

## MIT Portugal Program

The [MIT Portugal Program](#) (MPP) is one of MIT's largest international partnerships. It was launched in 2006 by the Portuguese government and MIT as a "strategic investment in people, knowledge, and ideas" to strengthen the country's knowledge base and international competitiveness in key focus areas. MPP involves Portugal's leading six universities alongside MIT, several public sector institutions, and national and international industry partners in a unique consortium structure.

In 2013, the Portuguese government and the Portuguese Science Foundation (FCT) renewed their commitment to the MIT partnership, leading to the signing of a contract for a second phase that will carry the relationship through 2017. The renewal builds on six years of successful collaboration between faculty and students at MIT and in Portugal and underscores the central role of the program in the country's scientific, technological, and socioeconomic development. It further spotlights the impact that MIT researchers have had on government, academia, and industry in Portugal. The first program phase was focused on the establishment of seven new graduate programs, the recruitment of top national and international students, the creation of national research clusters around four engineering systems focus areas, and the facilitation of institutional change for greater innovation and entrepreneurship efforts at Portuguese universities. Building on the significant achievements of the first phase, the second phase will emphasize critical mass research in the unique test beds and will accelerate performance in innovation, entrepreneurship, and industry partnership.

At MIT, MPP is hosted by the Engineering Systems Division. It was founded by professor Daniel Roos, who passed on its leadership to professor Dava Newman in 2012. To date, the program has enrolled more than 550 students in Portugal, supported more than 300 students at MIT, and involved 270 faculty in Portugal as well as 70 faculty at MIT. MIT faculty and research staff come from departments in all five schools. This broad expertise and institutional support has played a significant role in the success the MIT Portugal Program.

### Education

MPP plays a significant and ongoing role in Portugal's effort to reform and internationalize its science and engineering training, an undertaking aimed at educating future leaders in the knowledge-based economy, bringing about economic development and addressing pressing social challenges.

MPP offers a portfolio of graduate degrees to which MIT standards are applied. The program's four PhD and three executive master's programs focus on four areas of significance to engineering systems thinkers: bioengineering, engineering design and advanced manufacturing, sustainable energy systems, and transportation systems. Courses are co-taught by faculty at Portuguese institutions and by MIT faculty, and students have opportunities to conduct research at MIT-collaborating laboratories during their doctoral programs. Consortia of universities throughout Portugal have been

formed to establish these degree programs—the first such university collaborations in Portugal and the first to grant national degrees.

Thousands of students worldwide have applied to MPP's degree programs since the start of the program. As of spring 2013, the program had 371 doctoral students and 46 master's students, from more than 30 countries, who will soon add to its 151 graduates. The program has hosted a total of 162 visiting students at MIT, and five faculty on extended visits in the 2012–2013 period.

MIT Portugal has taken seriously the challenge of connecting engineering education to innovation, entrepreneurship, and industrial needs. All seven education tracks include some economic and business aspects of engineering, as well as training in policy, innovation management, and leadership. Designed with input from industry, the curricula have attracted a markedly different student body with more background and interest in industry work than those in comparable programs. Industry-based theses and internships provide a competitive advantage to more than 50 program partners.

### **Innovation Ecosystem**

In 2010, MPP launched the Innovation and Entrepreneurship Initiative (IEI) as a collaboration among the Instituto Superior de Ciências do Trabalho e da Empresa/ Instituto Universitário de Lisboa, the Deshpande Center for Technological Innovation, the MIT Entrepreneurship Center (E-Center), and the School of Engineering. IEI adapts elements of MIT's entrepreneurial ecosystem to MPP to expose participants to challenges and opportunities associated with technology commercialization, complementing MPP's education initiatives. IEI has three broad aims: to create new business ventures from emerging technologies, to support the expansion of the Deshpande and E-Centers' innovation teams (i-Teams) approach across MPP, and to design and implement a series of meetings and events to showcase technological innovations in Portugal.

