MIT and Masdar Institute Cooperative Program

MIT works with the Masdar Institute of Science and Technology to facilitate the development of human capacity in science and technology in Abu Dhabi. Now in its second phase, the Masdar Institute is helping develop a high-caliber workforce focused on research and development that can address grand challenges and underpin economic development in alternative energy and sustainable advanced technologies.

Objectives

From July 1, 2013, to June 30, 2014, MIT and the Masdar Institute continued to focus on:

- Developing a robust Masdar Institute research ecosystem for industry/government engagement by implementing joint researcher-to-researcher projects
- Leveraging the Masdar Institute's signature emphasis on advanced energy and sustainability to build educational links to industry and assist in the selection of new degrees and tracks within existing programs
- Seeding an innovation and entrepreneurship environment in terms of developing research mechanisms to engage industry and developing educational elements to amplify research impact
- Deepening the relationship between the Masdar Institute and MIT by engaging in co-advising of PhD students, student exchanges, and summer programs for institute students at MIT

Academic Programs

The educational mission of the Masdar Institute follows directly from the Institute's vision and mission: to provide students with the knowledge, skills, and experience necessary for successful careers in industrial or academic roles in their chosen fields, and with domain expertise and broad awareness in advanced energy and sustainable technologies and policies.

The structure of the academic programs is designed to encourage students and faculty to study and research across program boundaries. This enables researchers to tackle complex problems in energy and sustainability that cannot be confined to single disciplines. The master of science degree programs currently offered at the Masdar Institute were developed with assistance from MIT. In addition to the eight ongoing master of science programs, MIT worked with the institute to add a ninth, sustainable critical smart infrastructure, that began instruction in fall 2014. MIT also continued to assist the institute in establishing a chemical engineering practice option that will be operational in 2015.

MIT continued to advise on the curricula and structure of the Masdar Institute's accredited doctor of philosophy in interdisciplinary engineering. MIT faculty are currently serving on 18 of the institute's PhD student doctoral committees.

MIT has provided scholarly assessments for the hiring of 78 faculty: 38 at the assistant level, 22 at the associate level, 12 at the full professor level, and six professors of the practice.

Students

The Masdar Institute's enrollment reached 426 students in May 2014, with substantial growth from 231 students in September 2012. Students came from over 22 different countries.

Current Research Activities

The program is committed to building a thriving collaborative research environment and focuses on two distinct processes that contribute to and support the development of focused research centers at the Masdar Institute.

Masdar Institute and MIT One-to-One Joint Collaborative Research

One-to-one research builds upon and strengthens the strong relationship between the Masdar Institute and MIT and involves one MIT principal investigator (PI) and one Masdar Institute PI. Fifty one-to-one projects have been undertaken jointly by the institute and MIT. Currently there are eight active projects, with the following three awarded in 2013–2014:

- Natural Hazard Consideration for Abu Dhabi Transportation Infrastructure (June 1, 2014–May 31, 2016; professors Herbert Einstein and Joseph Sussman of MIT and professor Rita Sousa of the Masdar Institute)
- The Economic Impact of Advanced Technology and Automation on Oil and Gas Sector (July 1, 2013–June 30, 2105; professor Erik Brynjolfsson of MIT and professor Yousef Alhammadi of the Masdar Institute)
- Novel Control Strategies for Smart Grid Interface with High Penetration of Wind Power Generation (June 1, 2014–May 31, 2016; professor James Kirtley of MIT and professor Jimmy Peng of the Masdar Institute).

Masdar Institute and MIT Flagship Research Projects

The flagship research projects are a mechanism for broader collaborative research between the Masdar Institute and MIT. They are designed to bring together teams of faculty from the institute and MIT to address key strategic research areas with the intent of building critical mass, making a sizeable research impact, and fostering the strategic growth of Masdar Institute research centers. A total of nine flagship projects have been awarded to date. Six projects were added between July 2013 and June 2014:

