Research, Innovation and Enterprise 2025 Plan
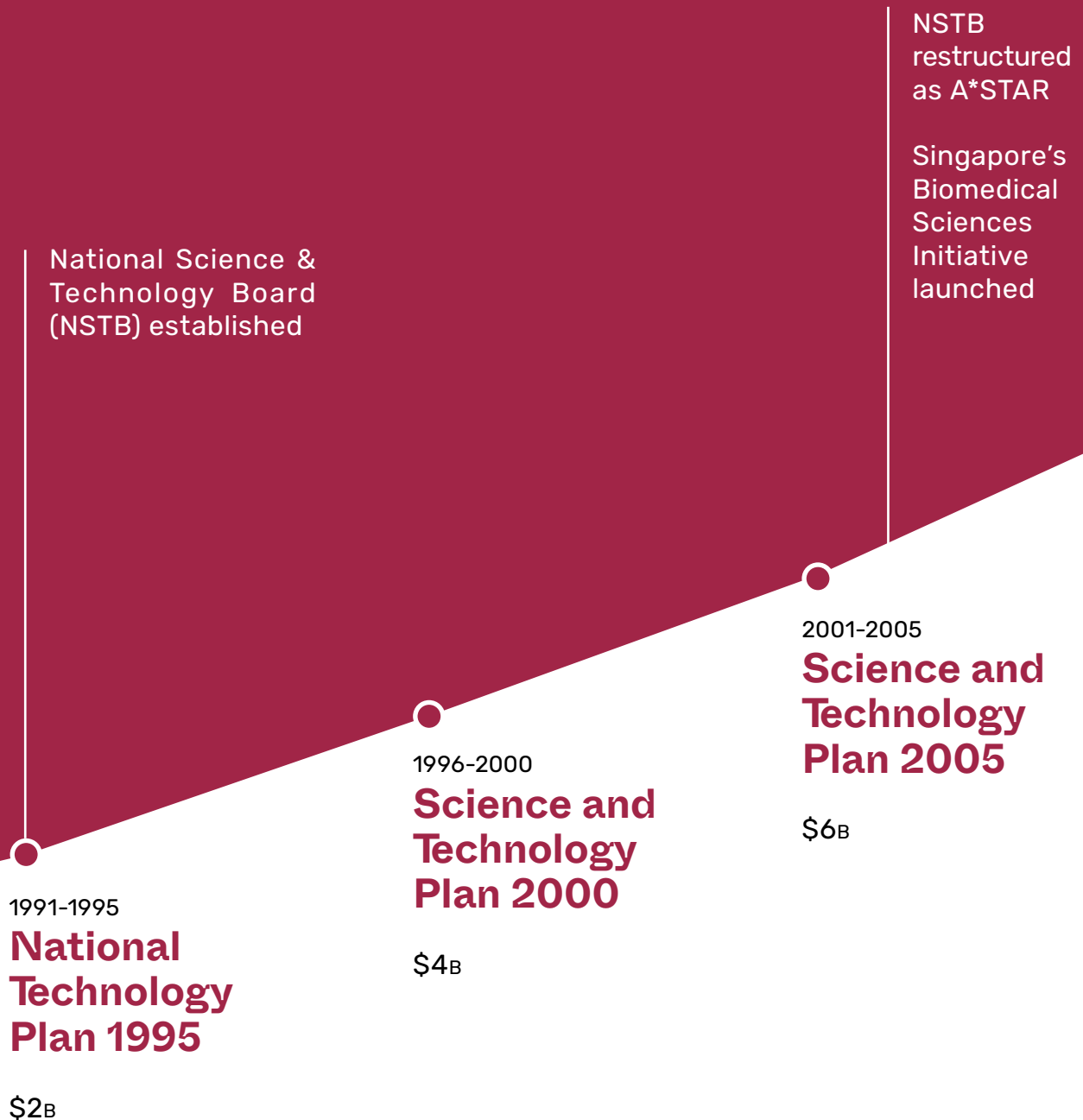
Contents

Introduction

Science and technology (S&T) is instrumental to Singapore's survival and success, and has helped us to overcome the constraints of our small size and limited resources.

