

## MIT Portugal Program

The [MIT Portugal Program](#) (MPP), launched in October 2006, is a strategic investment in people, knowledge, and ideas by the Portuguese government to strengthen the country's knowledge base and international competitiveness. This transatlantic collaboration involves MIT, together with government and academia in Portugal and global and Portuguese companies, in the development of education and research programs in engineering systems.

MPP is hosted by the Engineering Systems Division (ESD) and was founded by professor Daniel Roos. Professor Dava Newman currently serves as director of the program. MPP has faculty and research staff from departments in all five schools at MIT, as well as the Office of the Vice President for Research. This diversity of participation has played a large role in the success of MPP by providing expertise from many different fields of study.

### 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.

The program offers a portfolio of graduate degrees to which MIT standards are applied. MPP'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 studies. 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.

The MPP Education Innovation Awards were established in 2010 as part of a continuous effort to recognize and reward excellence in the design and delivery of educational programs in Portugal, and thereby give greater incentive to outstanding teaching as part of MPP's aim to ensure the quality of its degree programs.

Thousands of students worldwide have applied to MPP's degree programs since the start of the program. In spring 2012, the program had 307 registered doctoral students and 42 master's students from 28 different countries. The program has had 31 PhD graduates and 134 master's graduates, and has hosted 162 visiting students at MIT.

### Educating for Innovation

MPP has approached the challenge of connecting engineering education to innovation, entrepreneurship, and industrial needs very seriously. 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 that in comparable programs. Industry-based theses and internships provide a competitive advantage to more than 50 program partners.

### **MIT Portugal Program 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 (ISCTE-IUL), 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 Center and E-Center innovation teams (i-Teams) approach across MPP, and to design and implement a series of meetings and events to showcase technological innovations in Portugal.

More than 1,000 people have participated in MPP's innovation ecosystem, including innovators, industry experts, mentors, judges, catalysts, interviewees, sponsors, and speakers.

MPP's Venture Competition aims to foster the innovative and entrepreneurial spirit in Portugal. To highlight growing areas of entrepreneurial activity, the Venture Competition began with four tracks: sustainable energy and transportation systems; life sciences; information technology and the web; and products and services. Each of the four track finalists is awarded up to €100,000, and the finalists then compete during a televised event for an additional €100,000 award. During the venture phase, track finalist and grand finale awardees benefit from the direction of "catalysts," with an opportunity to double their award, for a total of up to €1,000,000 in track finals, grand finale, and venture phase awards. Awardees also benefit from an interactive "go-to-market" workshop, designed by professor Fiona Murray (associate director of E-Center) and research scientist Luis Perez-Breva, co-faculty directors of i-Teams.

Musikki was the 2012 winner of the ISCTE-IUL MIT Portugal Venture Competition. The specialized motor search provides users with all the information related to a musical artist or band, and that information is just a click away.

Winners and participants of the Venture Competition spend a week participating in eTeams III @MIT, an excursion into the MIT innovation ecosystem. The eTeams III @MIT curriculum provides practical advice on marketing and sales, as well as contributions from thought and practice leaders. Tangible outcomes from the visit include connections to potential partners (clinical and industrial) in the United States, an offer from the Cambridge Innovation Center to host the teams for up to a month, a large number of potential business contacts and peer advisors developed by the teams, and invitations to move forward on joint proposals with MIT faculty and/or entrepreneurs.

The sessions are complimented by networking events designed to hone pitching skills and expand the network of entrepreneurs and potential US partners for the visiting teams. The 2012 eTeams III week culminated with participation and networking at Deshpande Center's annual symposium, IdeaStream 2012, where the teams pitched their companies and networked with over 200 venture capitalists, angel investors, strategic investors, and founders.

## **Research**

The consortia created by MPP connect eight 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.

Portuguese Science Foundation (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 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 Innovations and Urban Revitalization (SOTUR): 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 (SCUSSE): 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 projects 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 Ocean, provide a real-world laboratory where MPP 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 present a natural test bed for designing and deploying integrated energy and transportation systems, whether on the islands of São Miguel, with its geothermal resources, or remote Corvo, 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.

## Personnel

MPP has attracted faculty and research staff from across MIT, including people from the following schools, departments, and programs:

School of Architecture and Planning:

- Department of Architecture
- Legatum Center for Development and Entrepreneurship
- Program in Media Arts and Sciences
- Department of Urban Studies and Planning

School of Engineering:

- Department of Aeronautics and Astronautics
- Center for Transportation and Logistics
- Department of Chemical Engineering
- Department of Civil and Environmental Engineering
- Computer Science and Artificial Intelligence Laboratory
- Deshpande Center for Technological Innovation
- Department of Biological Engineering
- Department of Electrical Engineering and Computer Science
- Engineering Systems Division
- Harvard/MIT Division of Health Sciences Technology
- Laboratory for Information and Decision Systems
- Materials Processing Center
- Department of Materials Science and Engineering
- Department of Mechanical Engineering
- MIT-Portugal Program
- Sociotechnical Systems Research Center

