Annex D

ACHIEVEMENTS OF THE BIOMEDICAL SCIENCES (BMS) INITIATIVE

How It Began

In 2000, the BMS Initiative was launched to establish BMS as the fourth key pillar of Singapore’s economy, alongside Electronics, Engineering and Chemicals. This fourth pillar encompassed the pharmaceutical, biotechnology, medical technology and healthcare industries. Beyond BMS manufacturing, Singapore had to move up the value chain and build a strong base in R&D.

Phase 1 (2000-2005): Building a Strong Foundation

Phase 1 of the BMS Initiative focused on building a strong foundation in basic biomedical research for Singapore. We invested in infrastructure to create the Biopolis in One North, raised the level of biomedical research institutes (RI) by establishing a strong foundation in basic science capabilities, and attracted research talent that would form the heart of this enterprise.

- **Establishing a critical mass of excellent research talent**
  Internationally renowned scientists helped to jumpstart Singapore’s BMS efforts by leading A*STAR BMS RIs and mentoring younger scientists. This group includes top scientists such as Edward Holmes and Judith Swain from the University of California, San Diego; Jackie Ying from the Massachusetts Institute of Technology; and David Lane, the co-discoverer of the p53 tumour suppressor gene.

  To build a strong core of local talent for the long term, the A*STAR Graduate Academy launched an ambitious scholarship drive to nurture a pipeline of scientific talent for Singapore. Two years ago, we hit our target of awarding 1,000 scholarships to deserving and outstanding young people by 2010.

- **Building a state-of-the-art research infrastructure**
  Biopolis Phase 1 was built and launched. This seven-building complex, which housed five A*STAR RIs with capabilities in molecular and cell biology, genomics,
bioengineering, bioinformatics, and bioprocessing respectively, attracted an accompanying base of private R&D laboratories and activities.

**Phase 2 (2006-2010): Building up Singapore’s Translational and Clinical Research Capabilities**

Phase 2 of the BMS Initiative focused on building up Singapore’s translational and clinical research (TCR) capabilities, while continuing to strengthen our foundation in basic research.

- **Establishing key TCR infrastructure**
  During this period, A*STAR established five new BMS RIs/consortia with the aim of accelerating the translation of basic research findings in the lab into clinical applications to improve human healthcare. This was accompanied by the launch of Biopolis phase 2, a two-building extension to house the new institutes as well as other industry outfits.

- **Deepening capabilities in TCR/ Developing Clinician Scientists**
  The National Research Foundation (NRF), through the Ministry of Health (MOH) provided S$125m in block funding for five TCR Flagship Programmes from 2006 to 2010. Research areas were in neuroscience, gastric cancer, eye diseases, infectious diseases and metabolic disorders. These were chosen taking into consideration their relevance to Singapore’s healthcare challenges. The TCR Flagships reflect a truly collaborative effort between clinicians and basic scientists across various RIs and healthcare institutes in Singapore.

  Some highlights include the Gastric Cancer programme which detected early gastric cancer in 17 people, while also contributing new knowledge that potentially impacts the detection and treatment for this type of cancer. Another key success is the development of the world’s first robotic flexible endoscopy system called Master and Slave Transluminal Endoscopic Robot (MASTER). Patients benefit from less pain and a faster recovery from this no scar surgery.

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1 BMRC’s Singapore Institute for Clinical Sciences (SICS) and Institute of Medical Biology (IMB) conduct translational and clinical research to bridge the gap between bench and bedside. BMRC has also launched consortia initiatives, which place significant emphasis on translational research in key areas, such as the Singapore Cancer Syndicate (SCS), Singapore Bioimaging Consortium (SBIC), Singapore Stem Cell Consortium (SSCC), Singapore Consortium of Cohort Studies (SCCS) and Singapore Immunology Network (SIgN).
The Eye programme has resulted in the development of a “made in Singapore” product, the Tan EndoGlide, which is the first donor insertion device approved by the Food and Drug Administration (FDA). It is a disposable device used in the transplantation of the cornea. Another key outcome is the establishment of ReLEx (Refractive Lenticule Extraction) SMILE (Small Incision Lenticule Extraction) as an alternative surgical procedure to LASIK (Laser Assisted in Situ Keratomileusis). Unlike LASIK, which uses two lasers and vaporises the corneal tissue to correct vision, ReLEx SMILE uses only one laser for the entire procedure and removes only an inner lens-shaped piece of cornea which corresponds to the patient's myopia and/or astigmatism, through a keyhole incision in the cornea. Moving ahead, the research team has patented a technology involving the cryopreservation of the refractive lenticule, with focus on re-implanting into the cornea. If successful, the surgical procedure can become “reversible”, hence adding to patient safety and confidence. This technology (through A*STAR’s Exploit Technologies) is currently licensed to a new spin-off company, Lenticor.

