



Singapore-MIT research center serves as model for innovative collaboration

<http://smart.mit.edu>

Fostering basic research that leads to commercial activity is a goal shared by the government of Singapore and the Massachusetts Institute of Technology (MIT). This common purpose, among others, is the foundation of the Singapore-MIT Alliance for Research and Technology (SMART) Center, a collaborative research center established in 2007 that is engaging in cutting-edge research on topics of global importance, such as energy consumption and infectious diseases.

The SMART Center is predominantly funded by Singapore's National Research Foundation (NRF), a government agency established in 2006 under the Prime Minister's Office to transform Singapore into a hub of science and technology activity. The center is the first to be established under a novel NRF program to build world-class research centers in Singapore, called CREATE. The Campus for Research Excellence and Technological Enterprise (CREATE) will eventually consist of several research centers, each led by an international research university or corporation.

CREATE will be a focal point for collaboration and innovation, with a campus located near the National University of Singapore. The centers will work directly with universities and laboratories in Singapore, attracting leading researchers and encouraging innovation and technology transfer. Other CREATE entities in various stages of operation involve the Swiss Federal Institute of Technology—Zurich, Technion—Israel Institute of Technology, Hebrew University of Jerusalem, the University of California—Berkeley, Ben-Gurion University, and the Technical University of Munich.

In the last several years Singapore has increased its investment in research and development (R&D) significantly,

from 1.9% of the gross domestic product (GDP) in 1990 to around 3% in 2010, and has set a goal of investing 3.5% of GDP in R&D by 2015. Singapore has introduced new tax deductions and other programs to encourage public and private investments in R&D and to attract new talent to the country.

Singapore is a knowledge economy, and investing in international research centers like SMART is considered an investment in its future. "Singapore has recognized that research, innovation, and enterprise are essential in positioning Singapore's economy competitively into the future. We continue to attract many global talents keen to participate in the country's economic development in many areas—investments, commerce, or R&D," according to an NRF spokesperson.

For MIT, the main benefits of working with Singapore are access to the rich expertise and infrastructure that Singapore has built up in recent years, and the opportunity for research in areas difficult to work on in Cambridge, such as dengue fever and monsoons. In addition, the SMART Center provides a base for MIT in Asia, and places MIT in close proximity to Singapore's research laboratories and the other CREATE entities. MIT has had very good relations with Singapore's government, researchers, and other leaders, said Claude Canizares, MIT's Vice President for Research and Associate Provost. "We've found a system that works pretty well." Although, he admits,

the logistics of more than 9000 miles and a 12–13 hour time difference can be challenging.

The SMART Center is composed of five interdisciplinary research groups (IRGs): biosystems and micromechanics, environmental sensing and modeling, infectious diseases, future urban mobility, and the newest IRG, low-energy electronic systems. IRGs are formed through an open call to all MIT faculty members for proposals that address problems of societal importance, are in a research area of interest to Singapore, and are difficult to study in Cambridge. The proposals are reviewed by MIT, and one is eventually selected as MIT's choice for the next IRG. MIT then submits this proposal to the NRF. The proposal is further reviewed by the NRF, and if the NRF



The 2011 Singapore-MIT Undergraduate Fellows spent the summer working at the Singapore-MIT Alliance for Research and Technology. *Courtesy: SMART*

board approves the proposal, it funds the IRG. Each IRG is led by a senior faculty member at MIT, and engages students and researchers from both countries. In total, about 800 researchers will be involved in these five IRGs, with roughly 40% coming from MIT.

"Materials play a key role in every aspect of our IRG," according to Gene Fitzgerald, the lead investigator for the low-energy electronic systems group. The IRG is composed of experts in materials, devices, and circuits working together to create electronic systems that can perform new functions while consuming less energy. In particular, the group aims to take advantage of



new technologies to create prototypes of novel integrated circuits that require less energy per function, consume less power, and increase performance.

