



Success Breeds Success – Experiences from Research & Innovation in Singapore



presented by

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The Research World has Gone from Bipartite to Tripartite





The Heterogeneous Rise of Asia

- China: Rising (more quantity than quality)
- India: Slowly developing (private sector leading)
- Japan: Stagnant at a high level
- Taiwan: Stagnant or even declining
- Hong Kong: High-level quantity & quality
- Korea: Strong & rapid development
- Singapore: Strong & rapid development
- Malaysia / Thailand: Slow development







World of R&D (2014)

Size of circle reflects the relative amount of annual R&D spending by the indicated country



Singapore: East Meets West

- Gained independence in 1965
 - Population size: \approx 5.47 million (2014)
 - Land area: 718 sq km (2014)
- English as the working language
- 3rd richest country in the World (2014): GDP per capital S\$ 71,318 (≈ € 49,100)
- GERD target: 3.5% in 2015
- Multicultural, highly cosmopolitan & diverse with people of Chinese, Malay, Indian & other ethnicities
- A rapidly emerging country when it comes to Academia & Research





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Singapore: A New Kid on the Block

- Significant investments in R&D only in the last 15 years
- Before year 2000, Singapore was not really on the world R&D scene

How to achieve rapid change of the ecosystem & its institutions?



Vibrant Academic Ecosystem in a Small Country

6 universities

- Nanyang Technological University (NTU)
- National University of Singapore (NUS)
- Singapore Management University (SMU)
- Singapore University of Technology & Design (SUTD)
- SIM University (UniSIM)
- Singapore Institute of Technology (SIT)

Research Institutes:

 Agency for Science, Technology & Research (A*STAR): 14 Research Institutes







INSTITUTE OF



CREATING GROWTH, ENHANCING LIVES

SMU





INSEAD The Business School

for the World®



Technische Universität Müncher

Imperial College London



Eidgenössische Technische Hochschule Zürich Swiss Federal Institute of Technology Zurich



The Singapore Government "Walks the Talk" for the Knowledge Society

RESEARCH

ENTERPRISE

COUNCIL

NNOVATION

• Research, Innovation & Enterprise Council (RIEC):

Chaired by the Prime Minister of Singapore, it brings together world-leading experts & 9 Cabinet Ministers to ADVISE the Singapore Cabinet on national research & innovation policies & strategies to drive the transformation of Singapore into a knowledge-based economy



Research & Innovation Drives Singapore

"I believe our future depends upon our ability to mobilise the qualities in our population to maximum advantage. It is the one thing we have which makes up for our lack of size and numbers, and it is of the utmost importance that, in the field of science and technology, we should lead the field in this part of the world."

The Late Mr Lee Kuan Yew 1st Prime Minister of Singapore Opening of the Science Tower in the University of Singapore, 1966

"... our R&D programme takes a longer time perspective. ... The Government remains fully committed to investing in R&D in order to develop a key capability that will keep our economy competitive in the long term."

Mr Lee Hsien Loong Prime Minister of Singapore Opening of Fusionopolis, 17 October 2008



Mr Lee Kuan Yew (1923 – 2015) 1st Prime Minister of Singapore



Mr Lee Hsien Loong Prime Minister of Singapore





Initiator of Singapore's Research Developments

The architect behind Singapore's quantum leap in research



Establishment of the National Research Foundation (NRF)

Dr Tony Tan Keng Yam President of Singapore (since 2011) Former Deputy Prime Minister Former Chairman of National Research Foundation



Singapore's Competitive Research Funders

- National Research Foundation (NRF)
- Academic Research Council of the Ministry of Education (MOE)
- Agency for Science, Technology & Research (A*STAR)
- National Medical Research Council (NMRC)
- Economic Development Board (EDB)
- Social Science Research Council



Singapore's Research Funding Landscape



Source: A*STAR

Tradition of Philanthropic Endowments – Generous Donation System

Encouraged & incentivized by Government

✓ Donors receive 2.5x tax reduction

 Endowed donations raised by universities are matched 1.5:1

For new institutions, eg. LKCMedicine: Government provide 3:1 match for first 10 years and 1.5:1 thereafter

 Example: LKCMedicine's S\$150 million donation from Lee Foundation will amount to S\$400 million, with Government matching between 1.5x to 3x



Singapore Rapidly Moving in Research; Innovation Lagging Behind

- Lack of role models
- Risk adverse
- Lack of Singapore industrial ecosystem
- Strong dominance of international multinational companies





