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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 on the Entrepreneurial Impact 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.

The Technology Licensing Office

For decades, MIT’s Technology Licensing Office has helped MIT faculty and researchers with patenting, licensing, and starting firms that build upon technology developed at MIT. In FY2011, MIT received 153 U.S. patents and filed 187 new U.S. patent applications. (See page 11 for more detailed TLO statistics.)

Industrial Liaison Program/Office of Corporate Relations

MIT has long held that breakthrough research hinges on open, consultative dialogue. The Office of Corporate Relations’ Industrial Liaison Program (ILP) was established in 1948, making MIT the first academic institution with a formal program designed to nurture university/industry collaboration. For six decades, the ILP has connected member companies with the latest research developments at MIT and enabled industry to support the Institute’s research and educational activities. Industry-sponsored research at MIT totaled \$110 million in FY10, or 15% of all MIT research funding.

The Deshpande Center for Technological Innovation

Established in 2002, the Deshpande Center is a Proof of Concept Center (POCC) that trains university faculty and researchers in forming companies and commercializing technologies. The center helps bridge the gap between basic research and a valid proof of concept. This training reduces technology risks and market risks so investors feel comfortable committing the resources to develop the technology outside of the university. Since 2002, The Center has funded more than 80 projects with over \$10 million in grants. Twenty projects have spun out of the center into commercial ventures, collectively raising more than \$180 million in outside financing and employing more than 200 people.

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 year-long educational experience designed to encourage MIT students to act on their talent, ideas, and energy to produce tomorrow’s leading firms. Since the \$100K competition was founded in 1989, it has served as the launch pad for more than 120 companies, which have generated over \$16 billion in market value and created over 4,000 jobs.

¹Roberts, E. and Eesley, C; Entrepreneurial Impact: The Role of MIT; The Kauffman Foundation, February 2009 (<http://www.kauffman.org/research-and-policy/mit-entrepreneurs.aspx>)

MIT Entrepreneurship Center

Proposed in 1990 by the then Dean of the MIT Sloan School of Management as a center to support entrepreneurship across the five Schools at MIT, the Entrepreneurship-Center (E-Center) creates great value for its stakeholders by connecting technologists and business people and fostering an environment that helps them accelerate the creation of new companies together. The E-Center's educational and networking programs help instill in students the skills and attitudes it takes to succeed as entrepreneurs. The E-Center also builds alliances between MIT entrepreneurs and local corporate and venture capital leaders, building a community of academic, government, and industry leaders focused on entrepreneurial ventures.

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. Since its launch in 2000, more than 1,400 entrepreneurs involved in nearly 800 ventures have enrolled in VMS mentoring. Of these, more than 130 have advanced to become operating businesses.

Benefits to the National Economy

In 2009, the Kauffman Foundation of Entrepreneurship released a study on MIT's Entrepreneurial impact on the nation's economy. The study found that the five states benefiting most from MIT-related jobs were Massachusetts, with just under 1,000,000 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 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 reported that 30 percent of foreign students who attend MIT found companies at some point in their lives. It stated 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."

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 Professor Alfredo Alexander-Katz and was funded by a grant from DuPont and grants from the German Government. <http://web.mit.edu/newsoffice/2009/micro-ants.html>

