Creating New Knowledge, Generating New Ideas

Professor Ho Teck Hua, Deputy President (Research and Technology) and Tan Chin Tuan Centennial Professor, National University of Singapore (NUS), explains the relationship between a university and research and the role of philanthropy in helping to find solutions to complex problems.

Why is research important to a university?

A university’s reputation and academic standing are built upon the quality of its research.

The central mission of a university is the creation and dissemination of knowledge. Hence it is important for a university to actively discover and create new knowledge and to generate new ideas, which in turn lead to new approaches to solving important problems. The source of all this new knowledge and new ideas is the research carried out by the university’s faculty and students.

The higher the quality of a university’s research, the greater its social and/or economic impact locally and globally. Once a university is recognised for its research excellence, it will be able to recruit the best academic talent from around the world, attract high quality students from local and international sources, and secure partnerships with premier academic institutions, key government agencies and leading industry players.

Has this been true for NUS? Has research played a key role in establishing our reputation?

Yes, it most certainly has.

The Singapore government has been investing significantly in public sector research and development (R&D) since the year 2000. As a result, more funding for grants and facilities has become available and NUS researchers have competed successfully for this funding. The additional resources have also enabled us to recruit more top-notch scientists to join NUS. The volume and quality of our research output have risen steadily since then and this has played a major role in NUS’ rapid rise to the top of the world university rankings.

“The volume and quality of our research output have risen steadily and this has played a major role in NUS’ rapid rise to the top of the world university rankings.”

Continued on page 6
Philanthropic support for MERCI, part of the NUS Yong Loo Lin School of Medicine, fosters innovations that have the potential to benefit millions of patients.

An electronic device that rotates bedridden patients’ bodies to prevent them from developing bed sores. A removable barrier in the stomach that helps resolve Type 2 diabetes by limiting the absorption of food and creating a feeling of fullness.

These are just two innovations to improve the lives of patients that were taken from concept to reality thanks to gifts to the Medical Engineering Research & Commercialization Initiative (MERCI) at the Department of Surgery at the NUS Yong Loo Lin School of Medicine.

"It is very challenging to obtain funding to transform an idea from being just an idea into a tested proof of concept that can be used to apply for government or other grants. These philanthropic gifts provide a much-needed leg up for our team who are working hard to understand what clinicians need and to translate those needs into products that will make a difference to patients’ lives," shares Professor C N Lee, Chair, MERCI.

Mr Prajogo Pangestu supported MERCI as a seed gift partner in 2009 and Mr Arthur Ng Boon Chye supported its belt. The Flipod, the product of this research, has many innovations under its belt. The Gastrointestinal Sleeve (GDS), designed to resolve both Type 2 diabetes and obesity, mimics the effects of bariatric surgery, where parts of the stomach and intestines are removed to reduce weight and bring diabetes into remission. The GDS is a safe, minimal invasive and reversible solution that is endoscopically inserted and anchored in the stomach. By occupying space in the stomach, the GDS prevents the absorption of food and reduces appetite. It can easily be removed at the end of the treatment.

"The gifts to MERCI have a multiplier effect: they have the potential to change the lives of not one patient but millions of patients. Moreover, they are part of the creation of an ecosystem, providing rewarding career opportunities for many, where medical technology solutions are conceptualised and eventually produced. These devices provide practical solutions to benefit patients in Singapore, across the region, and throughout the world," explains Prof Lee.

The Lloyd’s Register Foundation Institute for the Public Understanding of Risk was established through a generous gift of £10 million from the Foundation, a charitable foundation based in the United Kingdom (UK) that works to enhance the safety of life and property and advance public education. This is the Foundation’s largest gift outside the UK to date, and it is also the largest gift towards research that NUS has received from a foreign foundation.

The Lloyd’s Register Foundation Institute for the Public Understanding of Risk was established through a generous gift of £10 million from the Foundation, a charitable foundation based in the United Kingdom (UK) that works to enhance the safety of life and property and advance public education. This is the Foundation’s largest gift outside the UK to date, and it is also the largest gift towards research that NUS has received from a foreign foundation. It has received from a foreign foundation. In line with NUS’ commitment to the Institute, the University will contribute £11 million in funding for the new Institute.

"This new Institute will spearhead transformative research on the scientific understanding of risk and its practical application"
Spotlight on NUS Research: Anticipating What the World Faces Tomorrow

A leading global university centered in Asia*, NUS is internationally respected for its high-quality research in science, technology and the humanities — and increasingly, where these areas intersect.