Singapore's R&D journey started in 1991, with the establishment of the National Science and Technology Board, and the launch of the first five-year National Technology Plan. The aim was to develop high-technology activities that would move us up the economic value chain and build a strong base of scientists, engineers and technologists who would help to drive economic and enterprise transformation. These plans would be refreshed every five years to position Singapore as a knowledge-based, innovation-driven economy.

In 2010, Singapore's R&D strategy was expanded to span Research, Innovation and Enterprise (RIE). The RIE2015 and RIE2020 plans included translation, commercialisation and innovation strategies to tap on the growing pipeline of promising research outputs and support our enterprises.

Given the rapidly evolving global and technology landscape, RIE plans have also evolved to include White Space funding for unanticipated needs and opportunities. This has enabled Singapore to respond nimbly to new priorities, and to seed capabilities in critical, but then-nascent technology areas such as cybersecurity and food.

3 decades: The evolution of Singapore's RIE landscape

NSTB restructured as A*STAR

Singapore's Biomedical Sciences Initiative launched

National Science & Technology Board (NSTB) established

2001-2005
Science and Technology Plan 2005

$6B

1996-2000
Science and Technology Plan 2000

$4B

1991-1995
National Technology Plan 1995

$2B

Organisation of RIE
efforts around four
strategic domains

National Research Foundation
established

Launch of Strategic Research
Programmes in Environment
& Water Tech, Interactive &
Digital Media

2016–2020
**Research,
Innovation
and Enterprise
2020**

$19B

2011–2015
**Research,
Innovation
and Enterprise
2015**

$16B

2006–2010
**Science and
Technology
Plan 2010**

$13.5B

Deep research excellence

Steady and sustained investment in R&D is a key pillar of Singapore's economic development strategy.

We have built up a rich and diverse research ecosystem. Our Institutes of Higher Learning, Research Institutes in the Agency for Science, Technology and Research (A*STAR), academic medical centres and hospitals are well-regarded for research excellence. The Campus of Research Excellence and Technological Enterprise (CREATE) has established strong international partnerships between local research performers and their international counterparts.

We have developed world-class research infrastructure and facilities to strengthen our RIE ecosystem, including the St John's Island National Marine Laboratory, and the National Supercomputing Centre. Our researchers have also grown internationally-competitive capabilities in areas such as quantum technologies, glaucoma and retinal vessel research, 2D materials, and photonics. These have not only enabled new capabilities in adjacent technology domains, but also continue to attract local and global talent to work on emerging areas of science here. Since 1998, the number of researchers per 1,000 labour force has doubled, raising our national capacity for innovation across academia, industry, and government.

Over the years, we have seen a steady rise in the overall level of research quality in Singapore. The proportion of Singapore's publications amongst the world's most highly cited has grown steadily over the past 20 years. By 2013, Singapore had caught up with other Small Advanced Economies such as Switzerland and the Netherlands; and we have remained amongst the best over the past five years - 19% of our publications are in the top 10% most highly-cited publications worldwide.

