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MIT and Industry

Innovation Ecosystem

MIT is built on a foundation of innovation and entrepreneurship. Since its creation in 1861 by the Massachusetts State Legislature, MIT has been charged with the "development and practical application of science in connection with arts, agriculture, manufactures, and commerce." The Institute's motto, mens et manus—mind and hand—codifies its continuing commitment to serving society through the practical application of university research.

An institutional culture with a dynamic relationship to industrial innovation has grown on top of this foundation. The components of this ecosystem of innovation encompass education, business connections, and the commercialization of university research. MIT's innovation model encourages members of its research community—its students, researchers, faculty, staff, and alumni—to reach beyond MIT's campus. The success of this model is outlined in a 2009 Kauffman Foundation report *Entrepreneurial Impact: The Role of MIT*.[1] The report estimates that living MIT graduates have founded about 25,800 active companies, employing 3.3 million people and generating estimated annual world revenues of $2 trillion.

MIT's innovation ecosystem is sustained by the deep understanding of science and engineering instilled in its students and is enhanced by several Institute initiatives. A sampling of these initiatives are described below.

Technology Licensing Office

For decades, MIT's Technology Licensing Office (TLO) has helped MIT faculty and researchers with patenting, licensing, and starting firms that build upon technology developed at MIT. See page 9 for selected TLO statistics for FY2012.

Industrial Liaison Program

MIT has long held that breakthrough research hinges on open, consultative dialogue. Part of the Office of Corporate Relations, the Industrial Liaison Program (ILP) was established in 1948. The ILP is the largest conduit between corporations and MIT. More than 190 companies partner with the program to improve their access to MIT and advance their research agendas.

Deshpande Center for Technological Innovation

The Deshpande Center is a proof-of-concept group that depends on the financial and professional support of successful alumni, entrepreneurs, and investors to provide funding for innovative research and give guidance to help it reach the marketplace. The Deshpande Center has underwritten more than 90 projects, 26 of which have spun out into commercial ventures.

Innovation Prizes

A number of prizes at MIT spur students and faculty to explore difficult problems. One example is the MIT $100K Entrepreneurship Competition, a student-run, year-long educational experience that encourages students and researchers to act on their talent, ideas, and energy to produce tomorrow's leading firms. Over the years, the competition has helped launch more than 130 companies that have generated over 2,500 jobs and received $770 million in venture capital funding.

[1]Roberts, Edward B., and Charles Eesley. *Entrepreneurial Impact: The Role of MIT*. The Kauffman Foundation, 2009. (http://www.kauffman.org/research-and-policy/mit-entrepreneurs.aspx)

Martin Trust Center for MIT Entrepreneurship
The Martin Trust Center for MIT Entrepreneurship is committed to fostering and developing MIT's entrepreneurial activities and interests in three primary areas: education and research, alliance, and community. The Center educates and nurtures students from across the Institute who are interested in learning the skills to design, launch, and grow innovation-based ventures. The Center facilitates business and technology partnerships by combining breakthrough academic research with practical, proven experience. The people of the Center cultivate and nourish a thriving network that unifies academic, government, and industry leaders around the vision of entrepreneurial success.

MIT Energy Initiative
The MIT Energy Initiative (MITEI) is an Institute-wide initiative designed to help transform the global energy system to meet the needs of the future and to help build a bridge to that future by improving today's energy systems. Through its research program, MITEI addresses a critical link in the energy innovation chain—the pairing of MIT's world-class research teams with the best in industry who will be responsible for moving the products of this collaboration into the energy marketplace. See page 78 for more information.

Venture Mentoring Service
The MIT Venture Mentoring Service (VMS) connects members of the MIT community with advisory resources to increase successful outcomes and accelerate the commercialization of university innovations. The MIT VMS harnesses the knowledge and experience of volunteer alumni and other business leaders to help prospective entrepreneurs in the university community bring their ideas and inventions to market.

Benefits to the National Economy

In 2009, the Kauffman Foundation released a study on MIT's entrepreneurial impact on the nation's economy. The study found that the five states gaining the most jobs from companies started by MIT alumni were Massachusetts, with just under 1 million jobs; California, with 526,000 jobs; New York, with 231,000 jobs; Texas, with 184,000 jobs; and Virginia, with 136,000 jobs.

