National Innovation Systems in a Global Context – Perspectives from Singapore

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Deputy Chairman, Agency for Science, Technology & Research

National University of Singapore
National University of Singapore

- Comprehensive, research-intensive global university
- 3 campuses – Kent Ridge, Bukit Timah, Duke-NUS Graduate Medical School
Our world has changed ….

• Globalisation
  • Integration of national economies
  • Interconnectedness & the “shrinking globe”

• Rise of knowledge societies and economies
Rise of Knowledge-Based Economies

"The empires of the future are the empires of the mind."

- Sir Winston Churchill -
5 September 1943
Harvard University
National innovation systems in a global context

How should nations, and their universities, respond to this changing landscape?
National innovation systems in a global context

How should nations, and their universities, respond to this changing landscape?

How can nations, and their universities, seize the new opportunities? Help shape the changing landscape?
National Innovation Systems in a Global Context – Perspectives from Singapore’s national biomed science initiative

- Why BMS was selected as a focus
- Key approaches & challenges
- What we feel is critical for success
The Singapore Growth Story.....

GDP $B

60s: Labour-intensive
70s: Skill-intensive
80s: Capital-intensive
90s: Technology-intensive
Future: Knowledge-Intensive
Why BMS?

• Human health & disease – one of THE most important issues for the world, for the future

• Spectacular advances in BMS research technologies allow small newcomers to be competitive

• Changes in drug-discovery approach in big Pharma create market opportunities for small players
Does Singapore have a chance?

- Small population & talent base
- In late 1990s, BMS basic science capabilities relatively weak
- Competition intense; several established hubs already
Does Singapore have a chance?

- Excellent healthcare system
- 100 years-worth of the best and brightest in Medicine
- Global burden of disease shifting to Asia
  Importance of inter-ethnic differences in biology & response to treatment
- 3 Asian ethnic groups in Singapore population
Does Singapore have a chance?

BMS needs 2 things, which Singapore happens to be good at:

• long-term vision & view
  = substantial & long-term support

• close coordination between different agencies
Phase 1: 2000-2005
A highly coordinated approach

Ministerial committee

**Human Capital Development**
- Recruiting top scientists
- PhD & Postdoctoral Training & Career Development
- Public Awareness & School Outreach

**Intellectual Capital Development**
- Public R&D: RIs & Extramural Grants
- Economic Spin-offs from Public R&D
- Industry R&D

**Industrial Capital Development**
- Infrastructure Development
- Investment Promotion
- Equity Investment

**Ethical Frameworks**
(BAC, GMAC, NAACLAR)

**Legend:**
- Biomedical Research Council of A*STAR
- Biomedical Sciences Group of EDB
- Bio*One Capital of EDB

Universities
Healthcare institutions
Building R&D Human Capital

ROBUST PIPELINE
A*STAR Scholarships & Fellowships

Senior international researchers

Pro-Local

Pro-Foreign
Building Biomedical R&D Capabilities

Phase 1 (2000-2005)

- Institute of Molecular & Cell Biology
- Genome Institute of Singapore
- Bioinformatics Institute
- Bioprocessing Technology Institute*
- Institute of Bioengineering & Nanotechnology
Industrial capital: Biopolis

Phase 1
- All 5 BMRC Research Institutes
- Corporate labs
- S$500 million
- 2 million sqft

Biopolis Shared Facilities
- Scientific Services
- Core Services
- General Amenities
- Animal Facilities

Images courtesy of A*STAR
Industrial capital: Biopolis

Phase 2
- Additional 2 buildings
- Corporate labs
- 400,000 sqft

Images courtesy of A*STAR
Review of Singapore’s BMS Initiative: 2000 - 2005

- Critical mass of high quality research talent in Research Institutes & programmes
- Strong pipeline of local talent in research training
- State-of-art infrastructure in Biopolis, universities
- Growing base of industry R&D labs
- Substantially expanded BMS sector’s economic contribution
Strong Growth in BMS Manufacturing Sector

- Manufacturing output increased by 4-fold from S$6 billion to S$24 billion
- Employment opportunities doubled from 5,000 to 10,000 jobs
## Growing base of corporate R&D labs:

**Pre-2000: No significant activity; Rapid growth since 2000**

### GlaxoSmithKline
- **35 RSEs**
- Drug discovery for neuro-degenerative diseases

### Paradigm Therapeutics
- **21 RSEs**
- Use *in vivo* functional genomics to predict clinical utility of novel drug targets
- Focused on CNS and metabolic diseases

### S*BIO
- **55 RSEs**
- Genomics & small molecule technologies-based drug discovery

### PharmaLogicals Research
- **21 RSEs**
- Focus on breast cancer
- Chugai-Biostar (Mitsui/CIEA) JV

### Novartis
- **85 RSEs**
- Drug discovery for TB and Dengue

### Merlion Pharma
- **62 RSEs**
- Natural products research for drug discovery

### ESI
- **35 RSEs**
- Development of hES cells for applications in Diabetes & CVS

### Albany Molecular Research Inc
- **15 RSEs; 200 RSEs by 2008**
- Chemistry process development R&D

### Cordlife
- **15 RSEs**
- R&D in stem cell expansion

### ViaCell
- **10 RSEs**
- R&D in stem cell biology, protein chemistry & markers

### Lilly
- **33 RSEs**
- Oncology biomarkers research

### Maccine
- **20 RSEs**
- Preclinical service provider

### SingVax
- **7 RSEs; 60 RSEs by 2008**
- Development of vaccines for infectious diseases prevalent in Asia
Key recommendation for Phase 2