%

Proportion of Singapore's publications amongst the top 10% most highly cited worldwide
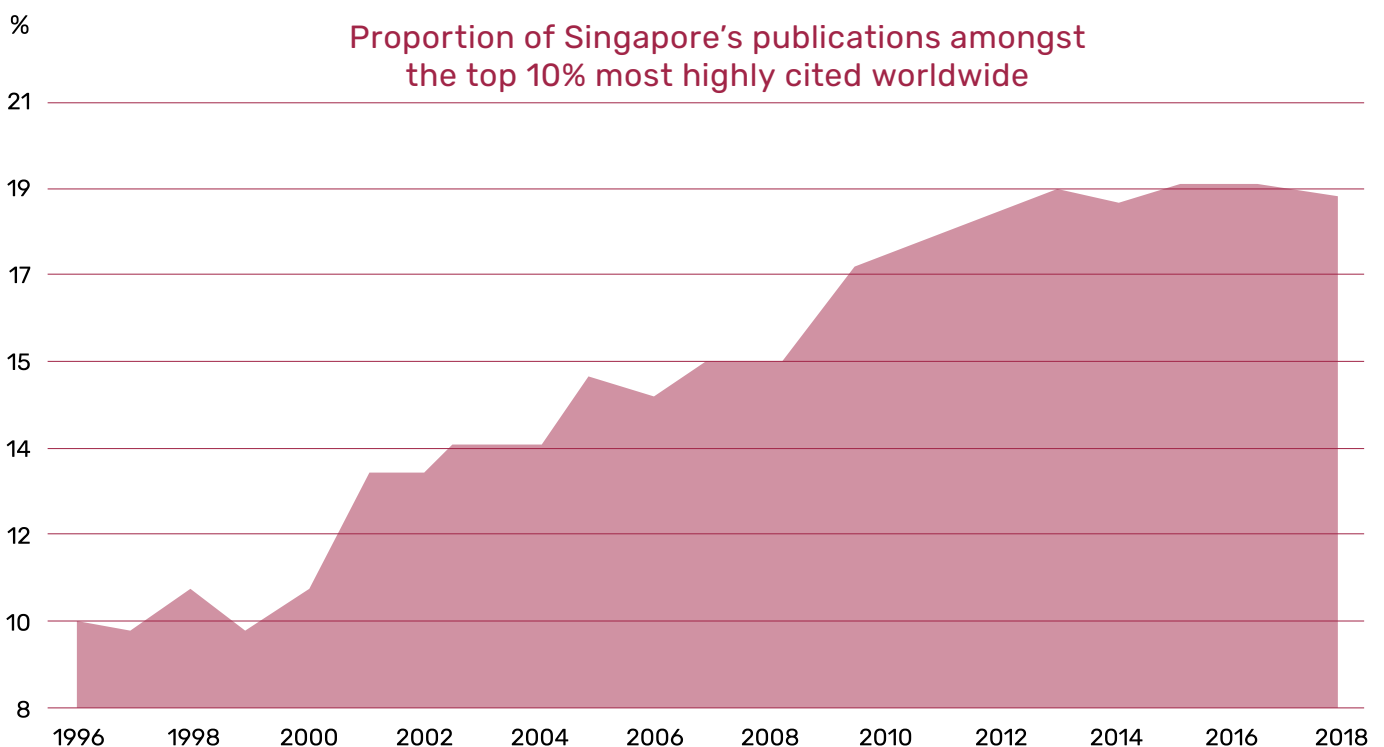
Vibrant and dynamic I&E ecosystem

Singapore has a vibrant and dynamic I&E ecosystem. Since 2014, Singapore has maintained its position as the top innovative nation in Asia Pacific on the Global Innovation Index, an annual ranking of 130 economies compiled by the World Intellectual Property Organisation, Cornell University and INSEAD. Private sector R&D activity has increased steadily, with annual business expenditure on R&D growing from $1.5B in 1998 to $5.6B in 2018.

Global companies have invested strongly in Singapore, creating vibrant industry clusters, enabling knowledge transfer to local enterprises, and creating good jobs for Singaporeans. 80 of the world's top 100 tech companies have established a presence here, including Google and Facebook. Through platforms such as corporate laboratories and technology consortia, RIE capabilities have also helped to hone the competitiveness of our local enterprises in the global economy through the development of differentiating capabilities. For example, local engineering companies such as Abrasive Engineering and 3D Metalforge have tapped on RIE partnerships to digitalise their capabilities and provide new service offerings to their customers. Our startup ecosystem has also grown in vibrancy, with about 36,000 startups choosing to locate themselves in Singapore. Many of these tech startups have formed strong RIE partnerships to build deep technology capabilities, and access a skilled workforce and international networks of partners and markets.

RIE2025

RIE remains a cornerstone of Singapore's development into a knowledge-based, innovation-driven economy and society. It is a key enabler in creating new avenues of growth and raising Singapore's economic competitiveness. It also generates scientific breakthroughs that meet our societal needs and improve the lives of Singaporeans.

We have evolved our RIE strategies to respond to new technological and societal driving forces. We will invest in a focused manner in strategic areas of national relevance, to address national needs, prepare for future challenges, and generate new opportunities for growth. These will help us, as a nation, to stay one step ahead of issues such as accelerating digitalisation, evolving global trade flows, and growing emphasis on climate change and sustainability. COVID-19 has also brought about unprecedented disruption to economies and societies. For example, over 75% of global manufacturing operations have been affected. But there are opportunities and hope – and Singapore is well-positioned to help our enterprises respond and emerge stronger.

Talent development continues to underpin our RIE efforts. We will continue to build up our local base of scientists, engineers and technologists, while remaining open to international talent, to create global impact.