Nearly 60 percent of companies founded by MIT alumni are located outside the Northeast. These companies have a large presence in the San Francisco Bay area (Silicon Valley), southern California, the Washington-Baltimore-Philadelphia belt, the Pacific Northwest, the Chicago area, southern Florida, Dallas and Houston, and the industrial cities of Ohio, Michigan, and Pennsylvania. The study also noted that "an important subset of the MIT alumni companies is in software, electronics (including instruments, semiconductors, and computers), and biotech. These firms are the cutting edge of what we think of as high technology and, correspondingly, are more likely to be planning future expansion than companies in other industries. They export a higher percentage of their products, hold one or more patents, and spend more of their revenues on research and development."

The study also found that MIT acts as a magnet for foreign entrepreneurs. It states that "half of those companies created by 'imported' entrepreneurs, 2,340 firms, are headquartered in the United States, generating their principal revenue ($16 billion) and employment (101,500 people) benefits here." See page 89 for more information on international entrepreneurs.

Industry

Selected Current Projects

Micro-Ants

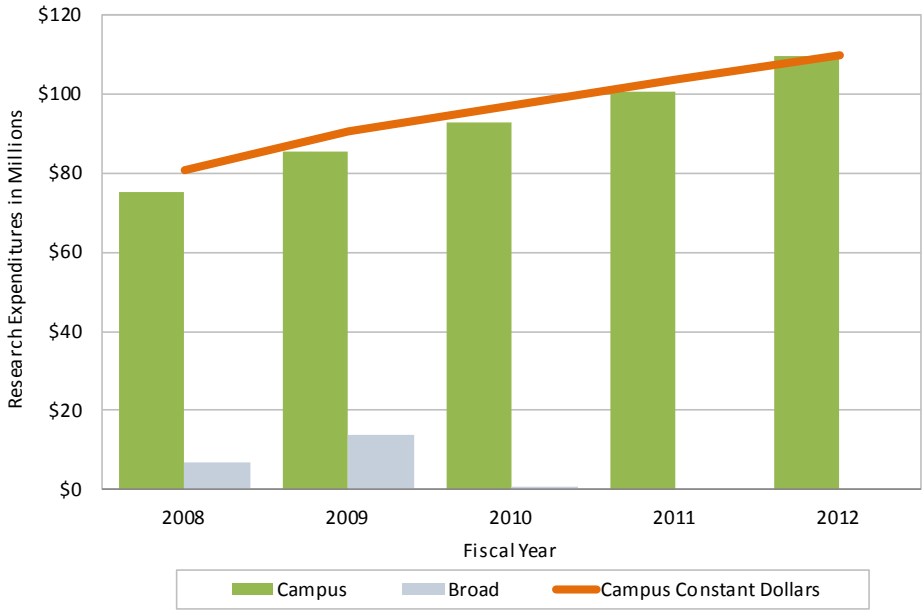
Researchers at MIT, in collaboration with researchers at Boston University and in Germany, have created a new system that uses microscopic magnetic beads suspended in liquid to move objects inside microfluidic chips. The beads, which are made of polymers with specks of magnetic material suspended in them, have been dubbed "micro-ants" for their ability to transport objects much larger than themselves. When they are placed in a rotating magnetic field, the beads spontaneously form short chains and spin, creating a current that can transport surrounding particles as much as 100 times larger than the beads. The new method could provide a simpler, less-expensive alternative to current microfluidic devices, a technology involving the precise control of tiny amounts of liquids flowing through microscopic channels on a chip in order to carry out chemical or biological analysis of tiny samples. The work may also help scientist better understand the human body. The micro-ants function similarly to cilia, which are tiny hair-like filaments that line organs like the trachea and the intestines. Like the micro-ants, cilia work in unison to create currents that sweep along cells, nutrients, and other particles. The work was led by Alfredo Alexander-Katz and was funded by grants from DuPont and grants from the German Government.

Closing in on Bionic Speed

Robots have the potential to go where it is too hot, too cold, too remote, too small, or too dangerous for people to perform any number of tasks, from repairing water leaks to stitching blood vessels together. MIT researchers, led by Sidney Yip, have proposed a theory that might eliminate an obstacle to achieving these goals—the limited speed and control of the "artificial muscles" that make these robots move. Today, engineers construct robotic muscles from polymers that carry an electronic current, which are triggered by activating waves called "solitons." Proposing a model that explains how these waves work, Xi Lin, a postdoctoral associate in Yip's lab, has developed an understanding which will permit engineers to design lighter, much more flexible polymers. Able to transmit the wave much more quickly, they can make the robot muscles move 1,000 times faster than those of humans. This work was supported by Honda R&D Co. Ltd., and DARPA.