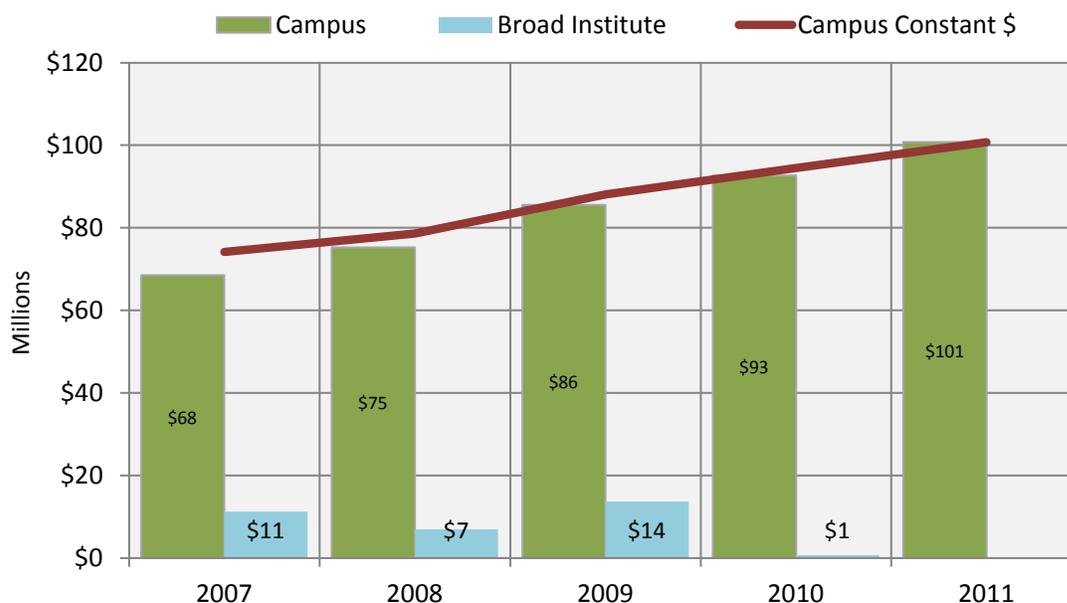
Closing in on Bionic Speed

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. Now MIT researchers, led by Sidney Yip, professor of nuclear engineering and materials science and engineering, 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.

MIT Campus Research Expenditures Fiscal Years 2007-2011

*The Broad Institute separated from MIT on July 1, 2009 and no longer receives funding through MIT. The chart below displays both campus research expenditures and Broad Institute research expenditures funded through MIT.

Research Expenditures	2007	2008	2009	2010	2011
Campus	\$68,482,744	\$75,259,081	\$85,562,146	\$92,649,701	\$100,762,512
Broad Institute	\$11,242,651	\$6,935,104	\$13,656,981	\$680,132	
Total Industry	\$79,725,395	\$82,194,185	\$99,219,127	\$93,329,833	\$100,762,512
Constant \$	\$74,168,788	\$78,595,403	\$88,124,899	\$94,510,126	\$100,762,515



Constant \$ calculated using the CPI-U weighted for the fiscal year with 2011 = 100

Leading Departments, Laboratories, and Centers Receiving Support in the Most Current Year

MIT Energy Initiative
 Chemical Engineering
 Computer Science and Artificial Intelligence Laboratory
 Media Laboratory
 Mechanical Engineering
 Sloan School of Management
 The Koch Institute for Integrative Cancer Research
 Aeronautics and Astronautics
 Center for Technology, Policy, and Industrial Development
 Research Laboratory of Electronics

Sponsored Research

MIT is a leader in conducting research sponsored by industry. More than 400 corporations supported research projects on the MIT campus in FY 2010, with expenditures exceeding \$110 million. Companies often join together in these collaborations to support multi-disciplinary research programs in a wide range of fields.

Service to Industry

Deshpande Center for Technological Innovation

The Deshpande Center for Technological Innovation nurtures marketable inventions by engaging industry to spark inventions that solve existing needs, and by funding proof-of-concept explorations with Ignition Grants. The Center fuels market-driven innovation by funding research with Innovation Grants, getting the business community involved at an early stage to help shape the direction of research, and by educating the research community about commercialization. It also implements innovation in the marketplace by catalyzing collaborations, directing researchers to appropriate business and entrepreneurial resources, and serving as a liaison between MIT and the local business community.

The Industrial Performance Center

The Industrial Performance Center supports interdisciplinary research and education aimed at understanding and improving industrial productivity, innovation, and competitiveness. Faculty and students from all five MIT schools participate in its programs. Since its founding in 1992, the Center has conducted research at more than 1,000 firms in major manufacturing and service industries in both advanced and emerging economies.

