIT

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

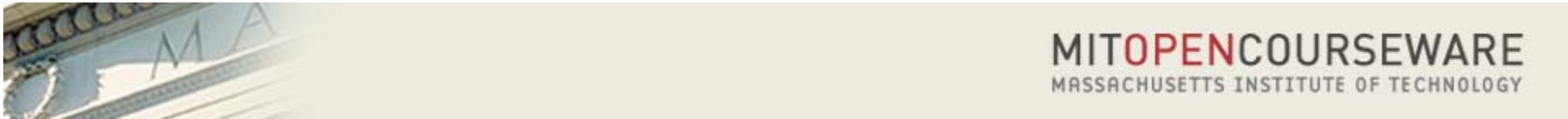


**D-Lab: Mobility** - focuses on improving wheelchair technology in developing countries





# MIT Educational Content Benefits Society



## Empowering Minds: Traffic by Country – August 2012

- 33 academic departments, voluntary contributions from 78% of MIT faculty

Country		Visits
1	United States	841,538
2	India	170,360
3	China	66,656
4	Canada	55,783
5	United Kingdom	45,453
6	Brazil	34,918
7	South Korea	34,177
8	Australia	26,209
9	Germany	25,207
10	Turkey	22,051



# MIT: Reinventing Residential Education and Benefits to Society

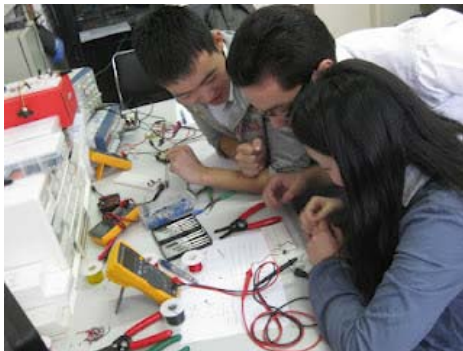


edX Cult  
Symbol?

[6002X.BLOGSPOT.COM](http://6002X.BLOGSPOT.COM)

External Impact: Developing World, STEM Pipeline, Community Colleges, etc.

## Where is this?



A. Agarwal



# Acknowledgements

- Jessica Landry, Assistant to the MIT Dean for Graduate Education
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- MIT Chairman John Reed
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US Army Research Office
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- Tim Swager, MIT Professor of Chemistry
- Larry Sass, MIT Professor of Architecture
- Ernest Moniz, Director of MIT Energy Initiative
- Dave Schmittlein, Dean of the Sloan School of Management