



# Asian Perspectives on Research/Science Parks: An Example of Singapore

**Phillip H. Phan**

**Warren H. Bruggeman '46 and Pauline Urban  
Bruggeman Professor**

**The Lally School @ RPI**

# Agenda

- **Science Parks in Asia**
- **Why Singapore?**
- **The Singapore Economic Context**
- **Science Parks in Singapore**
- **Institutions Supporting Science Parks in Singapore**
- **Lessons Learned**
- **Suggestion for Metrics**
- **Future Research Questions**

# Science Parks in Asia

- **Export versus R&D orientation**
  - *Export: India, Japan, Malaysia, Korea*
  - *R&D: Taiwan, China, Singapore*
- **Set up as FDI magnet with focus on knowledge industries**
- **Early park policies intersect post-WWII industrial policy focused on economic development around strategic industries**
- **Early park administration focused on estate planning and management**
- **Taiwan, China, Singapore moving from technology transfer to technology creation**

# Examples of Science Parks in Asia

- **Tskuba Science Town (Japan)**
  - *158 science parks (6 prefectures), designed to move high value added production to rural areas through agglomeration economies*
- **Hsinchu Science Park (Taiwan)**
  - *Founded in 1980, semiconductors. US\$1.7 billion on park infrastructure, 384 companies, 773 hectares*
  - *Also, Central Taiwan Science Park (aviation), Southern Taiwan Science Park (optoelectronics)*
- **Daeduck Science Park (Taejon, Korea)**
  - *Founded in 1973, 27 km<sup>2</sup>, 60 institutions, 12,000 scientists and technicians, 5000 supporting staff*
- **Zhongguancun Science Park (Beijing, China)**
  - *Founded 1988, 60 institutions (universities, corporate R&D labs such as Microsoft, IBM, Intel, Qualcomm, China Academy of Science, , film and tv studios,*
  - *Science parks in China focus on optics, wireless communications, telecommunications, media technology, medical electronics, biotechnology, nanotechnology*
  - *Also, Tsinghua Science Park, Shanghai Zhangjiang Science Park and Tianjin Economic Development Area, additional 10-15 to be built before 2010*
- **Software Technology Parks of India**
  - *Founded in 1990, network of 47 centers in Bangalore, Noida, Pune, Chennai, Hyderabad, and Mumbai, export oriented, incubation of new companies, tax attractive investment zone*
  - *Also, International Tech Park Bangalore, Technopark Trivandrum, TIDEL Park Chennai, Infopark Kochi, HITEC City Hyderabad*
  - *ITPB - JV of Tata Industries, Singapore Consortium, Karnataka Industrial Areas Development Board, 65 acres, 120 MNCs and large domestic IT firms, 19,000 professionals, export oriented*

# Why Singapore?

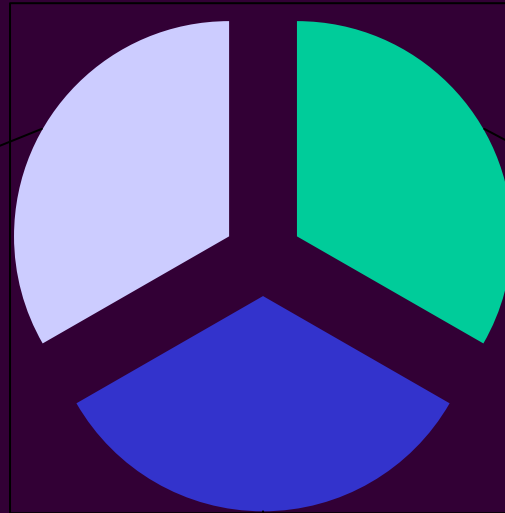
- Extreme case of government created parks
- Focused exclusively on R&D and knowledge creation (rather than transfer)
- Involves almost all government ministries
- Culminating effort involving all levels of society from grade school to post-graduate
- Embeds public and private corporation involvement
- Combines political rhetoric with economic, social, and demographic engineering
- Benchmark for China parks

# Singapore Economic Context

- **Top 10 in economic competitiveness (Global Competitiveness Report) 1997-2007**
- **GDP (PPP): US\$145 billion**
  - *1965-1985: 8.5% annual GDP growth*
  - *1986-1996: 9.2% annual GDP growth*
  - *1997-2000: 5% annual GDP growth (1997: 8.2%)*
- **Foreign reserves US\$200 billion (3<sup>rd</sup> quarter, 2007)**
- **Current account surplus 18% of GDP (1997-2007)**
- **Population 4.6 million (52% male)**
- **92.5% literacy rate**
- **Internet penetration of population 37%**
- **Mobile phone penetration of population 100%**
- **Per capita GNI US\$29,320 (#2 in Asia, after Japan), 65% that of U.S.**
- **Largest port in the world by shipment volume**
- **5000 MNCs (20% are regional HQs)**