Strong push from Government to focus more on Innovation



Brief History of NTU

- 1995: Founded as Nanyang University (Nantah; 1995)
- 1981: Establishment of Nanyang Technological Institute (NTI)
- 1991: Establishment of Nanyang Technological University (NTU)
- 1991 2001: Focused on education of engineers & business graduates for Singapore market
- 2001 2006: Establishment of several new disciplines
 - Biological Sciences, Humanities & Social Sciences, Physical & Mathematical Sciences and Art, Design & Media
- 2006 2015: Heavy investments in research & recruitments
- 2010: Establishment of Lee Kong Chian School of Medicine in collaboration with Imperial College London (first intake in AY2013)





• 2014: Establishment of Asian School of The Environment

NTU's Basic Facts & Figures

- Total student population: $\approx 32,500$
 - $\approx 23,500$ undergraduates
 - ≈ 9,000 graduate students
- International students:
 - 17.5% of undergrads
 - 52% of Masters
 - 79% of PhDs
- Total staff strength: \approx 6,850
 - ~ ≈ 1,700 faculty (including visiting faculty),
 943 international faculty
 - $\approx 2,350$ research staff
 - ≈ 2,800 admin & support staff





70% of international faculty & research staff





The NTU College Structure

College of Engineering

- Chemical and Biomedical Engineering
- Civil and Environmental Engineering
- Computer Engineering
- Electrical and Electronic Engineering
- Materials Science and Engineering
- Mechanical and Aerospace Engineering

College of Business

Nanyang Business School

College of Science

- Biological Sciences
- Physical and Mathematical Sciences
- Asian School of the Environment

- College of Humanities, Arts, & Social Sciences
 - Art, Design and Media
 - Wee Kim Wee Communication and Information
 - Humanities and Social Sciences
- Lee Kong Chian School of Medicine
 - Collaboration with Imperial College London

Autonomous Institutes

- National Institute of Education
- S.Rajaratnam School of International Studies
- Earth Observatory of Singapore
- Singapore Centre on Environmental Life Sciences Engineering





NTU in 2000...

- Educational Focus
- Limited to Engineering & Business
- Research not encouraged
- Old academic structure
- Ad-hoc recruitment/promotion
- Totally in the shade of NUS...

What catalysed the rapid climb?





Asian Normalised Research Impact Trends

NTU Top in Asia



Nature Index: NTU is no. 1 in Singapore!

New index launched in Nov 2014

- More inclusive; Broader scope of 68 top journals
- Different from Nature Publishing Index (covers only 18 Nature-branded journals)
- NTU ranked 33rd among 20,000 institutions worldwide & 6th in Asia-Pacific
 - NUS: 44th globally & 10th in Asia-Pacific

Subject rankings highlights

NTU

Chemistry: NTU ranked 6th in the world

	Subject Rank	
Subject	NTU	NUS
Chemistry	6	30
Earth & Environmental Sciences	254	350
Life Sciences	270	99
Physical Sciences	32	28





NTU – A Fast Rising University

- Recently ranked the world's no. 1 fastest rising young university by Times Higher Education
- Ranked 39th in QS World University Ranking
 Quantum leap of 35 places over 4 years
- Ranked 61st in Times Higher Education World University Rankings
 - Quantum leap of 113 places over 4 years
- Ranked 4th in QS Asia University Rankings
- Ranked 1st in QS Top-50 under 50



TECHNOLOGICAL

Broadening of Academic Portfolio

- Biological Sciences
- Humanities & Social Sciences
- Natural Sciences / Mathematics
- 2005 Art School
- Medicine (partnership with Imperial College London)
- Environmental Sciences





ACTION 1

Revitalising Human Resources

- American based appointment, promotion & tenure system with high bar for success
- Applied retroactively to all faculty at NTU (2007-2009)

ACTION 2

 Out of 750 cases, one third did not make the cut



 Strong emphasis on international recruitment



NTU's Top Recruitment – Examples of Eminent Senior Academics



Stephan Schuster From Penn State Uni, USA



Staffan Kjelleberg From UNSW, Australia



Phil Ingham, FRS From Uni of Sheffield, UK



Daniela Rhodes, FRS From Uni of Cambridge, UK



Kerry Sieh From Caltech, USA



Par Nordlund From Karolinska Institutet, Sweden



Sven Pettersson From Karolinska Institutet, Sweden



Bernd Schmitt From Columbia Business School, USA



James Best From Uni of Melbourne, Australia



David Becker From Uni College London, UK



Charles Salmon From Michigan State Uni, USA



Zhou Min From UCLA, USA





NTU's Outstanding Young Researchers (NRF Fellows)