Our 17 schools and faculties, and 30 university-level research institutes and centres, focus on addressing critical issues that are relevant to individuals, corporations and communities in Asia and the rest of the world. We devote resources to the translation of our research outputs into real-world solutions that aim to achieve economic and/or social impact.

Eight Research Clusters

NUS has established eight integrative research clusters drawn from multiple disciplines across the entire University to tackle complex challenges of importance to Singapore as well as the rest of the world.

1. Ageing

With ageing having one of the most rapidly ageing populations in the world, NUS researchers are studying the biological and environmental determinants of ageing well so as to better develop interventions that enable the elderly to remain healthy and active for as long as possible.

2. Asian Studies

Our researchers have developed unique expertise, insights and connections relating to critical issues in the wider Asian region such as political transitions, migration, urbanisation and the growth of market economies.

3. Biomedical Sciences and Translational Medicine

Tracking ever-evolving health issues, NUS emphasises “bench-to-bedside” translational research — moving seamlessly from laboratory experiments through clinical trials to point-of-care applications. The goal is to develop new drugs, diagnostics and devices for the prevention and treatment of diseases that are more common in Asians or have a unique pathology in Asian ethnic groups.

4. Finance and Risk Management

We contribute research that supports Singapore’s expanding role as an international financial hub, focusing in particular on those aspects of financial and banking systems that are relevant to policy makers, regulators and the financial industry (such as their resilience).

5. Integrative Sustainability Solutions

Harnessing NUS’ expertise in energy and environmental research, we advance novel integrated sustainability solutions that are optimised for tropical, urban and Asian settings. Some of our key areas of research include clean energy materials and systems, environmental surveillance and treatment of urban wasteways, water-to-energy conversion, seawater desalination, sustainable urban transport systems and enhancing liveability in high-density environments.

Our Research Ecosystem

- Over 2,000 research-active faculty members supported by over 3,000 research staff
- Over 8,000 papers published in internationally refereed journals
- Over 3,000 new and existing projects underway
- Over $371 million external research funding awarded
- Nearly 300 invention disclosures
- 520 patents filed
- 122 research awards received (Data from 2015)

NUS hosts three of Singapore’s five Research Centres of Excellence.

NUS has 28 university-level Research Institutes and Centres that focus on critical issues facing Asia and the world.

Spotlight on NUS Research: Getting a Foothold on Sustainability

We often hear the term ‘sustainability’ and the importance of conserving energy and resources. Sustainability, however, does not just refer to these aspects, but also the diversity, productivity and health of a nation in the long run.

Researchers at NUS and the National University Health System (NUHS) are investigating how a specially-formulated nutritional supplement taken before and during pregnancy could improve the health of the baby in the first year of life and beyond. The study, known as Nutritional Intervention Preconception and during Pregnancy (NiPPeR), may offer new insights into the long-term effects of pre-conception nutrition on the health of future offspring.

Ageing and quality of life

Our research works to ensure that an ageing population does not mean an increasing burden on society and at the same time does not decrease the quality of life for the elderly and their caregivers. The NUS Virtual Institute for the Study of Ageing (VISA) and Centre for Ageing Research & Education (CARE) are spearheading research efforts in these areas. Some main themes include neurocognitive disorders, retirement transition, long-term care and health and well-being.

Life in the future

As part of Singapore’s bid to become the world’s first smart nation, NUS has launched a Smart Nation Cluster integrating different disciplines. The three key research areas are: analysing big data from various sectors, optimising results obtained from this analysis, and safeguarding cyber security.

Stopping infectious diseases in their tracks

With increasing transnational movement of people, the spread of infectious diseases and strains has taken on a new urgency. NUS is pioneering the development and discovery of new and more effective methods for the treatment, prevention and control of new and emerging pathogens.

Making a resurgence worldwide, the incidence of the dengue virus has increased 30 times over the last five decades. Just last year, an NUS study identified a newly discovered antibody 5.7 that kills a strain of the dengue virus efficiently.

Plans are underway to test plans to test the 5J7 and discovery of 5J7 to target with therapeutics. This knowledge will help worldwide efforts to fight the poorly understood virus, which is a public health and research priority.

*12th worldwide and 1st in Asia according to QS World University Rankings 2016

Over the next 15 to 20 years, Singapore has to tackle key demographic issues such as an increasing elderly population, a rising rate of metabolic diseases and an increasing urban density.