# Productive Structure

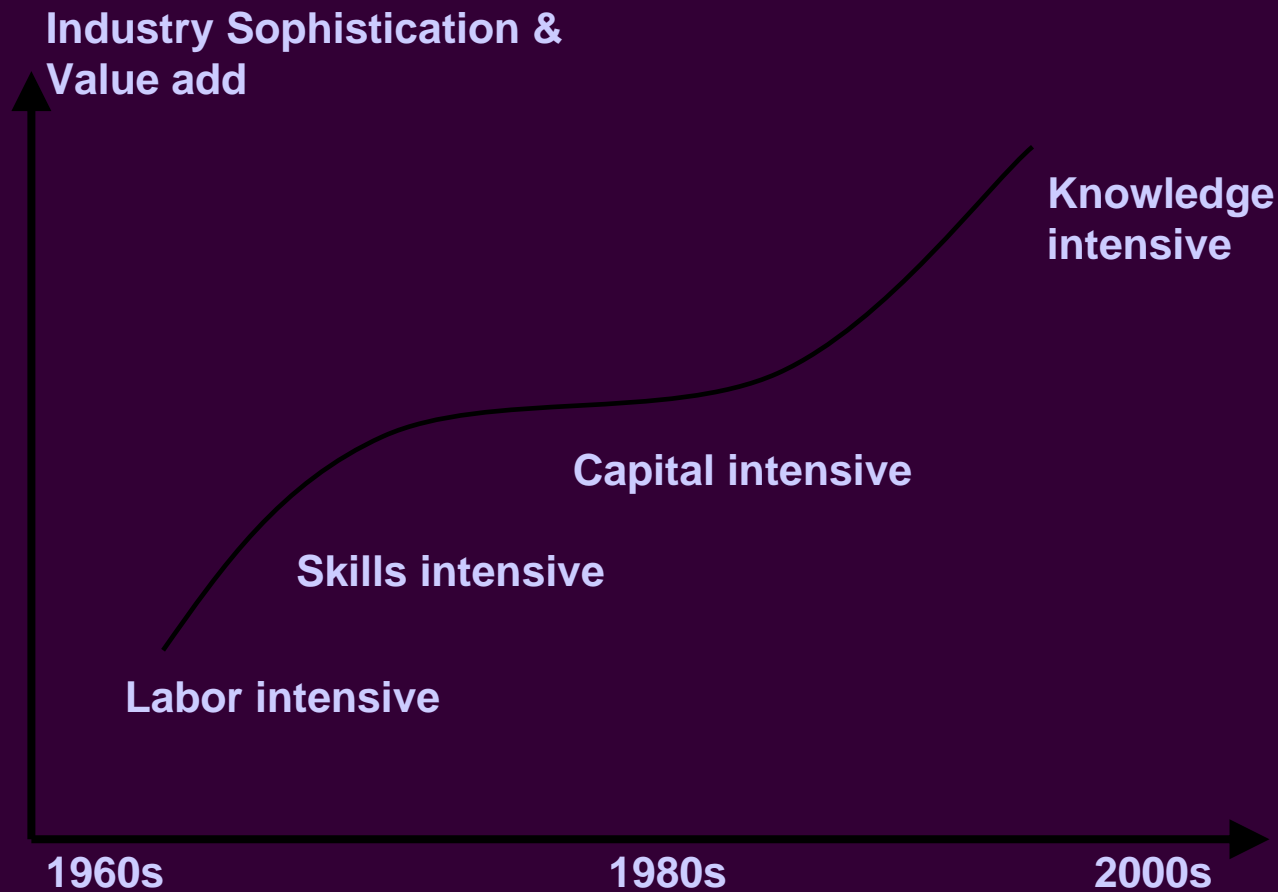
**Small & Medium  
Size Enterprises**  
(Banking and finance,  
non-bank services,  
logistics, niche  
manufacturing)



**Multinational  
Corporations**  
(Banking and finance,  
manufacturing, IT,  
pharmaceuticals,  
service, media)

**Government Linked  
Corporations**  
(Communications,  
media, transportation,  
IT, medical, finance)

# Singapore's Technological Transition





# 4 phases of Technological Transition

- **Industrial takeoff.** From 1960s to mid-1970s; high dependence on technology transfer from foreign MNCs.
- **Local technological deepening.** From mid-1970s to late-1980s; rapid growth of locally-based capabilities in MNCs, and the development of local supporting industries.
- **Applied R&D expansion.** From late 1980s to late 1990s, rapid expansion of applied R&D by MNCs, publicly-funded research institutions and local firms.
- **High-tech entrepreneurship and R&D intensification.** From late 1990s onwards, with emphasis on high-tech startups and shift in policies to develop technology creation capabilities