Leaders for Global Operations

Leaders for Global Operations (LGO) is an educational and research program that the MIT Sloan School of Management and the School of Engineering conduct in partnership with more than 25 global manufacturing and operations companies. The program educates new leaders in manufacturing and operations, and advances the understanding of manufacturing and operations principles. LGO views these two functions in the broadest sense, from product concept through delivery. Its 24-month program leads to two Master of Science degrees – one in engineering and the other in management. Students work with faculty in both schools and take part in activities that include six-month internships at partner companies.

MIT Center for Biomedical Innovation

An Institute-wide collaboration of faculty from the MIT Schools of Engineering, Management, and Science, the Harvard-MIT Division of Health Sciences & Technology, and their counterparts from government and industry, the MIT Center for Biomedical Innovation addresses the challenges of translating advances in the life sciences more efficiently and safely, from the laboratory to the public. The center provides a “safe harbor” in which major players across the biomedical spectrum – from medical researchers to federal regulators, payers, and experts in finance and marketing – can better appreciate each other’s concerns and communicate and collaborate more effectively.

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. MISTI programs are organized by region. The first one established, MIT Japan, today is the largest center of applied Japanese studies for scientists and engineers in that country. Other programs are in China, France, Germany, India, and Italy. MISTI also supports conferences and workshops that promote international learning and research at MIT, and provides training for corporations.

MIT Sloan Fellows Program in Innovation and Global Leadership

The MIT Sloan Fellows Program in Innovation and Global Leadership is a 12-month, full-time program for high-potential mid-career managers with strong technical and entrepreneurial backgrounds. Integrating management, technology, innovation, and global outreach, the program provides students with a rigorous academic curriculum, frequent interaction with international business and government leaders, and an exchange of global perspectives that enables them to develop their capacities as global innovators. The program attracts people from all over the world from a wide variety of for-profit and nonprofit industries organizations, and functional areas. Students can earn an M.B.A., an M.S. in management, or an M.S. in the management of technology.

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.

Professional Education Programs

To meet industries' need to bring large groups of employees up to speed in new or evolving areas of knowledge, in 2002 the MIT School of Engineering established its Professional Education Programs (PEP). An extension of MIT's Professional Institute (see following entry), PEP offers Internet-based courses that employees can participate in at their home institutions without traveling to Cambridge. MIT faculty also work with corporations to design customized curriculums that meet their specific needs, including those that integrate management with technological advances.

Professional Institute

Founded in 1949, MIT's Professional Institute (PI) brings more than 600 technical, scientific, business, and government professionals from around the world to campus each year for two- to- five-day courses that allow them to develop working knowledge in rapidly evolving technologies, industries, and organizational structures. PI's more than 40 courses, which can involve lectures, discussions, readings, interactive problem solving, and laboratory work, cover a broad range of topics, such as hydrologic modeling, bioinformatics, nanostructured fluids, supply chain network optimization, scientific marketing, and high-speed videography. Recent PI participants include employees from Amgen, Archer Daniels Midland, Johns Hopkins Applied Physics Lab, Kimberly-Clark Corporation, Nagoya City University, San Mateo County Transit District, Delft University of Technology, and the Department of Defense.

System Design and Management

System Design and Management (SDM) 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. This flexibility has made it possible for people like a captain in the U.S. Army commanding a division in Iraq, a captain in the Hellenic Air Force, or a General Electric aerospace engineer in Cincinnati to take advantage of SDM's technical, engineering, and management breadth. More than 50 companies and organizations from a wide range of fields have sponsored students in this program.

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.

Dupont

Established in 2000 and extended in 2005, the DuPont MIT Alliance (DMA) brings together each institution's strengths in materials, chemical, and biological sciences to develop new materials for bioelectronics, biosensors, biomimetic materials, alternative energy sources, and other high value substances. DuPont also works with MIT's Sloan School of Management to define new business models for these emerging technologies. Among DMA's accomplishments is a device for the tissue-like culturing of liver cells that provides a medium for testing the material similar to the toxicity of new pharmaceuticals. Another is the development of a material similar to the water-repellent surfaces of lotus leaves, which has potential for applications like self-cleaning fabrics, water-repellent windshields, and plumbing that resists the growth of harmful bacteria. To date, MIT and DuPont scientists have applied for more than 40 patents based on their research. In its second stage, DMA has moved into nanocomposites, nanoelectronic materials, alternative energy technologies, and next-generation safety and protection materials.