Thomas Pevrin LKY Fellow. From NTU

Zhou Jianrong From UIUC

Karen Crasta From A*STAR



Gao Yonggui Hilmi Volkan Demir Christos Cho Nam Joon From Cambridge From Bilkent Uni Panagopoulos From Stanford Uni From Cambridge Uni Uni





From Uni



Chen Xiaodong From Northwestern Washington St Louis Uni



Lan Shau-Yu From UC Berkeley



Mikinori Kuwata Ali Miserez From Harvard From EPFL



Uni



Chi Yonggui From UC Berkeley



Naohiko Yoshikai From Uni of Tokyo



Adam Switzer From Uni Hong Kong



Berkeley





Troy Lee From NUS



Chong Yidong From Yale



Gao Weibo From ETH Zurich



Frederique Oggier Emma Hill From Harvard-From EPFL Smithsonian Center for Astrophysics



Nathalie Goodkin From Uni Hong Kong



Sylvain Barbot From NTU





Judith Hubbard From NTU



Uni





Kim Young Jin From KAIST



Xiong Qihua From Harvard



Top Recruitment: Origins of NRF Fellows & Nanyang Assistant Professors

Stanford University, USA	University of Oxford, UK
Harvard University, USA	University of Cambridge, UK
Georgia Institute of Technology, USA	University of London, UK
California Institute of Technology, USA	Max Planck Institute, Germany
University of Washington, USA	Charles University, Prague, Czech Republic
Northwestern University, USA	Katholieke Universiteit Leuven, Belgium
University of California, San Diego, USA	Interuniversity Microelectronics Centre, IMEC, Belgium
Chinese University of Hong Kong, PRC-HK	Hong Kong Polytechnic University, PRC-HK

>80 outstanding young researchers

33 out of 68 NRF Fellows (49%) chose NTU as host institution 50 Nanyang Assistant Professorships awarded (from >2,800 applicants worldwide)

Non-Fatalistic Strategy

- Strong governance A high-level & pro-active university board
- Top-down university management (with big ears)
- Strategic plan with prioritised areas

ACTION 3

- Economical incentives
 for success
- Strong follow-up culture from Ministry





Emphasis on Research

For promotion & tenure

ACTION 4

- Start up research funding / seed funding
- Initially reduced teaching load for new hires
- Push for external research funding
- Establishment of interdisciplinary
 thematic research centres
- Priority of research areas in so-called Peaks of Excellence
- International academic & industrial partnerships





Reform of Education – Reduction in Passive Consumption of Lectures



Infrastructure Investment

NIU investing >S\$1.8 billion in new infrastructure

- Halls of residence for students; 50% more residential rooms for students
- 16,000 students on campus;
 1,000 professors
- Medical school

ACTION 6

- 24 Hours Learning hubs
- Research labs
- Restaurants, cafes, etc
- MRT/LRT connection



Universities Today are GLOBAL Taking NTU to the World &

Bringing the World to NTU

International academic & industrial collaborations

ACTION 7

Institute of Advanced Studies

Ambition that 80% of all NTU undergraduate students spend 1 semester abroad Global Dialogue at NTU (Partnerships with Times Higher & the Nobel Foundation)

> 75% international faculty

NTU satellites abroad





Strong Drive for Innovation

- NRF proof-of-concept grants
- 10% innovation overheads
- SPRING Singapore connect
 SMEs & universities
- Funds for industrial collaboration



 University Boards having special Enterprise committees



NTU's Global Research Alliances with Industry





NTU's Start-ups & Spin-offs



over the past 10 years

UNIVERSITY



Key Changes Behind Progress

- 1. Broadening of academic portfolio
- 2. Revitalising human resources
- 3. Non-fatalistic strategy
- 4. Emphasis on research
- 5. Reform of education
- 6. Infrastructure Investment
- 7. Internationalisation
- 8. Creating global partnerships

Strong financial support from Singapore Government



Singapore Challenges

- Strong utilitarian approach Focused on the Singapore economy
- Priority on short-term national problems
- Administration of research funding not yet mature
- Risk adverse mindset
- Innovation not vibrant
- Tensions between legacy & rapid change
- Few Singaporeans favour an academic career



- Asia & Singapore are developing very fast
- What about Europe & Austria?
- Academically, the West has influenced the East; When will the East start to influence the West?



Yunnan Garden Residential Campus

One of the world's 15 most beautiful campuses, according to American Express' Travel + Leisure magazine