# National Science and Technology 5-year Plans

- 1991-1995: \$2 billion in R&D spending, accelerate technology infrastructure, encourage private-sector R&D, develop technical HR, 1.1% R&D/GDP in 1991
- 1996-2000: 2.6% R&D/GDP by 2000, 66 scientist and engineer/10k workers, accelerate inflow of foreign talent, Technopreneurship 21 (T21) to foster high-tech start-ups.
- 2001-2005: \$7 billion to develop infrastructure and attract international talent, listing rules relaxed to allow technology to raise funds easily, US\$1 billion fund of funds to invest in international venture capital firms to encourage establishment of regional HQ, creation of Bio-Medical Research Council, and Science and Engineering Research Council.
- 2006-2010: 3% R&D/GDP by 2010, strengthen linkages between public and private sector R&D, One-North Science Park (US\$15 billion), Biopolis, Singapore Science Park Phase 3

# Science Parks in Singapore

## ■ Singapore Science Park (SSP), 1980

- *65 hectares, 3 phases, 307 tenant companies (IT and electronics), 2 venture capital firms*
- *Alliances with Sophia Antipolis (France) + Heidelberg Technology Park (Germany)*
- *MNC oriented, technology transfer and absorption*

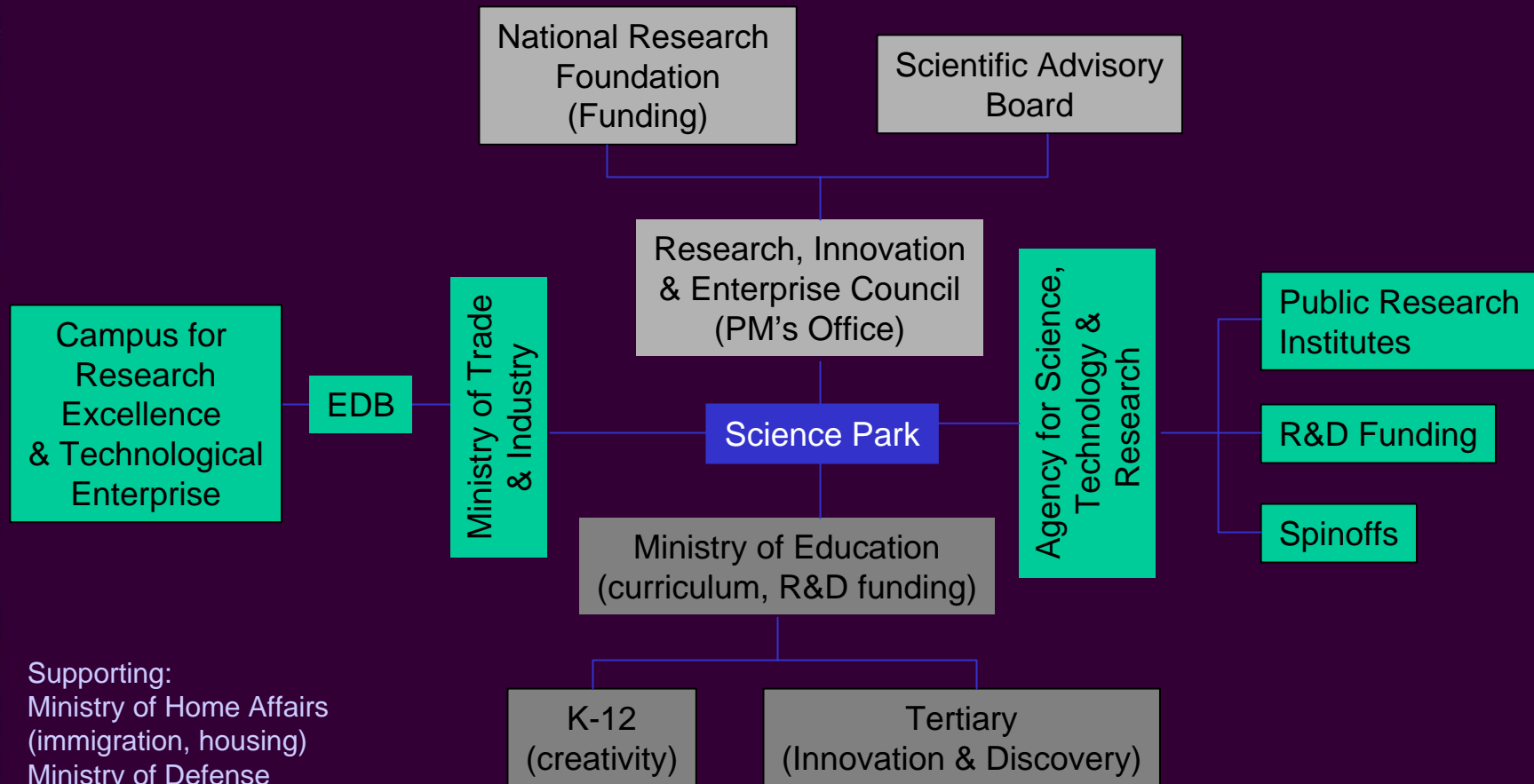
## ■ One-North Science Habitat (1N), 2005