To endure, Singapore must anticipate the challenges that will impact Singapore and the world and acknowledge the need to be future-ready.

With its multi-disciplinary teams, NUS is well positioned to provide research leadership across the wide range of issues relating to sustainability. Philanthropy, as well as excellent leadership, has played a pivotal role in the success of NUS sustainability research.

Examples of our sustainability research:

- Water, the source of life

Singapore’s unique water resource environment requires innovative water management solutions. NUS is committed to reinforcing Singapore’s water security and to helping establish Singapore as a water research hub.

Researchers at the NUS Department of Chemical and Biomolecular Engineering have developed innovative membrane technologies for clean water, clean energy, biofuel separation and carbon dioxide capture. These have great relevance and application in various areas of national importance, including the recycling of waste water and desalination of seawater, uncovering alternative clean energy options such as hydrogen, and reducing Singapore’s carbon emissions profile.

Modulating metabolic disorders

In Singapore, the obesity rate has increased from 8.6 per cent in 1992 to 15.3 per cent in 2010. Furthermore, 4 per cent of people aged 24 to 35 this year can expect to be diabetic by the time they are 65, based on projections by the NUS Saw Swee Hock School of Public Health. Many people who are obese or diabetic are afflicted by these conditions because their mother had gestational diabetes mellitus (GDM), or diabetes caused by the stress of pregnancy.

The rate of GDM in Singapore is alarmingly high, revealed GUSTO, a longitudinal study on babies conducted by the National University Hospital and the KK Women’s and Children’s Hospital. One in five of 11,336 pregnant women tested here had GDM — more than double the 9.2 per cent in the United States.

We often hear the term ‘sustainability’ and the importance of conserving energy and resources. Sustainability, however, does not just refer to these aspects, but also the diversity, productivity and health of a nation in the long run.

Researchers at NUS and the National University Health System (NUHS) are investigating how a specially-formulated nutritional supplement taken before and during pregnancy could improve the health of the baby in the first year of life and beyond. The study, known as Nutritional Intervention Preconception and during Pregnancy (NiPPeR), may offer new insights into the long-term effects of pre-conception nutrition on the health of future offspring.

Ageing and quality of life

Our research works to ensure that an ageing population does not mean an increasing burden on society and at the same time does not decrease the quality of life for the elderly and their caregivers. The NUS Virtual Institute for the Study of Ageing (VISA) and Centre for Ageing Research & Education (CARE) are spearheading research efforts in these areas. Some main themes include neurocognitive disorders, retirement transition, long-term care and health and well-being.

Life in the future

As part of Singapore’s bid to become the world’s first smart nation, NUS has launched a Smart Nation Cluster integrating different disciplines. The three key research areas are: analysing big data from various sectors, optimising results obtained from this analysis, and safeguarding cyber security.

Stopping infectious diseases in their tracks

With increasing transnational movement of people, the spread of infectious diseases and strains has taken on a new urgency. NUS is pioneering the development and discovery of new and more effective methods for the treatment, prevention and control of new and emerging pathogens.

Making a resurgence worldwide, the incidence of the dengue virus has increased 30 times over the last five decades. Just last year, an NUS study identified a newly discovered antibody 5.7 that kills a strain of the dengue virus efficiently. Plans are underway to test plans to test the 5J7 and discovery of 5J7 to target with therapeutics. This knowledge will help worldwide efforts to fight the poorly understood virus, which is a public health and research priority.

Over the next 15 to 20 years, Singapore has to tackle key demographic issues such as an increasing elderly population, a rising rate of metabolic diseases and an increasing urban density.

To endure, Singapore must anticipate the challenges that will impact Singapore and the world and acknowledge the need to be future-ready.

With its multi-disciplinary teams, NUS is well positioned to provide research leadership across the wide range of issues relating to sustainability. Philanthropy, as well as excellent leadership, has played a pivotal role in the success of NUS sustainability research.

Examples of our sustainability research:

- Water, the source of life

Singapore’s unique water resource environment requires innovative water management solutions. NUS is committed to reinforcing Singapore’s water security and to helping establish Singapore as a water research hub.

Researchers at the NUS Department of Chemical and Biomolecular Engineering have developed innovative membrane technologies for clean water, clean energy, biofuel separation and carbon dioxide capture. These have great relevance and application in various areas of national importance, including the recycling of waste water and desalination of seawater, uncovering alternative clean energy options such as hydrogen, and reducing Singapore’s carbon emissions profile.