IEI's flagship initiative is the [Building Global Innovators](#) (BGI) venture competition, held annually in Portugal. BGI selects, supports, and directs startups in four tracks. Each of the four track finalists is awarded up to €100,000, with an opportunity to double the award, for a total of up to €1,000,000 in track finals, grand finale, and venture phase awards. BGI holds a number of specifically designed events, among which are the e-teams crash course I, II, and III, or interactive “go-to-market” workshops designed by professor Fiona Murray (associate director of the E-Center) and research scientist Luis Perez-Breva, co-faculty directors of i-Teams. In the first three editions since March 2010, BGI has received 287 submissions from 27 countries, and semifinalists have raised over €15 million in venture capital, resulting in the creation of over 150 jobs.

For the third edition (2012–2013), the jury selected Veniam from the sustainable energy and transportation systems track as the winner of the grand finale. Veniam sells a low-cost box that once plugged into existing vehicles can turn cars, taxis, buses, and trucks into mobile hotspots. The fourth edition was launched successfully in summer 2013.

## Research

The consortium created by MPP connects six Portuguese universities with 20 Portuguese research centers and national associated laboratories. These consortia, working with laboratories and departments at MIT, have developed an array of leading-edge research projects that are carried out at MIT as well as in Portugal by program faculty, students, and industry affiliates. Research focuses on three application areas: sustainable energy and transportation systems, stem cell engineering for regenerative medicine, and materials and design-inspired products. This research includes developing renewable sustainable energy systems, designing alternative modes of transportation that are both energy efficient and effective, and developing next-generation biomedical products and therapies.

FCT-funded research projects targeting the program's three application areas are being carried out by joint teams that include MIT faculty and staff and researchers from various Portuguese institutions and companies. The highlights below illustrate a few of the exciting directions that have emerged from these MPP research efforts.

### Stem Cell-based Therapies

The Mesenchymal Stem Cell-based Therapies project applies cross-disciplinary approaches to establish safer and more efficient methods to isolate and grow stem cells through optimization of culture conditions, reduction or elimination of animal-derived components, and controlling microenvironmental factors affecting cell growth. The team is evaluating the importance of three-dimensional scaffolds to sustain cell adhesion and proliferation. These scaffolds could ultimately be the basis for bioreactor design for clinical-scale culture of human mesenchymal stem cells.

### Tissue Regeneration

The Regeneration of Ischemic Tissues by Transplantation of Human Stem Cells and Biomaterials project is developing approaches for the regeneration of cardiac muscle after myocardial infarction (heart attack). Recent clinical data indicate that cardiac function may be improved with the application of stem cell therapies. This project is testing several strategies. One involves the transplantation of progenitor cells isolated from human cord blood, bone marrow, or human embryonic stem cells in three-dimensional scaffolds. Another uses cardiac patches to deliver biomolecules. A related goal of this cross-disciplinary project is to use stem cells and biomaterials for the regeneration of chronic wounds in diabetic patients.

### Medical Devices

The creation of the Health Cluster Portugal (HCP) reflects the growing importance of medical devices in Portugal. HCP is a private initiative bringing together more than 100 members: universities; research and development institutions; hospitals; public agencies; and companies in the sectors of medical devices, pharmaceuticals, biotechnology, and others. The medical device sector receives a great deal of attention within HCP, and MPP has already made significant contributions in this area. These include the development of a smart stent graft implanted by minimally invasive therapy and a novel ankle-foot orthosis to help patients recover lost mobility or to master movements they were previously unable to make.

## Transportation Systems Projects

Transportation systems research has focused on integrated systems, intelligent transportation systems, air systems, and high-speed rail systems. The program emphasizes crosscutting research and interdisciplinary collaboration. An emergent research strand on intermodal mobility strategies has examined issues across the transportation systems spectrum.

Highlights of some of the transportation systems projects include:

- Strategic Options for Integrating Transportation and Urban Revitalization: development and calibration of two integrated land use/transportation simulation models
- Smart Combination of Passenger Transport Modes and Services in Urban Areas for Maximum System Sustainability and Efficiency: assessment of new transportation modes and services, together with the implementation of parking enforcement policies and dynamic congestion schemes
- Exploration of Portugal's High-speed Rail and Economic Development Strategy Solutions.