For RIE2025, we will emphasise three strategic focus areas to build on the progress achieved in the past RIE plans and create greater value from our RIE investments.

Focus Area 1:
Expand RIE mission to tackle a broader spectrum of national needs

In RIE2025, we will build on our RIE capabilities to tackle a broader spectrum of national needs, enhance Singapore's competitive advantage in the long-term, and anchor our position as a Global-Asia node of technology, innovation and enterprise. RIE investments will be integrated tightly with national initiatives, such as the work of the Future Economy Council to drive economic growth and industry transformation, and our Smart Nation efforts to build a digital future for Singapore.

Focus Area 2:
Enrich our scientific base

Sustained investment in scientific excellence is essential to grow our base of capabilities. Over the years, our universities and research performers have built up foundational research capabilities. These form the pipeline for future value creation activities, and have strengthened their international research influence and attractiveness to top scientific talent.

In RIE2025, we will maintain our strong support for basic research. This will allow us to build up a critical mass of top research talent working on challenging research questions, forming a strong base of knowledge and capabilities for transformative innovations.

We will also continue to take a portfolio approach to research funding to ensure targeted support for the various segments of the research ecosystem. In RIE2025, we will increase support for investigator-led grants to encourage bottom-up research ideas and sustain a healthy research ecosystem. We will also increase funding for medium-sized grants to bring together capabilities with sufficient scale for impact. We will strengthen inter-disciplinary research needed to address complex challenges, such as climate change, and in novel and emerging areas such as materials informatics, nanoelectronics and nutri-epigenetics.

Focus Area 3:
Scale up platforms to drive technology translation and strengthen the innovation capabilities of our enterprises

Under the previous RIE plans, we have established I&E platforms that have shown good progress in driving technology translation of public sector S&T and innovation capabilities, to create value for our enterprises. Examples of these platforms include the National Additive Manufacturing Innovation Cluster (NAMIC) and the Diagnostic Development (DxD) Hub, which have driven industry and market adoption of additive manufacturing capabilities and diagnostic devices, respectively. These platforms have strengthened key capabilities at a national level, and also established strong partnerships with companies to catalyse new products.

In RIE2025, we will scale up these I&E platforms to expand our reach and support to local enterprises in technology translation and commercialisation. This will accelerate the speed at which companies can translate R&D into market-ready products and solutions. The platforms will serve as a node to bring together key stakeholders across the R&D community, enterprises, government agencies, and regulators, as a collaborative ecosystem to enhance the cross-pollination of ideas, knowledge, expertise and technology, and catalyse value creation.

We will also build on these platforms to move into high-growth adjacencies. For example, DxD Hub will move into other complementary areas of medtech, such as integrated medical devices or digital health. We will also further customise our I&E strategies to meet the different needs of various enterprise segments, address industry capability gaps, and strengthen our international networks to enhance our enterprises' access to technology, partners, talent and markets worldwide.

To grow the pool of talent in Singapore who can help bring nascent technologies to market and enhance the innovative capacities of our enterprises, RIE manpower schemes will be enhanced to gather and nurture 'bilingual' talent, who have both technological and business expertise. Opportunities for on-the-job-training through internships and traineeships in A*STAR Research Institutes and corporate laboratories sited in our autonomous universities will further develop their knowledge and skills, and facilitate strong networks across industry, academia and government.

RIE2025 Structure

Our RIE2025 efforts will be organised along four strategic domains, supported by three cross-cutting horizontals.

Manufacturing, Trade and Connectivity (MTC)

Leveraging R&D to reinforce Singapore's position as a global business and innovation hub for advanced manufacturing and connectivity

Human Health and Potential (HHP)

Better transform and protect health, advance human potential and create economic value for Singapore

Urban Solutions and Sustainability (USS)

Renew and build a liveable, resilient, sustainable and economically vibrant city for tomorrow

Smart Nation and Digital Economy (SNDE)

Develop technology leadership to drive our Smart Nation ambition, and anchor Singapore's position as a trusted digital innovation hub

Academic Research

Build a robust base of research capabilities and peaks of international excellence

Manpower

Nurture a strong research and innovation talent pipeline

Innovation and Enterprise

Accelerate enterprise innovation

RIE2025 Budget

The government will sustain investments in research, innovation and enterprise at about 1% of Singapore's GDP over 2021-2025 for RIE2025. This is about $25B, and reflects the Singapore government's sustained, long-term commitment to R&D through economic cycles.