Modulating metabolic disorders

In Singapore, the obesity rate has increased from 8.6 per cent in 1992 to 15.3 per cent in 2010. Furthermore, 4 per cent of people aged 24 to 35 this year can expect to be diabetic by the time they are 65, based on projections by the NUS Saw Swee Hock School of Public Health. Many people who are obese or diabetic are afflicted by these conditions because their mother had gestational diabetes mellitus (GDM), or diabetes caused by the stress of pregnancy.

The rate of GDM in Singapore is alarmingly high, revealed GUSTO, a longitudinal study on babies conducted by the National University Hospital and the KK Women’s and Children’s Hospital. One in five of 11,336 pregnant women tested here had GDM — more than double the 9.2 per cent in the United States.
NUS has established the Smart Nation Research Cluster to support Singapore’s Smart Nation vision.

The Smart Nation Research Cluster brings together researchers from multi-disciplinary backgrounds of engineering, mathematics, medicine, computer and social science, to collaborate on real-world solutions and ground-breaking innovations to improve people’s daily lives, as well as enhance individual and corporate security against cyber threats.

The Smart Nation Research Cluster Includes:

1. NUS Institute of Data Science
   The Institute of Data Science (IDS) taps on NUS’ extensive strength in data science and analytics. IDS coordinates and supports data science research initiatives across NUS, fostering impactful all-rounded solutions in the area of healthcare and security research that would benefit individuals, businesses and institutions in Singapore and beyond.
   To achieve these goals, IDS will foster strong inter-disciplinary collaborations with local and international researchers, industry partners and policy makers. IDS and its first Industry partner Microsoft Singapore will work on a series of industry-relevant data science research and education projects.

2. National Cybersecurity R&D Laboratory
   Advances in digital technology and hyperconnectivity have enhanced the way we live, work and play. However, this has also made us vulnerable to cyber security risks as never before. At IDS, the researchers work hard to find solutions and technology that would make Singapore’s cyber space secure.
   a) Singapore Cybersecurity R&D Consortium
      Building on NUS’ expertise in computing, information system design, quantum technology, cryptography, business, the Singapore Cyber Security Consortium will provide a seamless platform that engages with industry partners to increase cyber security technology awareness, facilitate the translation of promising cyber security technologies and lower the entry barrier for these technologies across industries. Such engagement will enable greater translation of use-inspired research, and greater deployment of cutting-edge technologies across companies.
   b) NUS-Singtel Cyber Security R&D Laboratory
      NUS researchers at this laboratory will leverage on their data analytics expertise to develop solutions that will enable IT service providers to automatically detect and respond to security attacks as they occur in real time. The NUS-Singtel Cyber Security Lab will develop novel, holistic solutions for security analytics, secure smart grids, securing the Internet of Things, and other key elements of the Smart Nation.
   c) National Cybersecurity R&D Laboratory
      The National Cybersecurity Laboratory harnesses its researchers’ expertise in the cyber economy, system and software cyber security to focus on areas such as cloud provisioning technology and big data management. This shared national research infrastructure aims to bring the local cyber security research community and industry partners together to carry out research on vulnerability assessment.
      Equipped with computing resources as well as application services for cyber security operation and development, this laboratory will curate useful datasets that enable repeatable and controlled cyber security experimentation and development of application services.

3. Institute of Operations Research and Analytics
   This research programme will conduct cutting-edge basic and applied research on the optimisation, analysis and management of service systems, that would enhance supply chain, healthcare, urban management, environmental and water systems in Singapore.

4. Virtual NUS
   a) Skyways Project
      Skyworks is a national project between Airbus Helicopters and the Civil Aviation Authority of Singapore to develop an Unmanned Aircraft System that addresses safety, sustainability and efficiency for parcel deliveries in urban environments.
      Airbus will use the NUS campus as a testbed to trial this last mile delivery system for delivery of small parcels to NUS staff and students across the campus.
      NUS researchers will also collaborate with Airbus to optimise and manage the drone’s flight control systems as well as enhance the cyber security features in its control software systems. The Skyworks Project will help to preproof to authorities and the general public that commercial drones can operate safely over urban areas.

A gift from CDL helps fund research into the space that we know as home, from building technologies to green innovations and the lifestyle choices we make.