Materials also play a key role in the biosystems and micromechanics IRG, which studies mechanics at the molecular, cellular, and tissue levels, *in vitro* and *in vivo*, to better understand the interactions between diseased tissue, biology, and mechanics. Materials are essential tools in the *in vitro* experiments, which involve a lot of behind-the-scenes manufacturing, characterizing, and processing of materials, said Krystyn Van Vliet, lead investigator for the IRG. For example, experiments might involve materials that mimic biological tissue or require a new kind of polymer to differentiate cells based on their migration properties. In addition, the group is developing new tools for characterizing the optical properties of tissue *in vivo*, which could also be applied to engineered materials.

The SMART Center also includes an

innovation center focused on translating basic research into commercialized applications, preferably in Singapore, modeled after the Deshpande Center for Technological Innovation at MIT. The Innovation Center offers grants for prototyping and proof-of-concept experiments, mentoring by volunteers from the Singapore business community, and educational entrepreneurship programs.

The SMART Center grew out of an ongoing relationship between MIT and Singapore, which started with a letter of interest from then Dean of Engineering at MIT to then Deputy Prime Minister of Singapore in 1997. The Singapore-MIT Alliance (SMA) was formed in 1998 as an education and research collaboration involving MIT and the two research universities in Singapore, the National University of Singapore and the Nanyang Technological University, primarily in the areas of engineering and life sciences. The SMA is now winding down, but the creation of SMART provides an op-

portunity to greatly expand that research collaboration, according to the NRF.

Faculty and students in Singapore and MIT have benefited greatly from the collaboration, both academically and culturally. “I figured the SMA and my involvement in Singapore in general may enhance my own development as well as possibly moving my own research ideas forward,” said Fitzgerald. “It turns out that I have met close collaborators and friends; understand Asia more than I did before, of course, in particular, Singapore; and have now been able to launch a big collaborative vision that I could not have done without SMA and SMART. I now realize that SMA and SMART are glimpses of what collaborative innovation will look like in the future.”

For more information on the SMART Center and opportunities for involvement, visit <http://smart.mit.edu>.

Kendra Redmond

USA, Europe collaborate on smart grid standards

www.nist.gov www.cen.eu www.cenelec.eu www.etsi.org

This fall, the U.S. Commerce Department’s National Institute of Standards and Technology (NIST) and the European Union’s (EU) Smart Grid Coordination Group (SG-CG) jointly announced their intention to work together on Smart Grid standards development, emphasizing common goals and areas of focus.

Both NIST and the SG-CG have mandates to coordinate the development of a standards framework for Smart Grids, which can unlock innovation in the electrical sector. The two organizations outlined areas for future collaboration in a joint white paper, which can be accessed from the NIST website. The SG-CG represents three private-sector standards organizations: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), and the European Telecommunications Standards Institute (ETSI).

Smart Grids are next-generation electrical grids that attempt to predict and intelligently respond to the behavior and actions of all electric power users connected to it in order to efficiently deliver reliable, economical, and sustainable electricity services. The new collaboration is meant to ensure that Smart Grid standards on both continents have as much in common as possible, so that devices and systems that interact with these grids can be designed in similar fashion.

Smart Grids are expected to ease the incorporation of renewable energy sources, energy-saving devices, and electric vehicles into the power system. Overall goals include the reduction of carbon emissions and security of supply.

“It is promising to see that NIST and SG-CG will be supporting a number of common positions and areas of collaboration to ensure a consistent set of international standards,” said Ralph Sporer,

chair of SG-CG.

According to NIST’s George Arnold, the national coordinator for Smart Grid Interoperability in the United States, the many facets of Smart Grid development—spanning multiple sectors of the economy and a wide range of stakeholders—make the standardization effort anything but business as usual, but this collaboration will advance efforts in the long run.

To promote this transformation, governments on both sides of the Atlantic have taken a number of actions in recent years, including the U.S. Energy Independence and Security Act of 2007 and the American Recovery and Reinvestment Act of 2009, and Europe’s Directives 2009/72/EC and 2009/73/EC within the framework of the 3rd Package for the Internal Energy Market. This legislative effort has translated into a number of standards initiatives like the NIST Framework and Roadmap for Smart Grid Interoperability Standards in the United States and a Smart Grid mandate in the EU. □