Other programmes have also made good progress. Although still early days, the team working on the Metabolic programme, which was the latest programme to be awarded in 2008, has managed to build up a birth cohort study named GUSTO (Growing Up in Singapore Towards Healthy Outcomes). This is Singapore’s largest and most comprehensive birth cohort studying the impact of mothers' diet and lifestyle during pregnancy on their babies' growth after birth. The cohort study has attracted interest from clinician experts and researchers from around the world, as well as the nutrition industry.

In addition, to recognising the achievements of clinician scientists who had devoted time and effort to TCR, MOH launched the Clinician Scientist Award (CSA) and Singapore Translational Research (STaR) Investigator Award to provide salary and research grant support to such individuals. As at June 2012, a total of 12 awards have been given out under the STaR Award and 38 under the CSA.

- Developing Medical Technology industry in Singapore

In 2009 at the International Advisory Council, Singapore announced that it would be ramping up its BMS effort to develop the medtech industry in Singapore.
To that end, A*STAR established a collaboration with the Centre for Integration of Medicine and Innovative Technology (CIMIT) in Boston, as well as the Singapore-Stanford Biodesign Programme. These initiatives will see the collaboration of Singapore BMS researchers and clinician scientists as well as their science and engineering counterparts in the development of medtech technologies.

- Engaging industry
  Creating economic value from R&D is an important outcome of the BMS initiative.

A*STAR, EDB and MOH have jointly set-up the Singapore Biomedical Sciences Industry Partnership Office (BMS IPO). BMS IPO serves as the one-stop coordinating office between the various research agencies and performers in Singapore with industry players seeking to establish multi-party collaborations.

A*STAR also has a technology transfer arm called Exploit Technologies to identify technologies with potential for commercialisation, and bring them to market by licensing intellectual property and spinning off high potential companies. It also has an Industry Development Group (IDG) under its Biomedical Research Council (BMRC) which specialises in negotiating collaborations between pharma and biotech players and the BMS RIs. These are powerful R&D collaborations which involve the co-development of potential new products or new technology platforms.

In addition, a new MOH initiative is being developed to harmonise the commercialisation activities in the clinical community to foster closer engagements with industry.

Phase 3 (2011-2015): Integrating for Greater Economic and Health Impact
Phase 3 of the BMS Initiative focuses on the integration of knowledge and capabilities across disciplines and agencies to achieve even greater economic impact. Building on the success in facilitating dialogue between biomedical scientists, clinicians and other professionals to translate research findings into medically relevant applications will enhance our ability to partner multi-disciplinary research collaborations with industry for greater impact.

The PM announced in 2010 that the Government has allocated $16.1 billion to R&D funding over the next five years. This is based on a Whole-of-Government assessment of R&D
efforts across all agencies at a national level. For BMS R&D, the Government has committed $3.7 billion over the next five years. This is a 12% increase over the $3.3 billion committed to BMS R&D from 2006 to 2010. This is especially significant in the face of the shrinking R&D budget in most countries.

This increase in funding to BMS will support three main areas to capture growing opportunities arising from global trends in the BMS industry:

- **Enhanced Industry Engagements for Greater Economic Outcomes**
  BMRC will establish technology platforms that will bring together researchers and groups from different disciplines in synergistic ways, so as to provide multi-disciplinary solutions to problems of interest to industry. MOH and EDB are supporting the National Cancer Centre Singapore and other healthcare partners to establish the Roche Translational Medicine Hub, which will facilitate the conduct of cutting edge research involving Singapore investigators and Roche collaborators.

- **Focusing on Mission-Oriented Programmes with high growth potential**
  A*STAR’s BMS R&D will focus on Mission-Oriented Programmes in the Pharmbio, MedTech, Personal Care and Nutrition sectors, to draw on existing strengths and capitalise on growing Asian markets to create better economic value.

  MOH’s research will focus on addressing key disease areas that are of national and regional importance, and where Singapore has the potential and capability to become a world leader.

- **Seamless integration and translation as key competitive advantages**
  Biopolis, the integrated research campus for the Biomedical Sciences, clearly demonstrates Singapore’s commitment and success in this sector. First established in 2003, Biopolis has expanded through four phases, and houses BMRC’s seven RIs, as well as research consortia, independent laboratories and shared research facilities. In addition, it houses R&D centres of more than 35 pharma, biotech and med tech companies such as Abbott, GSK, Merck, Mesoblast, Novartis, Takeda and most recently, Chugai Pharmaceuticals and Greatbatch.
This co-location in a single campus promotes opportunities for public-private partnership, and A*STAR’s RIs have forged R&D collaborations with many of these companies. In recent years, we have seen our research capabilities attract interest from companies in the nutrition, skincare and consumer care sectors; with companies such as Danone, Abbot Nutrition, and Procter & Gamble also setting up R&D centres at Biopolis.

In the academic medical centres and healthcare institutions, MOH’s focus in clinical research is evident through the establishment and continual funding of the Singapore Clinical Research Institute as well as the two Investigational Medicine Units at NUHS and SingHealth to support clinical trials and related research. Clinicians now have access to key infrastructure and research manpower support to bring key questions arising from their clinical observations, to form properly designed and conducted research studies with the eventual goal of improving clinical outcomes for patients.