- Information and Decision Architectures for Robustness, Resilience, and Risk Mitigation in Power Grids (July 1, 2013–June 30, 2016; MIT principal investigators: Dr. Munther Dahleh, Dr. Madavij Roozbehani, Dr. Asuman Ozdaglar, and Dr. Konstantin Turitsyn)
- BIOREFINERY—Integrated Sustainable Processes for Biomass Conversion to Biomaterials, Biofuels, and Fertilizer (July 1, 2013–June 30, 2016; MIT principal

investigators: Dr. George Stephanopoulos, Dr. Kristala Prather, Dr. Bradley Olsen, and Dr Yuriy Roman)

- High Performance Compact Solar Thermal Power and Cooling System (July 1, 2013–June 30, 2016; MIT principal investigators: Dr. Evelyn Wang, Dr. Gang Chen, and Dr. Nicholas Fang)
- Full Spectrum Solar Energy Water Splitting for Storable Fuel Generation (June 1, 2014–November 30, 2016; MIT principal investigators: Dr. Sang-Gook Kim, Dr. Yang Shao-Horn, and Dr. Alexie Kolpak)
- Development of Advanced Microclimate and Urban Energy Analysis Modeling Environment and Its Validation by Wide Area Sensor Networks and Remote Sensing for Future Adaptation of Urban Infrastructure (June 1, 2014–November 30, 2016; Dr. Leslie Norford, Dr. Christoph Reinhart, and Dr. Steven Leeb)
- Advanced Thermal Energy Storage System Directly Charged by Concentrated Solar Power (June 1, 2014–November 30, 2016; Dr. Alex Slocum, Dr. Charles Forsberg, and Dr. David Trumper).

Accomplishments

During this reporting period, an additional 13 MIT faculty participated in the program (for a total of 115), along with 12 additional research scientists or postdocs (for a total of 62). These researchers are from 24 different centers, labs, and departments at MIT. No posting to Abu Dhabi is required.

An additional 31 MIT students were supported by the program, raising the total number to 227; these students, from 19 different departments, labs, and centers, have had funded interactions with Masdar Institute faculty, students, and staff.

MIT students traveling abroad under the program participated in over 40 conferences and workshops.

The program has helped build experience and capacity at MIT for collaborative institution building and research.

An additional 10 visits to Abu Dhabi by MIT faculty and staff took place during this reporting period, bringing the total number of visits to 160; an additional 11 visits to MIT by Masdar faculty and staff took place, bringing that total to 161.

Masdar Institute and MIT participants authored 15 peer-reviewed journal articles, for a total of 81 to date. In addition, Masdar Institute faculty independently authored more than 50 papers during this reporting period.

“Stochastic Testing Method for Transistor-Level Uncertainty Quantification Based on Generalized Polynomial Chaos,” authored by MIT professor Luca Daniel and Masdar Institute professor Ibrahim M. Elfadel (together with Dr. Tarek A. El-Moselhy and Zheng Zhang), won the prestigious Donald O. Pederson Best Paper Award from the Institute of Electrical and Electronics Engineers (IEEE).

Two additional Masdar Institute faculty members spent time at MIT over the reporting period, bringing the total number to 55.

MIT interviews all faculty and senior-level Masdar Institute administrators. The current number of Masdar faculty is 82. Also, MIT reviewed and provided scholarly assessments of an additional 26 suggested elective courses at the institute, raising that count to 107 elective courses.

The Masdar Institute has filed over 120 utility patents, invention disclosures, and provisional patents.

Impact of Social and Cultural Policies and Events

The success of the Masdar Institute is highly dependent on the government's acceptance of the notion of a private, not-for-profit, research-based university operating in Abu Dhabi. The Masdar Institute is an agent of change for the diversification of the Abu Dhabi economy, but change is never easy, and long-term commitment is crucial with respect to human capital development, institutional independence and flexibility, and financial support. This applies to all aspects of building a research-based university.

Over the last year, several events have been organized to foster connections with government and industry stakeholders and to further build strong connections between the Masdar Institute and MIT. A particularly important effort is to foster the building of an ecosystem supporting entrepreneurship and innovation that can help bring about the economic transformation desired in Abu Dhabi and the United Arab Emirates (UAE).

On March 24, 2014, the Masdar Institute and MIT hosted a one-day symposium, Perspectives on Sustainable Critical Infrastructure. The symposium aimed to highlight challenges and opportunities in developing critical infrastructure sustainability. Discussions centered on how integration and interdisciplinary approaches early in the design stage allow for better utilization of limited resources and how this integration can provide tangible results in three critical infrastructure areas: transportation systems, supply chains and logistic systems, and urban planning and operations.