The Singapore home, both as living space and a business, has come under the microscope thanks to a gift from City Developments Limited (CDL), a Singapore-listed international real estate operating company, to the NUS School of Design and Environment (SDE) to fund research into building innovations, sustainability, lifestyle and public policy development. The gift supports two new research laboratories: the NUS-CDL Smart Green Home and the NUS-CDL Tropical Technologies Laboratory (”T Lab”)

These initiatives, which are also supported by the Singapore Economic Development Board (EDB), will further strengthen Singapore’s position as a leading international Smart City and improve the quality of life in our highly urbanised environment.

The NUS-CDL Smart Green Home will be considered as an adaptable indoor-outdoor research space that can be configured to test lifestyle scenarios, space-use configurations, features and technologies that are emerging or on the horizon.

Echoing the former Dean of SDE, Professor Pang Chye Kiang, the new Dean, Professor Lam Khee Poh, explained, “The purpose of the NUS-CDL ‘T’ Lab is to examine integrated technology solutions for people-centric, climate-responsive buildings of the future. The research directions include ‘Healthy, Green Living,’ to find out how we integrate passive and active building systems, and ‘Future Lifestyles’ to explore the adaptability of the Singapore home – its shell and fit-out – to living, safety and security, work-life balance, social and cultural expectations.”

The NUS-CDL Smart Green Home will serve as a thought leader to help position Singapore as a global leader in Smart City research, provide new opportunities for cutting-edge basic and applied research and be used as a demonstration project.

Mr Grant Kelley, CDL Chief Executive Officer, says, “In support of the national vision for a smarter, greener and more livable Singapore, CDL is excited to collaborate with NUS on the NUS-CDL Smart Green Home and T’ Lab, with EDB as our supporting partner. For over 20 years, CDL has championed leading-edge innovations in our projects to create impactful and long-term value for homeowners. With CDL’s expertise in applying novel building technologies, we look forward to sharing our industry knowledge and carrying out pilot testing at our future developments. The capabilities developed by the two NUS-CDL platforms will also set new benchmarks for the building industry, as Singapore gears up to become a smart and sustainable nation.”
BUSINESS LEADER GIVES TO ADVANCE RESEARCH INTO AGING

Mr Leong, who has already established a scholarship at NUS, supports research into problems faced by the elderly.

Mr Leong Mun Sum, Managing Director of the Leung Kai Fook Medical Company (LKF), has made a gift to the NUS Faculty of Science to support research on addressing the needs of an ageing population.

The research will seek to identify natural and cost-effective treatments for conditions commonly faced by the elderly, such as arthritis.

“We have very few resources to do basic research. We hope teaming up with a university will help lead to advances in research.”

Mr Leong’s interest in research, and ageing in particular, stems from the nature of his business, and the challenges that lie ahead for Singapore.

He explains, “Research is very important to a medical company. LKF is no exception. But, we have very few resources to do basic research. We hope teaming up with a university will help lead to advances in research.

“There is much publicity around the government’s plans to address the needs of the ageing population. It is one of my hopes that NUS will come up with solutions to help the elderly.”

The businessman, a pharmacist by training, also understands the multiplier effect of the community coming together to make a difference. “There is a Chinese saying – 抛砖引玉 – throw a stone and attract the jade. I hope that a small company like LKF, by throwing a piece of stone, can attract large companies and organisations to join us by throwing large pieces of jade into the medical, pharmaceutical research, education pool and create a wave,” he shares.

“There is much publicity around the government’s plans to address the needs of the ageing population. It is one of my hopes that NUS will come up with solutions to help the elderly.”

Corporate social responsibility is one of the pillars of LKF, which was founded by Mr Leong’s late father, Mr Leong Yun Chee, in 1928.

“My father’s contributions to charities and education are well-known. Today we continue to be an enterprise that practises the philosophy 取于社会, 回归社会: take from society and return to society,” says Mr Leong, who himself has won the Public Service Medal and Public Service Star for his valuable public service to the people of Singapore.

Mr Leong also made a gift to set up the Leong Mun Sum Scholarship at the NUS Department of Pharmacy.

LKF, a home-grown Singapore company, manufactures Axe Brand, one of the leading brands of medicated oil in Asia.

To explore working with NUS to foster innovation and find solutions to complex problems, please contact askdvo@nus.edu.sg or call 1-800-DEVELOP (1-800-338-3567).