Industry Campus and Broad Institute Research Expenditures (in U.S. Dollars)*
Fiscal Years 2008–2012

	2008	2009	2010	2011	2012
Campus research	75,259,081	85,562,146	92,649,701	100,762,512	109,744,829
Broad Institute research	6,935,104	13,656,981	680,132	0	0
Total Industry	**82,194,185**	**99,219,127**	**93,329,833**	**100,762,512**	**109,744,829**
Constant dollars†	88,352,894	105,185,002	97,993,272	103,714,730	109,744,829



*The Broad Institute separated from MIT on July 1, 2009 and no longer receives funding through MIT. The chart above displays both campus research expenditures and Broad Institute research expenditures funded through MIT.
†Constant dollars are calculated using the Consumer Price Index for All Urban Consumers weighted with the fiscal year 2012 equaling 100.

Leading Departments, Laboratories, and Centers Receiving Support in Fiscal Year 2012
(shown in descending order of expenditures)

MIT Energy Initiative
Chemical Engineering
Computer Science and Artificial Intelligence Laboratory
Media Laboratory
Sloan School of Management
Mechanical Engineering
Koch Institute for Integrative Cancer Research
Sociotechnical Systems Research Center
Aeronautics and Astronautics
Research Laboratory of Electronics

MIT is a leader in conducting research sponsored by industry. Approximately 200 industrial sponsors supported research projects on the MIT campus in FY2012, with nearly $110 million in expenditures. Companies often join together in these collaborations to support multi-disciplinary research programs in a wide range of fields.

Service to Industry

Industrial Performance Center

The Industrial Performance Center (IPC) is dedicated to the study of innovation, productivity, and competitiveness in the nation and around the world. The Center specializes in bringing together multidisciplinary teams of researchers in engineering, science, management, and the social sciences to carry out innovative, applied research on industrial growth and transformation, national and regional economic growth and competitiveness, and innovation performance. The IPC seeks to help leaders in business, government, education, and other sectors of society better understand global industrial developments and create practical new approaches for strengthening public policies, business strategies, technical practices, and educational programs.

Leaders for Global Operations

The Leaders for Global Operations (LGO) program is an educational and research partnership among global operations companies and MIT's School of Engineering and Sloan School of Management. Its objective is to discover, codify, teach, and otherwise disseminate guiding principles for world-class manufacturing and operations. The 24-month LGO program combines graduate education in engineering and management for those with two or more years of full-time work experience who aspire to leadership positions in manufacturing or operations companies. A required six-month internship comprising a research project at one of LGO's partner companies leads to a dual-degree thesis, culminating in two master's degrees—an MBA (or SM in management) and an SM in engineering.

MIT International Science and Technology Initiatives

The MIT International Science and Technology Initiatives program (MISTI) enlarges students' opportunities for international learning through on-campus resources and internships in foreign companies and laboratories; supports faculty collaborations with researchers abroad; and works with corporations, government, and nonprofit organizations to promote international industry, education, and research. More than 400 students participate annually in MISTI internships, preparing for their stay abroad with integrated courses in foreign languages and cultures. See pages 90–91 for more information.

MIT Sloan Fellows Program in Innovation and Global Leadership

This full-time, 12-month (June–June) immersive MBA program is designed for high-performing mid-career professionals. The program typically enrolls more than 100 outstanding individuals with 10–20 years of professional experience from at least two dozen nations, representing a wide variety of for-profit and nonprofit industries, organizations, and functional areas. Many participants are sponsored by or have the strong support of their employers, but the program also admits independent participants, many with unique entrepreneurial experiences and perspectives. The program is characterized by a rigorous academic curriculum, frequent interactions with international business and government leaders, and a valuable exchange of global perspectives.

Office of Corporate Relations
MIT's Office of Corporate Relations promotes creative collaboration among MIT, industry, and government. Its Industrial Liaison Program enables member firms to draw upon MIT expertise to inform their own technology strategies, and at the same time helps faculty members stay abreast of the latest industrial developments.