Ford Motor Company

Since it was launched in 1997, the Ford-MIT Alliance has joined MIT and Ford researchers on a wide range of education and research projects that emphasize environment and design. Built on a long history of working together, the alliance grew from a recognition that changes brought about by globalization and the impact of advanced information technologies require new models of university/industry collaboration. The more than 80 research projects supported by the Ford-MIT Alliance include climate and environmental research, the development of cleaner engine and fuel technologies, computer-aided design, and automobile voice recognition systems, such as the one MIT and Ford researchers are working on to allow drivers to direct their autos' navigation systems by speaking, rather than by entering the information with keystrokes.

Hewlett-Packard Company

With the ultimate goal of expanding the performance and flexibility of the commercial, educational, and personal services that digital information systems provide, Hewlett-Packard and MIT established an alliance in 2000 to investigate new architectures, devices, and user interfaces, and to develop new ways to create and handle digital information. The HP/MIT Alliance has helped launch Dspace, the MIT Libraries' pathbreaking digital archive which opens up the intellectual output of MIT faculty and research staff to researchers around the world. It also supports the MIT Ultra-Wideband group, which is advancing UWB communication, and the MIT Center for Wireless Networking, which explores ways to expand the capabilities of wireless appliances and the networks and server architectures that they use.

Microsoft Corporation

Called iCampus, the Microsoft/MIT collaboration supports projects among Microsoft researchers and MIT students, faculty, and staff that advance IT-enabled teaching models and learning tools for higher education. Established in 1999, iCampus has funded dozens of faculty and student projects. Among its products are a new course in introductory physics; a Web-accessible microelectronics teaching laboratory; and a new tool for environmental researchers in the field – an electronic notebook that makes it possible to streamline data collection and improve its accuracy. This breakthrough was the product of a student-designed course set up with iCampus funding specifically for developing a software application that would enable environmental scientists to dispense with paper notebooks, gather data electronically, integrate it with environmental and GPS sensors, and carry out computations in the field. The tool also lets them transmit data wirelessly to a remote server, where not only are their records invulnerable to the hazards of wind, water, and other factors that make data collection in the field precarious; they also are readily available to other researchers.

Pirelli Labs

Working on the MIT campus and in Pirelli Laboratories near Milan, Italy, scientists from both organizations are collaborating on a new generation of nanotechnology integrated optical systems. By miniaturizing the components and using all of the wavelengths available in a fiber optic cable to maximize the amount of data transmitted on each fiber, this technology will both dramatically reduce manufacturing and delivery costs and make it possible to provide enormous broadband capacity to consumers. The collaboration's ultimate goal is to provide residential subscribers highest-quality broadband telecommunication services and much lower cost.

Project Oxygen Alliance

A partnership among the MIT Computer Science and Artificial Intelligence Laboratory and six corporations – the Acer Group, Delta Electronics, Hewlett-Packard, Nippon Telegraph and Telephone, Nokia, and Philips – Project Oxygen's goal is to make computation and communication resources as abundant and as 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. The researchers are creating, for example, speech and vision technologies that enable humans to communicate as naturally with computers as they do with people. They are developing centralized networks and robust software/hardware architectures that can adapt to mobile uses, currently available resources, and varying operating conditions. Researchers also are at work devising security and privacy mechanisms that safeguard personal information and resources.

Quanta Computing

In today's computing environment, people using personal service technologies must navigate among an array of devices – from cell phones to computers to personal digital assistants. In 2005, MIT and Quanta Computing established Project TParty to address this complexity. Engineers from Quanta are collaborating with researchers from MIT's Computer Science and Artificial Intelligence Laboratory to design new platforms for computing and communication, reengineer and extend the underlying technical infrastructures, create new interfaces, and explore new ways of imaging, accessing, and integrating information. Their goal is to design new products that will make the personal use of computer technologies much easier and more productive.