- *US\$15 billion,*
- *SME oriented, technology creation*
- *Includes residential, libraries, k-12 schools, zero emissions transportation, sports clubs, theatres, art galleries, world class shopping*
- *The Biopolis (biotechnology based) research facility*

# Differences between SSP & 1N

- **Seamless communication**
  - *Fiber optic, wideband wireless, emissionless transportation links to main road and subway network*
- **Geographic proximity between work, living, play**
  - *Estate planning integrates office, lab, residence, and in/ outdoor recreation facilities*
- **Horizontal and vertical integration of research partners (technology)**
  - *Multiuse lab spaces, embedded venture capital and technology commercialization facilities/ companies, research and tax grants that encourage multidisciplinary teams*

# Institutions Supporting Science Parks



Supporting:

- Ministry of Home Affairs (immigration, housing)
- Ministry of Defense (R&D Funding, technology)
- Ministry of Health (R&D Funding, technology)

# Research, Innovation and Enterprise Council (PMO)

## ■ National Research Foundation

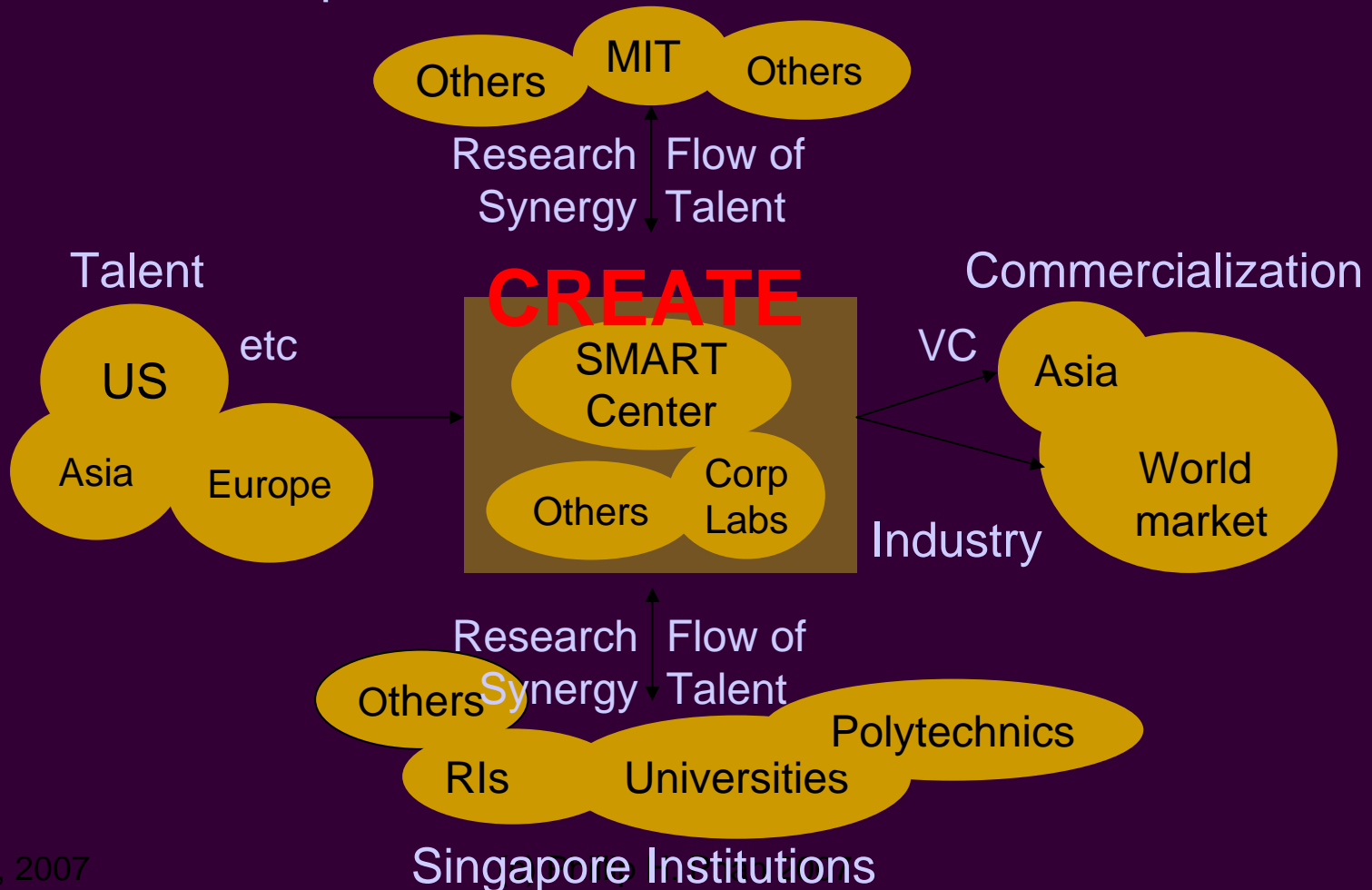
- *S\$5 billion*
- *Competitive Research Programme (CRP) Funding Scheme*
  - S\$10 million/ program over 3-4 years
  - Multidisciplinary industry/academic teams
- *NRF Research Fellowship Program*
  - 3-year US\$1.5 million grant for individual scientist
- *Scientific Advisory Board (SAB)*