In April 2014, the MIT and Masdar Institute Cooperative Program jointly sponsored the second UAE Workshop on Innovation and Entrepreneurship with the Masdar Institute. In June, MIT conducted an entrepreneurship boot camp, From Academic Laboratory to Commercial Marketplace, in Abu Dhabi. The purpose of the boot camp was to provide Masdar Institute faculty and graduate students with tools to help them translate their exciting ideas from their emerging technology into a product that meets a consumer need.

On April 15, 2014, MIT president Rafael Reif visited the Masdar Institute and presented a lecture titled "Science, Technology, and Education: Research Universities as Engines of a Modern Economy." Dr. Reif visited with government leaders, academicians, and industrialists to promote the view that investment in research universities brings forth new knowledge and human capital, which in turn accelerates innovation.

On June 2, Massachusetts governor Deval Patrick led a group of the Commonwealth's government and industry leaders on an innovation mission to the United Arab Emirates to expand opportunities between the Commonwealth and the UAE for economic development and job creation, focusing on the innovation economy sectors. The governor and members of the delegation visited the Masdar Institute and engaged in a roundtable discussion with institute president Fred Moavenzadeh, institute faculty and representatives, and representatives from MIT.

Also in June, a group of 14 UAE national students from the Masdar Institute received firsthand entrepreneurial experience during a two-week summer workshop at MIT. The students were accompanied by Dr. Behjat Al Yousuf, the institute's dean of students, and Dr. Irfan Saadat, professor of electrical engineering and computer science at the institute. Expert presentations, workshops at the MIT Self-Assembly Lab, case study discussions, and visits to incubators and startup companies were all part of the program. The workshop's impact went beyond the classroom and brought an awareness to the students of the meaning of teamwork and observing and embracing the MIT academic philosophy and culture.

Program Governance

Cooperative Program Steering Committee

The Cooperative Program Steering Committee oversees the program's intellectual and strategic goals. The committee also reviews the recommendations of the joint Research Advisory Committee.

MIT steering committee members are Dr. Duane Boning (program director), Dr. Charles Cooney (MIT faculty director, Deshpande Center for Technological Innovation), Dr. Claude Canizares (vice president), and Patricia Vargas (program executive director). Masdar Institute members are Dr. Sultan Al Jaber (UAE minister of state and chairman, Abu Dhabi Future Energy Company), Dr. Fred Moavenzadeh (president, Masdar Institute), Dr. Mohammed Sassi (interim dean of faculty, Masdar Institute), and Hamza Kazim (vice president of operations and facilities, Masdar Institute).

Research Advisory Committee

The Research Advisory Committee reviews all research proposals, monitors progress on research projects, and makes recommendations to the Cooperative Program Steering Committee.

Committee members from MIT are Robert Armstrong (professor of chemical engineering and director of the MIT Energy Initiative), professor Munther Dahleh (acting director of the Engineering Systems Division and interim director of the Laboratory for Information and Decision Systems), John Lienhard (professor of mechanical engineering and director of the Abdul Latif Jameel World Water and Food Security Lab), Eugene A. Fitzgerald (professor of materials science and engineering, and program director Boning. Masdar Institute members are Hassan Arafat (associate professor of water and environmental engineering), Ibrahim Elfadel (professor of microsystems engineering and head of the Institute Center for Microsystems), Bruce Ferguson (professor of the practice,

engineering systems and management, and head of the Institute Center for Innovation and Entrepreneurship), Taha Ouarda (professor of water and environmental engineering and Head of the Institute Center for Water and Environment), and Jens Ejbye Schmidt (professor of chemical engineering and head of the Institute Center for Energy).

Organization

The director of the MIT and Masdar Institute Cooperative Program is Dr. Duane Boning. Patricia Vargas is the executive director, Peter R. Jones is the assistant director for research and education, Paul Arsenault is administrative and financial officer, Susan Cass is the director of communications, and Danielle Atwell is the manager of outreach.

Duane Boning
Director