A diversified portfolio of foundational and applied research, talent development, and innovation and enterprise
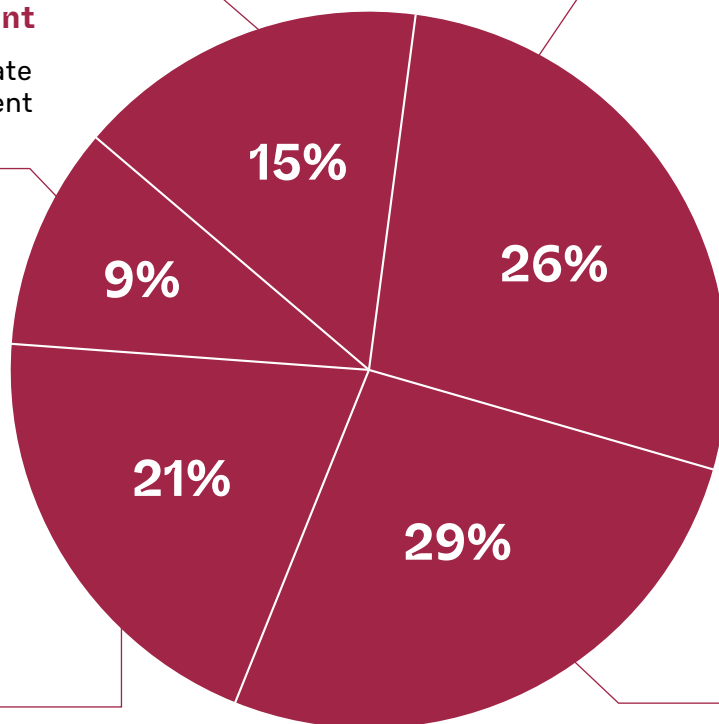
White Space

$3.75B set aside for agility; support new programmes to respond to future needs and emerging opportunities

Mission-oriented research

$6.5B to support the expanded missions of RIE domains

Talent development

$2.2B for postgraduate programmes, I&E talent development

Dedicated Innovation & Enterprise activities

$5.2B to establish new I&E platforms, strengthen enterprise innovation capabilities, and develop entrepreneurial talent

Core capabilities in universities and A*STAR Research Institutes

$7.3B to strengthen our core capabilities in universities and A*STAR Research Institutes

Manufacturing, Trade and Connectivity

Singapore has invested in R&D in advanced manufacturing and engineering technologies since its first National Technology Plan in 1991 to promote an knowledge-based, innovation-driven economy.

Over the years, RIE efforts have supported the continued growth and competitiveness of Singapore's manufacturing and engineering sectors. This has significant spill-over to the Singapore economy: for every \$1M of value-add (VA) generated by the manufacturing sector, a corresponding \$0.28M of VA was produced in the rest of the economy, particularly in knowledge-intensive services[1].

Singapore's strong technological capabilities have attracted and anchored multinational companies (MNCs) to establish corporate laboratories, R&D centres and perform high VA manufacturing activities in Singapore. This has brought direct benefits such as good jobs for Singaporeans, as well as benefits to the economy, such as technology transfer. In addition, the impact of RIE investments in cross-cutting technologies such as additive manufacturing can be seen in both manufacturing and non-manufacturing sectors.

[1] Source: Ministry of Trade and Industry's Economic Survey of Singapore.

Key achievements
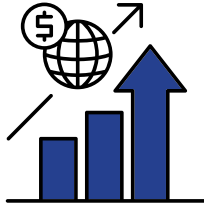
20.9% contribution of manufacturing to SG's GDP in 2019
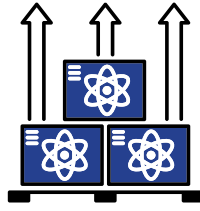
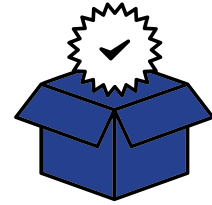4th largest exporter globally of high-tech products in 2017

12.8% of SG's workforce in manufacturing in 2019

$932M industry spending on R&D from 2015 – 2019

>5,000 public-private project collaborations from 2015 – 2019

>1200 new/improved products and processes for manufacturing companies from 2015 – 2019

Future of manufacturing:
Driving Industry 4.0

A model of a factory of the future, Model Factory at the Advanced Remanufacturing and Technology Centre (ARTC) is part of A*STAR's Model Factories Initiative to support the industry in their digital transformation journey.