# SAB Identified Research Areas

- **Biomedical sciences, environmental and water technologies, and interactive and digital media**
- **S\$1.4 billion over 5 years**
- **Expected to create 86,000 jobs and \$30 billion in Gross National value-added by 2015**
- **S\$1 billion for joint research programs between local research institutes and foreign research universities**
- **S\$1 billion over 5 years for research centers containing globally renowned researchers**

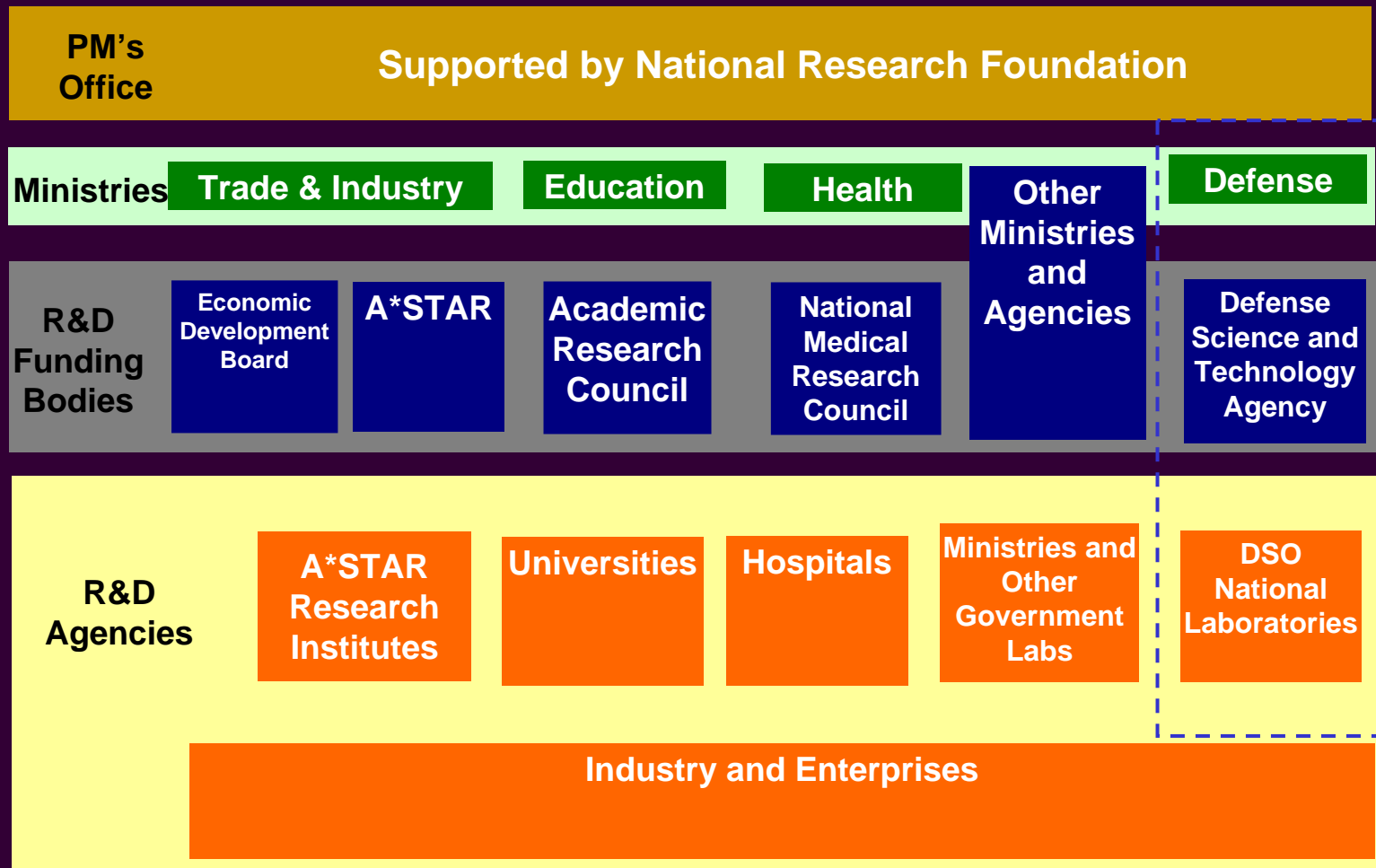
# Campus for Research Excellence And Technological Enterprise