“It is no longer good enough to cure cancer in the mouse”

Ed Holmes. UCSD

“The most important ‘model’ is man

S Brenner
Build Translational and Clinical Research Capabilities

**Economic growth & job creation**
- Industry R&D investments
- Manufacturing investments (Pharma, biotech, medtech)
- Commercialisation of local IP

**BENCH**
- Excellent basic research
  - Biopolis Consortium
  - University Peaks of excellence

**INDUSTRY**

**TCR**

**BEDSIDE**
- Better healthcare
  - Promote Singapore Medicine
Building Biomedical R&D Capabilities

Phase 1 (2000-2005)
- Institute of Molecular & Cell Biology
- Genome Institute of Singapore
- Bioinformatics Institute
- Bioprocessing Technology Institute*

Phase 2 (2006-2010)
- Institute of Bioengineering & Nanotechnology
- Singapore Bioimaging Consortium
- Singapore Institute for Clinical Sciences
- Singapore Stem Cell Consortium
- Singapore Immunology Network
- Experimental Therapeutics Centre
- Institute of Medical Biology

National University Health System
Academic Medical Centre
National University Health System

MOHH

Joint venture

NUS

Strategic plans;
Unified resource allocation system
Harmonised HR framework
Monitoring performance

NUHS

BOARD

NUHS CE

Management agreement

NUH

Management agreement

SOM

FOD
National Innovation Systems in a Global Context – Perspectives from Singapore’s national biomed science initiative

• Why BMS was selected as a focus

• Key approaches & challenges

• What we feel is critical for success
Critical success factors

- Strong governmental commitment with long-term view
- Adequate sustained support
Increasing R&D funding
Critical success factors

- Visionary, strong leadership
- Very close coordination between agencies
- Active partnerships with leading institutions & agencies internationally
BMS International Advisory Council

Sir Richard Sykes (Chairman)
NHS London
(UK)

Dr Sydney Brenner
The Salk Institute of Biological Sciences (USA)

Sir John Bell
University of Oxford
(UK)

Sir Leszek Borysiewicz
Medical Research Council
(UK)

Sir Philip Cohen
University of Dundee
(UK)

Dr Suzanne Cory
WEHI
(Australia)

Dame Sally Davies
National Health Services
(UK)

Dr William Evans
St Jude Children’s Research Hospital (USA)

Dr Peter Gruss
Max Planck Society
(Germany)

Dr Helen Hobbs
Univ. of Texas Southwestern
(USA)

Dr William Kelley
University of Pennsylvania
(USA)

Dr Anthony Pawson
Samuel Lunenfeld Research Institute (Canada)

Dr Harriet Wallberg-Henriksson
Karolinska Institutet
(Sweden)

Dr Tadataka Yamada
Gates Foundation
(USA)

Dr Rolf Zinkernagel
University of Zurich
(Switzerland)

EMERITUS

Dr David Baltimore
Dr Philippe Kourilsky
Sir Keith Peters
Sir George Radda

Dr Samuel Barondes
Dr Richard Lerner
Dr John Reed

Dr Alan Bernstein
Dr Susan Lindquist
Dr John Shine

Dr Colin Blakemore
Dr Paul A. Marks
Dr Axel Ullrich

Dr Stanley N. Cohen
Dr John Mendelsohn
Dr Alex Ulrich

Dr Leland Hartwell
Dr Alan Munro
Dr Hans Wigzell
When physician-scientists Judith Swain and Ed Holmes take up their posts in Singapore…, they will join a star-studded community at one of the world’s most rapidly developing biomedical research centres. …they are the latest of many Western scientists who have headed for the impressive facilities of the tiny city-state.

*Naturejobs, 5 Jul 06*
## Research Collaborators

- Riken
- University of Milano – Bicocca
- Max-Planck Institute of Biochemistry
- The Liggins Institute
- Australia National University

## Manpower Training

- University of Illinois at Urbana-Champaign
- University of Cambridge
- University of Sheffield
- Karolinska Institut
- University of Oxford
- University of Dundee
- Imperial College London
- Carnegie Mellon University

## Joint Research Funding

- University of California, San Diego
- Juvenile Diabetes Research Foundation
- Centre for Public Health Research
- Medical Research Council
- National Office for Research and Technology

## Others

- Regional Emerging Diseases Intervention
- Collège de France
- Keystone Symposia
- American Association for Cancer Research
NUS Joint & double-degrees with leading overseas universities

Legend
- Total DD / JD Programmes
- DD / JD graduates

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<th>Year</th>
<th>Total DD / JD Programmes</th>
<th>DD / JD Graduates</th>
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<tr>
<td>2007/2008</td>
<td>168 graduates</td>
<td>168 graduates</td>
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805 scholars & fellows supported to-date, comprising:
491 BMRC scholars & fellows
314 SERC scholars & fellows

BSc to PhD to post-doc training in top centres around the world
Conclusion

Perspectives from Singapore’s BMS drive

- Why BMS was selected

- Approach – highly coordinated, focused, emphasis on building human capital, intellectual capital, industrial capital

- Critical importance of being fully plugged in internationally - partnerships, advisors, recruitments
Conclusion

Critical success factors:

• Strong long-term government commitment
• Adequate sustained support ($)
• Visionary & strong leadership
• Very close coordination