Other highlights involve capturing uncertainty in biofuels for transportation—resolving environmental performance and enabling improved use and economic and environmental sustainability of electric vehicle systems

## Green Islands

The Azores, an archipelago of nine islands in the Atlantic, provides a real-world laboratory where the MIT Portugal Program is collaborating with the Regional Government of the Azores, the University of the Azores, and local energy suppliers to investigate ways of dramatically reducing fossil fuel use and greenhouse gas emissions. The Azores presents a natural test bed for designing and deploying integrated energy and transportation systems, whether on São Miguel Island, with its geothermal resources, or remote Corvo Island, where fuel delivery can be challenging in the winter.

Key insights from current research show many near-term benefits could result from implementing smart systems in the Azores, such as electricity storage, smart variable charging of electric vehicles, and efficient homes and businesses that respond to real-time island energy conditions. These technologies can help the islands' power grids operate more smoothly, thereby saving money and reducing emissions.

## Events

Each year, MPP hosts a number of high-profile events, both at MIT and in Portugal, to promote science and technology education and to help foster MPP student and researcher interactions with industry and the public. Several such events are highlighted below.

## National Week of Science and Technology

On November 20, 2012, MPP led discussion sessions and activities at the [National Week Dedicated to Science and Technology](#), at the Pavilhão do Conhecimento (Lisbon), focusing on how science and technology can affect three key areas of Portugal's future: cities, industry, and health. Questions addressed included: How can the scientific advances in the fields of bioengineering, regenerative medicine, and medical devices help us live longer and better? The increasing influx of people from rural areas to cities is putting a lot of pressure on large urban centers. How will our cities be organized efficiently? How do we differentiate our products and services in order to make them more innovative, and how will this impact industries in the near future?

## Visit by US Ambassador to Portugal, Allan J. Katz

With the intent to encourage investment and bilateral trade between the United States and Portugal, with particular focus in the Azores, US Ambassador to Portugal Allan J. Katz led a Business Development Road Show that included Massachusetts and Missouri. MPP participated as a partner in this six-day event (April 28–May 3, 2013), bringing 24 Portuguese companies and institutions to Boston, MA, and Kansas City, MO.

While in Boston on May 1, 2013, the ambassador and the Portuguese companies visited the Cambridge Innovation Center, followed by a meeting with the Mass Technology Leadership Council and the Mass High Technology Council. Jennifer Kratochwill and Flavia Cardarelli, of MPP, led visitors through the [MIT Media Lab](#), an interdisciplinary research laboratory. Later, Dava Newman, welcomed the ambassador and the Portuguese companies. The convoy had lunch with MPP staff and students, including those involved in the eTeams III @MIT program.

## Education, Employment, and Entrepreneurship Forum

The Education, Employment, and Entrepreneurship (E3) Forum, an international conference organized by MPP PhD students, was held in June 2013 at the Pavilhão do Conhecimento–Ciência Viva, in Lisbon. The main objective of the E3 Forum was to fill the gap between research and current practice, academic paths and “real world” problems, and to provide an opportunity to raise awareness about ongoing research projects. Students had the opportunity to present their work, build a contact network, and learn more about possible career paths in academia and industry, as well as the opportunity to hear success stories related to the creation of technology-based companies.

The forum featured a range of plenary and parallel sessions, awards, and keynotes. Speakers included Rosalia Vargas (executive director of Ciência Viva), Pedro Carneiro (a member of the board of directors at FCT), Cristina Godinho (head of the innovation department at the Efacec Group), Elisa Martin Garijo (director of technology and innovation at IBM), Mary O'Donovan (organization development director at Hovione), José Carlos Gonçalves (president of Portugal Outsourcing), and Ivo Yves Vieira (chief executive officer of Lusospace).

### **Special Seminar: Human Spaceflight–Exploration from Earth to Mars**

In October 2012, MPP director Dava Newman held a special seminar and public outreach talk on human spaceflight, at the Lisbon Planetarium.

### **Visit by Director of Scientific and Technological Platforms at Champalimaud Foundation**

Also in October 2012, the director of scientific and technological platforms at the Champalimaud Foundation, Tania Vinagre, visited MIT, discussing common interests between Portugal's largest private foundation, the Champalimaud Foundation, and MPP in the areas of scientific and technological innovation.