Under the Future of Manufacturing initiative, A*STAR established three public-private partnership platforms to drive innovation, knowledge transfer and Industry 4.0 technology adoption in the manufacturing sectors.

The A*STAR Model Factory Initiative supported over 100 companies and deployed close to 2,600 technologies to enhance business productivity and efficiency. For example, Abrasive Engineering (AE) leveraged the Model Factory to optimise its machine maintenance cycles and minimise disruptions to the factory floor through Industrial Internet-of-Things (IIoT) technologies. Additionally, AE incorporated advanced image analytics and an online quality check system for higher quality assurance. This enabled AE to attract a larger customer base, resulting in a 40% revenue increase.

Through Tech Access, 149 unique companies have gained access to A*STAR's research infrastructure and expertise. This includes Sanwa-Intec (Asia) Pte Ltd, which used A*STAR's 3D X-Ray Computed Tomography System to conduct non-destructive scanning of their precision insert moulding samples to identify and rectify design issues, thereby improving product quality.

The Tech Depot, which provides companies with plug and play technologies for easy adoption, has enabled more than 800 digital adoptions by 635 companies, leading to productivity improvements of more than 20% for these companies.

RIE2025 Strategies

In RIE2025, the Manufacturing, Trade and Connectivity (MTC) domain will strengthen Singapore's positioning as a manufacturing hub and a Global-Asia node for technology, innovation, and enterprise. Our RIE investments will also anchor our competitiveness in areas of emerging opportunities, such as connectivity and supply chain management. These will enhance Singapore's value proposition to global manufacturers, open up networks to new markets and new expertise, as well as enable them to strengthen their supply chain resilience through digital technologies.

The MTC domain will deepen manufacturing capabilities and cross-domain technologies, such as artificial intelligence (AI), that will seed growth in adjacent sectors. Sustainable manufacturing will be a key focus area in RIE2025, driven by climate change concerns and greater awareness of the need to minimise our carbon and waste footprint. In RIE2025, we will also scale up tech translation platforms to enhance economic value capture, such as through the National Robotics Programme.

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Deepen the capabilities and competitiveness of our manufacturing sector

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Enhance Singapore's connectivity and capabilities in aviation and maritime

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Strengthen enterprise resilience, responsiveness and sustainability

① Deepen the capabilities and competitiveness of our manufacturing sector

The MTC domain will deepen the capabilities of our manufacturing sectors to help businesses expand into growth markets. For example, our public research institutes will strengthen their capabilities in technologies such as microelectromechanical systems (MEMS) to support the electronics sector in capturing new growth opportunities, such as in autonomous vehicles and healthcare wearables.

We will continue to build on our strengths in manufacturing technologies such as advanced materials, as a strong foundation for our efforts in RIE2025. For example, A*STAR's programme for Accelerated Materials Development for Manufacturing will leverage digital technologies such as machine learning, artificial intelligence, robotics and automation to accelerate the pace of materials innovation, which can be applied across multiple industry sectors.

Global trends in sustainability bring a competitive advantage to manufacturers that can successfully incorporate sustainability practices - for instance, minimising negative environmental impact and conserving energy and natural resources. In RIE2025, we will launch new initiatives to enhance enterprise capabilities in adopting sustainable manufacturing processes.

WHAT ARE MEMS?

MEMS are miniature integrated systems that contain mechanical and electronic components between 1 and 100 micrometres in size. Their small size enables batch production, which allows for the utilisation of fewer resources and at a lower cost than their larger counterparts, as well as the cost-effective integration of multiple functionalities onto small devices. MEMS can sense, control and actuate on the micro scale, and generate effects on a macro scale.

MEMS sensors have diverse applications in mobile phones, the Internet of Things, and satellite technology. New applications continue to be developed every day.

Electronics:
Capturing new opportunities

Singapore's strong R&D capabilities have helped to bolster the electronics sector. For example, our strengths in MEMS research have helped to anchor the manufacturing activities of leading multinational companies in Singapore.