## Top Research Institutions in the World

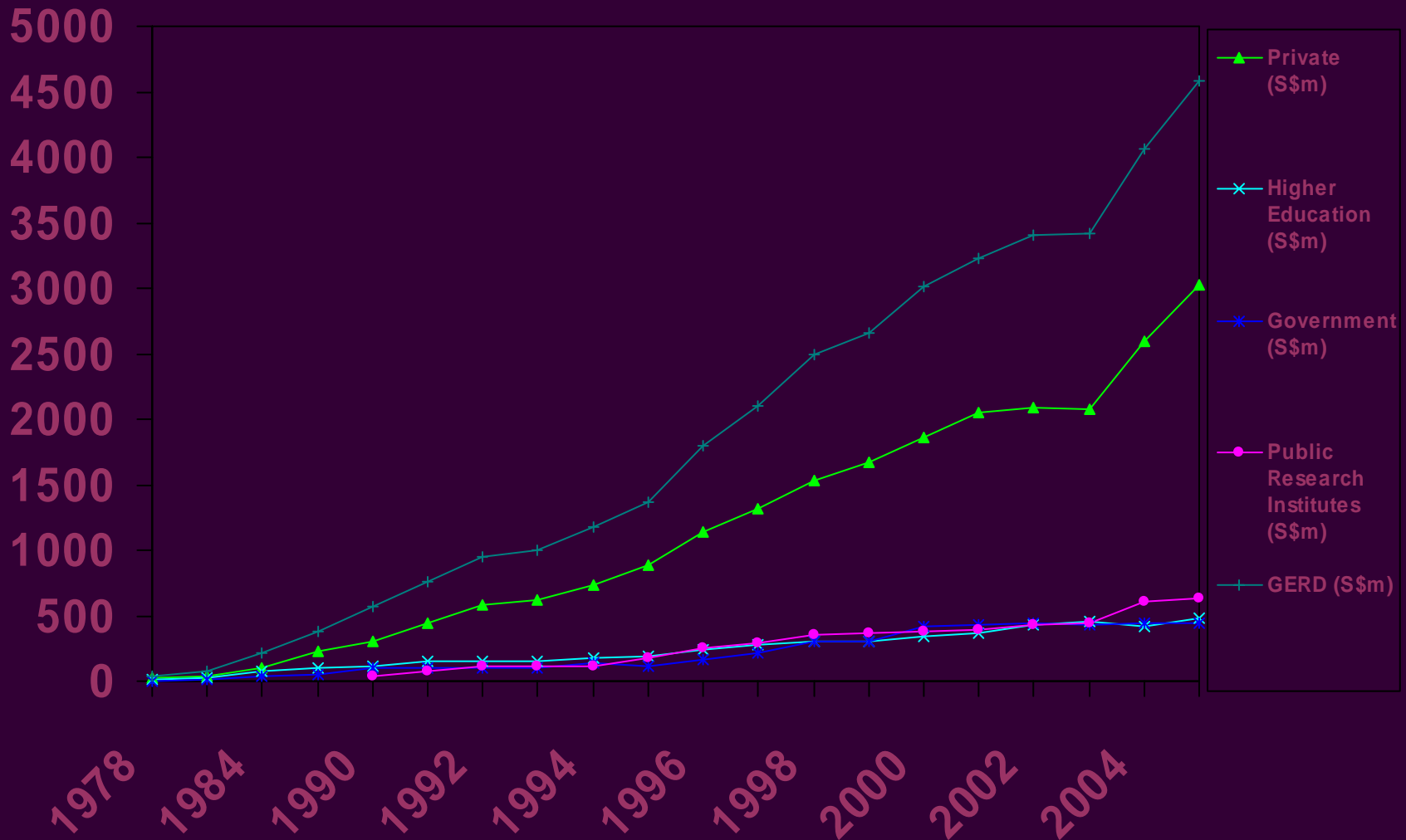




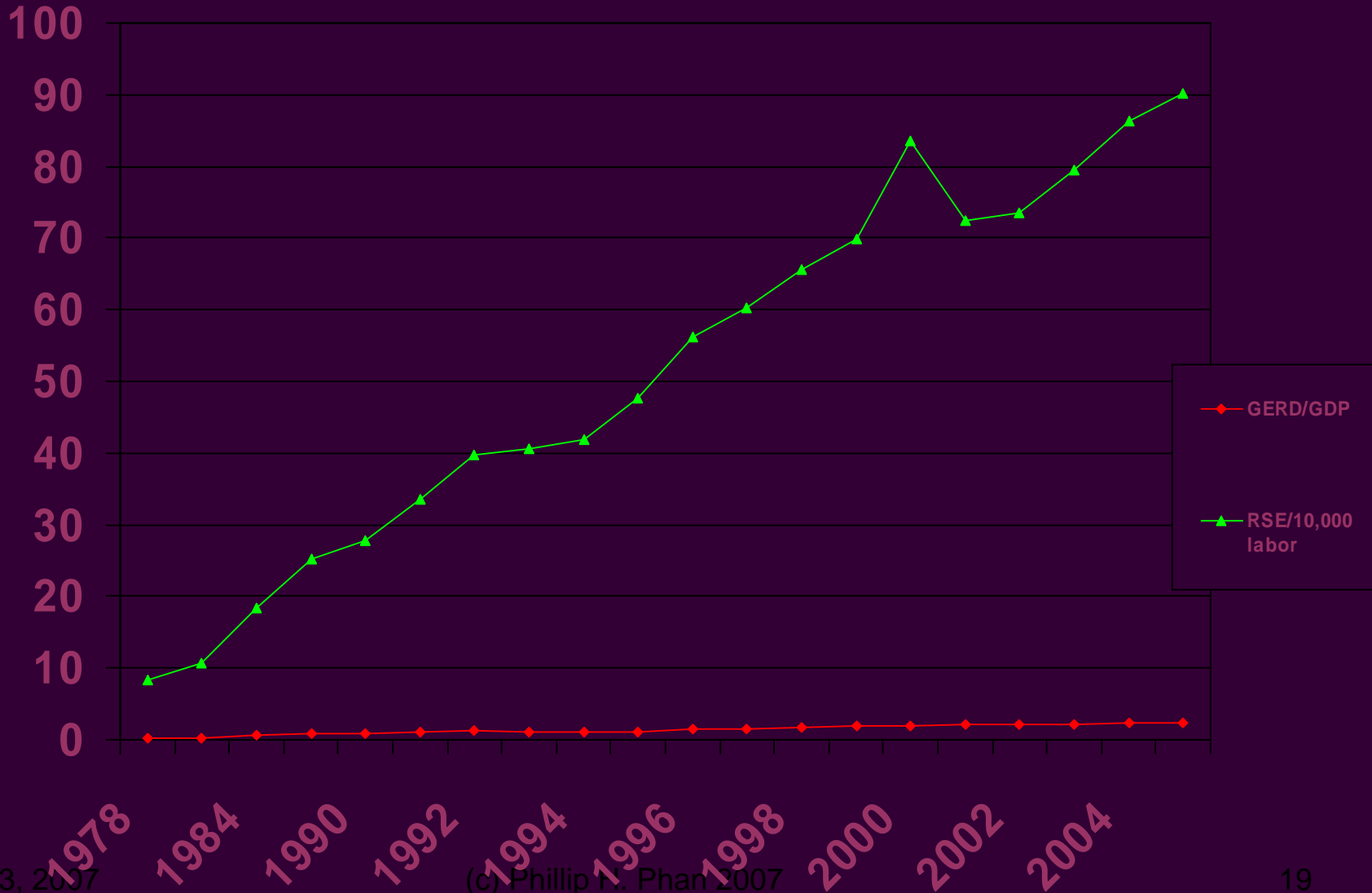
# Institutions Supporting R&D



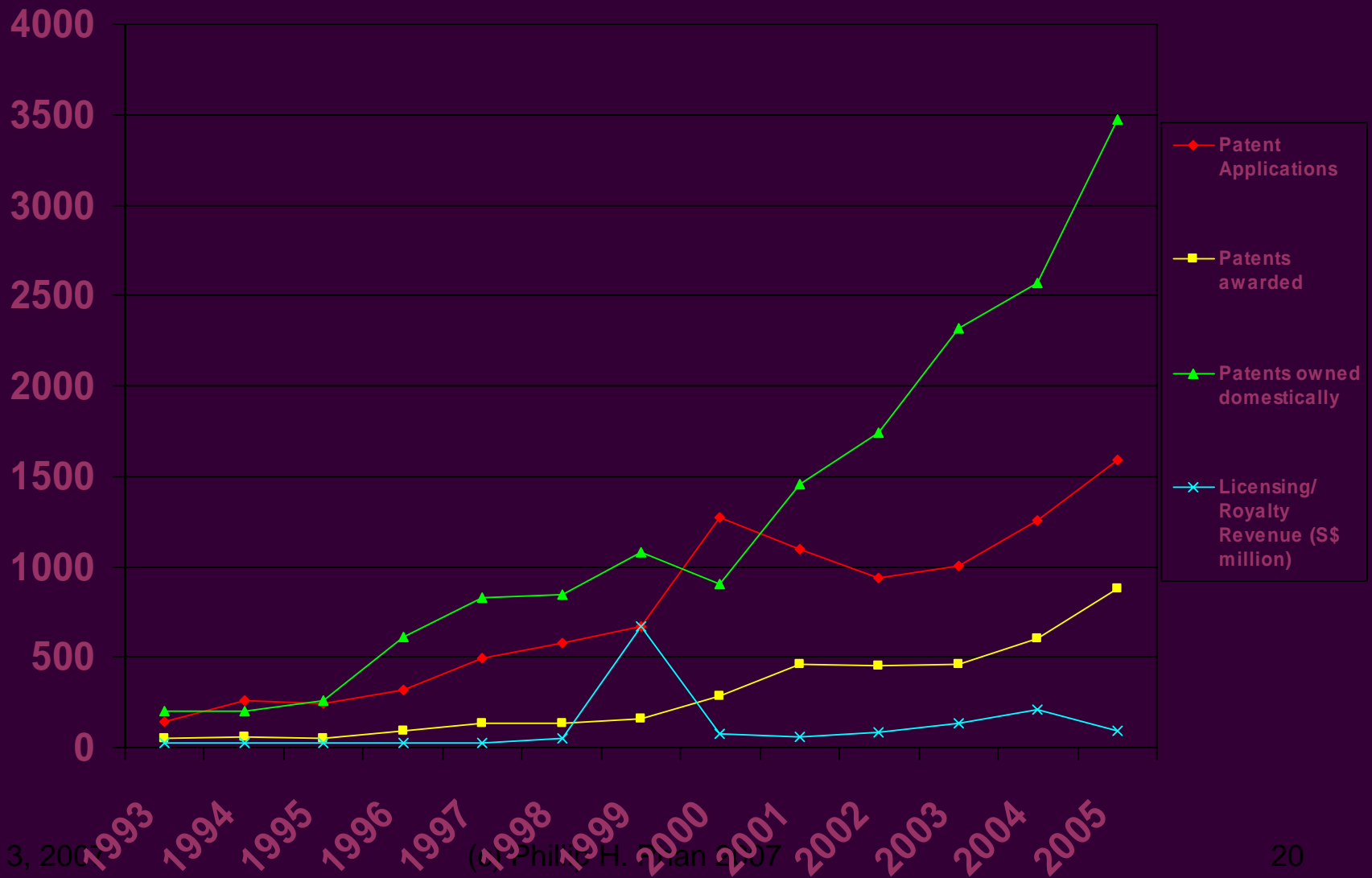
# R&D Spending 1978-2004



# R&D Capabilities



# R&D Output



# Lessons Learned in the Singapore Example

- Science parks are expressions of national technology and development policies
- Supporting *institutions* create necessary initial conditions
- Talent matters as much if not more than dollars
- Estate planning matters (implication for talent)
- Societal commitment to innovation matters
- Science parks are part of a global network of national knowledge creation capabilities
  - *Transnational learning and knowledge transfer*
  - *Talent magnets*
  - *Hubs for University, MNC and SME interactions*