School of Humanities, Arts, and Social Sciences:

- Anthropology Program
- Department of Economics
- History Section
- Department of Political Science
- Program in Science, Technology, and Society
- SHASS Department Heads

School of Science:

- Department of Biology
- Department of Brain and Cognitive Sciences
- Department of Physics

MIT Sloan School of Management:

- Martin Trust Center for MIT Entrepreneurship

Office of the Vice President for Research:

- David H. Koch Institute for Integrative Cancer Research
- MIT Energy Initiative
- Operations Research Center
- Technology Licensing Office

Institute Professors

Industrial Liaison Program

MIT Enterprise Forum

MIT Venture Mentoring Service

## Events

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

### **Visit by Ambassador João Mira Gomes, Portugal's Representative to NATO**

Ambassador João Mira Gomes of Portugal, permanent representative to NATO, visited the MIT campus in March 2012 to meet with faculty and students from MPP, in advance of the NATO summit in Chicago in May. He spoke about some of the key challenges in

the global community. Ambassador Mira Gomes and the students discussed some of the major challenges in terms of international security, including issues of petroleum, immigration, poverty, and nuclear proliferation. He emphasized the complexity of each challenge and the need for international collaboration in determining effective responses.

### **Visit by Paulo Portas, Portugal's Minister of Foreign Affairs**

Portugal's minister of foreign affairs Paulo Portas visited the MIT campus in June 2012 and met with an MIT delegation that included provost L. Rafael Reif, School of Engineering dean Ian Waitz, directors of MPP, and MPP faculty. Following this meeting, Foreign Minister Portas addressed a crowd of more than 200 people to discuss the economic situation in Portugal and the European Union. He lauded MIT as a "cathedral of innovation" and heralded the "immense number of interesting projects" stemming from MPP. "I believe the MIT Portugal Program is very helpful to internationaliz[ing] Portuguese enterprises, Portuguese business, and Portuguese startups," he said during the event's question and answer session. "I believe in scientific cosmopolitanism and international innovation... I believe this program can open our economy, open our universities, open our enterprises, and open our scientists."

### **MIT Portugal Program Third Program-wide Conference—Universidade do Minho, Guimarães**

The theme of the May 2012 MPP conference was Excellence in Engineering for Innovation in Global Markets. The conference was attended by students, researchers, business leaders, and others.

The conference was opened by rector António Cunha, Universidade do Minho, and Miguel Seabra, president of FCT. Professor Ernest Moniz delivered the keynote lecture, titled "Climate and the Clean Energy Future: Opportunity or Train Wreck." Many of the session titles reflected the positive impact MPP has had in Portugal: Innovation for Economic Development; Economic Impact and Case Studies (all presented by industry partners or startups spun out of MPP); Scientific and Technological Impacts: Opening New Dimensions.

One of the highlights of this year's conference was the poster and pitch presentations by MPP students. Students from the second year onward prepared poster presentations of their ongoing research plans, providing a unique opportunity for an interactive discussion with MPP faculty, industry participants, and fellow colleagues. Close to 80 works were on display and judged by an MIT faculty panel that elected the six best posters for a pitch presentation during the conference's second day. The students had 10 minutes to present their work to an attentive audience that then cast its votes. First place was awarded to Paulo Melo, a bioengineering PhD student at Instituto Superior Técnico, for his presentation Muscle Dynamics Identification for Functional Electrical Stimulation Control Applications.

## Education, Employment, and Entrepreneurship (E3) Forum

The E3 Forum, an international conference organized by MPP PhD students, was held on June 28, 2012, at the Pavilhão do Conhecimento–Ciência Viva, in Lisbon. The forum's main objective 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.

In addition to professor Leonor Parreira, Portugal's secretary of state for science, international speakers included Murat Isikveren (head of the Energy and Buildings Research Program, Veolia Environnement), António Portela (chief executive officer, Bial), Brock Reeve (executive director, Harvard Stem Cell Institute), António Murta (managing partner and cofounder, Pathena), Nathan Kievman (LinkedIn specialist; founder, Linked Strategies), Luis Barros (International Innovation and Entrepreneurship Initiative–MIT), among others.

## Impacts of the MIT Portugal Program

### MIT Portugal Startup Companies

*Biomode*: Participation in 2008 BioTeams innovation and entrepreneurship activity led to the December 2010 launch of Biomode SA. The company secured funding from the venture capital fund InovCapital ACTec.

*Cell2B*: A biotechnology company founded in 2011 and specializing in the development of cell therapies for medical applications, Cell2B 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 3 billion euros annually.

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

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

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

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

*Watt-IS*: Watt Intelligent Solutions was formed in 2012 and is dedicated to providing high value-added services to the electricity supply undertakings and its 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, of interest to the whole European research area. The assessment cited the program as 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 very solid success record with regard to three goals: collaborative research projects, excellence in teaching and training, and effective commercialization and entrepreneurship.

### **A Sustainable Network**

MPP 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 for 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**