MIT Professional Education
MIT Professional Education provides short courses, semester or longer learning programs, and customized corporate programs for science and engineering professionals at all levels. Taught by renowned faculty from across the Institute, MIT Professional Education programs offer professionals the opportunity to gain crucial knowledge in specialized fields to advance their careers, help their companies, and have an impact on the world.

System Design and Management
The System Design and Management program educates engineering professionals in the processes of engineering and designing complex products and systems, and gives them the management skills they need to exercise these capacities across organizations. Sponsored by the School of Engineering and the Sloan School of Management, the program offers a joint master's degree from both schools. Students can pursue these degrees either on campus or through a hybrid on-campus/off-campus curriculum that uses video conferencing and web-based instruction.

Strategic Partnerships

In 1994, MIT began to build new kinds of research partnerships, creating longer-term alliances with major corporations that would allow these companies to work with MIT to develop programs and strategies that address areas of rapid change. In return for their research and teaching support, the corporations share ownership of patentable inventions and improvements developed from the partnership. In a number of these alliances, funds are earmarked for specific education projects.

A selection of these partnerships are described below.

DuPont
Established in 2000, the DuPont MIT Alliance (DMA) brings together each institution's strengths in materials and chemical and biological sciences to develop new materials for bioelectronics, biosensors, biomimetic materials, alternative energy sources, and new high-value materials. DuPont also works with MIT's Sloan School of Management to define new business and policy models for these emerging technologies. Each year, the DMA supports first-year graduate students through it's DuPont Fellows program.

Eni S.p.A
In February 2008, an alliance was signed between Eni and MIT. This alliance brought the creation of the Eni-MIT Solar Frontiers Center (SFC). The SFC, headquartered on the MIT campus, promotes research in advanced solar technologies through projects ranging from new materials to hydrogen production from solar energy. Eni collaboration with MIT promotes the creation of technological and cultural synergies through a multidisciplinary approach. In particular, the cooperation between MIT researchers and those of the Research Center for Non Conventional Energy, Eni Donegani Institute, promotes the exchange of expertise through the pursuit of common objectives. In addition to the SFC, Eni supports projects in energy research at MIT on traditional hydrocarbons, methane hydrates, global climate change, and transportation options.

Strategic Partnerships
(continued)

Ford Motor Company
Ford and MIT have been collaborating since the 1950s. In 1998 the Ford-MIT Alliance was formalized and has created a model for mutually beneficial university-corporate research. Ford and MIT collaborate on a broad range of technical, business, and policy topics focused on the future of transportation, including: vehicle autonomy, active safety, materials science, energy storage, powertrain efficiency, enterprise modeling, and health and wellness.

Novartis
Novartis and MIT have launched a long-term research collaboration aimed at transforming the way pharmaceuticals are produced. The partnership, known as the Novartis-MIT Center for Continuous Manufacturing, will work to develop new technologies that could replace the conventional batch-based system in the pharmaceuticals industry—which often includes many interruptions and work at separate sites—with continuous manufacturing processes from start to finish. The Novartis-MIT Center for Continuous Manufacturing combines the industrial expertise of Novartis with MIT's leadership in scientific and technological innovation.

Project Oxygen Alliance
A partnership among the MIT Computer Science and Artificial Intelligence Laboratory and six corporations—Acer, Delta Electronics, Hewlett-Packard, Nippon Telegraph and Telephone, Nokia Research Center, and Philips Research—Project Oxygen's goal is to make computation and communication resources as abundant and easy to use as oxygen. Working also with support from the Defense Advanced Research Projects Agency, the project seeks to free people from computer jargon, keyboards, mice, and other specialized devices they rely on now for access to computation and communication. For example, the researchers are creating speech and vision technologies that enable humans to communicate as naturally with computers as they do with people.

Quanta Computing
Taiwan-based Quanta Computer Inc., the world's largest original design manufacturer of notebook computers, and MIT Computer Science and Artificial Intelligence Laboratory began the T-Party project collaboration in 2005. The goal of this project is to make the dream of having complete access to your own personalized environment—your notes, presentations, music, TV recordings, photo albums, recipes—from anywhere in the world, anytime a reality. The technologies they are exploring to support their vision fall into five categories: connectivity, devices, applications, automation, and natural interactions.