



Singapore Promotes Sustainable Society Technology Innovation

Abstract:

The Singapore Nanyang Technological University (NTU) - Rice University (Rice U) joint symposium on Transformational Information Engineering and Science (TIES) was held on 28-29 January 2010 to inaugurate the launch of bi-national Institute of Sustainable and Applied Infodynamics (ISAI). This symposium covered areas ranging from the emerging field of infodynamics, application of computational science in multi-disciplinary fields, sustainability driven by low energy consumption and highly integrated functional systems enabled by nanotechnology, ICT and biomedical technology, as well as history and policy for science and technology innovation. This article highlights presentations given by distinguished speakers especially on technology innovation policy, nanotechnology and virtual hospitals.

The rapid growth of information science and technology is increasingly challenged by limits on miniaturization and energy consumption. Progress needs innovative technologies and team efforts, since many of the most challenging scientific and technology problems are interdisciplinary, and it requires international collaborations as well as government-academic-industry cooperation. Nanyang Technological University (NTU) in collaboration with Rice University (Rice U) jointly organized a symposium on Transformational Information Engineering and Science (TIES) on 28-29 January 2010 at the NTU campus in Singapore. This symposium brought together distinguished speakers from NTU, A*STAR, Rice U, UC Berkley, University of California-Los Angeles (UCLA), ONR Global, Caltech and Ecole Polytechnique Fédérale de Lausanne (EPFL) with diverse expertise, discussing the impact of fundamental research on technology innovation, history and policy for science and technology innovation, application of computational science in multi-disciplinary fields, as well as sustainability driven by low energy consumption and highly integrated functional systems enabled by nanotechnology, ICT and biomedical technology.

Basic research needs government leadership on funding. The Japanese government has been the world leader in R&D investment, reaching 3.4% of GDP by 2006. In spite of the global economic recession, governments are still investing in innovation. As a developing country, Chinese national R&D investment increased from close to zero to 1.4% of GDP within 5 years during 2001 to 2006. Korea is also very aggressive in its national R&D investment, overtaking the USA and Germany and reaching 3.3% in 2006. Singapore has entered the league of R&D - intensive countries since 2005. Its national R&D investment is 2.8% of GDP in 2008 and targeting to reach 3% by 2010 and 3.5% within



next 5 to 10 years. Singapore has become a strong R&D leader especially in the ASEAN region. To maximize the outcome of government S&T investment and accelerate science advancement and technology innovation, it's very important to keep a balance between technological development-oriented research and fundamental curiosity-driven research when governments make the strategic plans for national R&D investment. "There is a tendency to focus on technology stages ready to move forward and produce economic value. But much innovation - especially highest impact innovation - is ultimately rooted in deep scientific understanding," said Prof. Eugene H. Levy, Provost of Rice University.

Sustainable development of ICT requires high performance, low cost and energy saving devices, enabled by nanotechnology, intelligent architecture design and software. Prof. Bob Curl, Nobel Laureate in Chemistry in 1996, gave an overview of ancient nanotechnology and modern nanoscience. Prof. James M. Tour, a well-known molecular nanotechnology pioneer from Rice U. and winner of the 2008 Feynman Prize in Experimental Nanotechnology, presented his research on nano carbon memory devices (including CNT, graphene, graphene ribbon and amorphous carbon). "Individual carbon nanotube (CNT) is difficult to position, which is the primary challenge for scale-up of CNT-based nano devices. Graphene is much easier to control, but it's planar and not suitable to be used for vertical devices," said Prof. Tour. His group developed an amorphous carbon stripe memory device by depositing amorphous carbon onto a vertical hole in the silicon dioxide (SiO_2) layer. This memory device shows high on/off ratio, fast switching time, and durable cycles. He further demonstrated similar reproducible memory switching in MWCNT, TiN and metal islands nanogap systems on SiO_2 substrates. Prof Soon Fatt Yoon from NTU presented his group research work on a 3-D opto-electronic IC enabled by III-V/Si integration. His group created Ge/SiGe/Si substrate to realize quantum dot (QD) emitter on low cost silicon. The growth of ICT increases energy consumption resulting in exponential increase of carbon emission since 2000. In order to sustain the development, scientists are working on ICT innovation to improve energy efficiency. Prof. Yeow Meng Chee from NTU presented nanowire decoders using nanowire crossbar architecture. This new design will effectively save the data bus energy consumption which is claimed to account for up to 80% of power loss.

The world is becoming "small" because of technology innovation. The lab on chip will not only revolutionize health care and offer personalized medicine, but is also instrumental in environmental monitoring. Do you know that 50-80% of routine medical problems can be resolved by phone or internet? Imagine obtaining medical diagnosis and medical treatment without physically seeing a physician? Dr Danny Petrasek from Caltech presented a virtual hospital concept at this symposium. The realization of virtual hospital is an extremely complex task because it requires close collaborations among physicians, scientists, administrators, political and industry leaders. Although different

technologies in both hardware and software are being developed in advancing health care, such as tele-radiology and tele-pathology through internet, remote robotic surgery, mobile/internet diagnostics and continuity of care connected by web based EMR and a network of global healthcare providers, the “virtual hospital” development is yet to be coordinated and integrated. With the synergetic advancement in ICT, biomedical technology and nanotechnology, the virtual hospital is expected in the near future.

The Institute of Sustainable and Applied Infodynamics established jointly by NTU and Rice U will continue to facilitate the collaborative innovation between the two universities for sustainable growth in communication, education, health, media and security. As in the win-win collaboration, “NTU will benefit the high impact multidisciplinary research while Rice U. – together with its partner universities in the institute – will gain high impact in increased globalization to research with this foothold in Asia”, said Dr. Vincent Mooney, Visiting Associate Professor in the School of Electrical and Electronic Engineering, NTU, and Associate Professor of School of Electrical and Computer Engineering, Georgia Tech, USA.



Fig. Nobel Laureate Prof Bob Curl taking Q&A after his presentation at the symposium.