# Metrics for Evaluating Science Park Outcomes

- **What is the purpose of the park?**
  - *Export orientation*
  - *Knowledge transfer*
  - *Knowledge creation*
- **Export**
  - *Ratio and rate of foreign/ domestic sales*
  - *Number and rate of foreign/ domestic joint ventures*
- **Knowledge transfer**
  - *Space uptake by foreign R&D based firms*
  - *Formal links between park and domestic knowledge institutions (universities, skills training centers, etc.)*
  - *Patents applied and received by park tenants*
  - *Rate of IP commercialization by park tenants*
- **Research productivity**
  - *Ratio of commercial to scientific space*
  - *Ratio and rate of MNC/ SME space uptake*
  - *Patents applied and received by domestic park tenants*
  - *Rate of IP commercialization by domestic park tenants*

# Remaining Research Questions

- **How to model and measure the link between science parks and economic development in the international context?**
  - *Mid-range theory development (absorptive capacity, spillover, agglomeration, network economics, what?)*
- **What is the appropriate economic model of a science park?**
  - *Political context drives input, output, throughput indicators*
- **Do science parks lead or lag knowledge accumulation and scientific takeoff?**
- **What does it mean that science parks lag the development of a field?**
  - *Singapore is unusual that it leads scientific knowledge development, China emulates in nanotechnology).*
- **What are the links between science parks, technology (national innovation) policy, and industrial policy?**