### **Keynote for European Science Television and New Media Awards**

MPP director Dava Newman delivered a keynote address at the European Science TV and New Media Awards in November 2012, at the Pavilhão do Conhecimento, in Lisbon.

### **Impact of the MIT Portugal Program**

#### **MIT Portugal Program Startup Companies**

*Biomode SA* was launched in 2010 as a result of participation in 2008 BioTeams innovation and entrepreneurship activity. The company secured funding from the venture capital fund InovCapital ACTec.

*Cell2B* is a biotechnology company specializing in the development of cell therapies for medical applications. The company is developing an immunomodulatory therapy to increase the success rate of transplantation, a procedure that affects 175,000 patients per year in Europe and the US, representing a potential market of three billion euros annually. The processing of cellular therapies for medical applications is the main activity of Cell2B, which aims to improve treatment and quality of life for its patients.

*Inside Building* was formed in January 2011, and is dedicated to energy certification activities and quality of technical management of buildings.

*Matera* was launched in 2009 by an MPP researcher, and focuses on the development of materials and surfaces with antimicrobial properties for biomedical, environmental, and industrial applications.

*MediaOmics* uses modern bioinformatics and systems biology tools to develop high performance, chemically-defined cell culture media for life sciences research institutions and industries. It is a pioneer company in cell functional enviromics sciences and derived technologies that has the unique capability of engineering cellular metabolism towards a desired state by manipulation of medium components.

*RetroSiM* (Retrofit Simulation Monitoring) aims to address the energy efficiency evaluation process through a building retrofit recommendation platform that makes it possible to scale and systemize the retrofit recommendation process, providing

users with the information to support the definition of intervention measures aimed at minimizing energy use in buildings in a cost-effective manner while satisfying the occupant and owner needs.

*SilicoLife* was established in April 2010 from that year's BioTeams activity, and develops computational tools and modeling to accelerate the optimization of bioprocesses in the biotechnology industry using metabolic engineering.

*Stematters* focuses its activity on the development and commercialization of novel regenerative therapies for bone and cartilage tissue engineering.

*TREAT U* is dedicated to the development of targeted nanotechnology-based platforms for the specific delivery of drugs (either small drugs or small interfering RNA) with technological advantages that outrun different products commercially available or in clinical trials, namely in the oncology area. *TREAT U*'s platforms are an appealing technology for the pharmaceutical industry and bring value to patients, physicians, and the healthcare system.

*Watt Intelligent Solutions* was formed in 2012 to provide high value-added services to the electricity supply undertakings and their customers, fostering energy efficiency and better management of energy consumption through detailed analysis of consumption data collected by smart meters.

### **Global Recognition**

In a recent independent assessment, the Finnish National Academy recognized MPP and its Portuguese sister collaborations as an excellent and commendable initiative, interesting to the entire European research area. The assessment called the program a model of good practice and applauded its many successes, including national collaboration, internationalization, and attention to quality. The academy found MPP to have a solid success record with regard to the three goals of collaborative research projects, excellence in teaching and training, and effective commercialization/entrepreneurship.

### **A Sustainable Network**

MIT Portugal has pioneered a globally unique model of collaborative education and research that unites Portugal's universities, industries, and government behind a shared agenda of excellence and innovation. On an institutional level, MPP has created strong, globally visible research clusters in key focus areas that are crucial to the future of Portugal. Students and faculty alike benefit from the dense consortium network and the high connectivity of the program with leading groups around the world.

### **Becoming a Model**

From its inception, MPP has strived to become a model international program where innovative research and educational programs from around the globe combine to

address some of today's greatest technical, economic, and social challenges. It has been both the driver and the result of important ongoing reforms of the Portuguese higher education system.

The program has left its mark in curriculum design and innovative practices at Portuguese universities—a mark that other programs now seek to emulate. MPP faculty share their program experience and practices, while the program as a whole has provided incentives for forming clusters of excellence and creating broader systemic change.

The international student body stands witness to the growing global visibility of Portuguese universities initiated by this unique transatlantic partnership. The MIT Portugal Program has added a distinctively Portuguese edge to the global science and innovation community.

**Dava Newman**

**Director**

**Professor of Engineering Systems and Aeronautics and Astronautics**