In 2019, STMicroelectronics (ST) opened its newest wafer fabrication facility in Singapore. A global semiconductor company, and Europe's largest semiconductor chip maker based on revenue, ST's journey in Singapore started with its first assembly and testing facility here in 1969. ST now employs about 4,000 people locally.

In 2020, ST partnered with A*STAR and ULVAC to open a cutting-edge R&D line in its Singapore facility. The world's first "Lab-in-Fab" will produce Piezo MEMS, which have applications across various market segments, such as smart glasses, healthcare apparatus, and 3D printing.

(2) Enhance Singapore's connectivity and capabilities in aviation and maritime

Connectivity is critical for Singapore's survival, resilience and prosperity. As supply chains continue to evolve in a COVID world, our R&D serves to deepen automation and digitalisation in the aviation and maritime sectors, and enhance the competitiveness, efficiency and resilience of our airport and sea port operations.

To future-proof our airport and sea ports, we will also develop decarbonisation technologies and infrastructure to support industry demand for sustainable fuels. This will enable Singapore to shape the future of the global aviation and maritime industries and capture new opportunities. We will also develop even more advanced Air Traffic Management (ATM) capabilities to enhance Singapore's capabilities in managing one of the world's most complex blocks of airspace to the highest standards of safety and efficiency. These state-of-the-art solutions will help to anchor Singapore as a global and regional leader in ATM and support our ability to adapt and respond to increasing operational challenges.

Air traffic management:
Transforming operations with intelligent solutions

AI-based tools could enable air traffic controllers to handle complex traffic scenarios more safely and efficiently

The next bound of Singapore's ATM capabilities will bring it from a human-centric operation to an advanced human-machine partnership, leveraging digital technologies for decision support and to optimise operations.

In collaboration with our research institutes, the Civil Aviation Authority of Singapore is studying and developing AI-based tools that can enhance situational awareness for air traffic controllers, and deliver data insights and predictive capabilities to improve decision-making. These will enable smoother air traffic flows in the air and on the ground, minimise the likelihood of air traffic conflicts, and improve the resilience and efficiency of aerodrome operations even under poor visibility conditions. Advances in digital air and ground assistant tools will allow our controllers to handle complex traffic scenarios more safely and efficiently, even under difficult operating conditions, and pave the way for innovative concepts that can further improve the efficiency and safety of our air navigation operations.

③ Strengthen enterprise resilience, responsiveness and sustainability

In RIE2025, the MTC domain will undertake efforts to strengthen enterprise resilience, responsiveness and sustainability, such as through supply chain transformation and wider adoption of technologies such as additive manufacturing (AM).
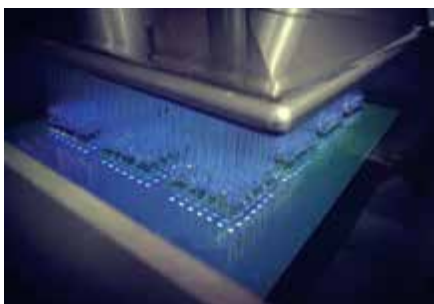
Changes in the global economy have disrupted supply and production chains. At the same time, they have exposed vulnerabilities and created new opportunities for businesses. Manufacturers worldwide are evolving their operations to increase the resilience of their supply chains. In RIE2025, we will embark on research programmes to address enterprises' supply chain concerns – for example, A*STAR's ARTC will develop platform technologies to enable enterprises to digitalise their supply chains for end-to-end visualisation and reconfiguration.

Technologies such as AM will enhance the flexibility and efficiency of manufacturing operations, as well as facilitate new concepts such as circular design. The National Additive Manufacturing Innovation Cluster (NAMIC) will scale up to strengthen relationships with key players across manufacturing, support the next phase of AM industrialisation, and target R&D efforts to meet industry needs and demand.

WHAT IS ADDITIVE MANUFACTURING?

AM is the industrial term for 3D printing, a computer-controlled process of making an object by depositing material in layers based on 3D model data. AM technologies facilitate design freedom, enable mass customisation, and can produce complex parts unachievable through traditional manufacturing methods. AM also helps to reduce material wastage, which is key to sustainable manufacturing, and increases the resilience of supply chains by enabling on-demand local manufacturing.

NAMIC:
Accelerating additive manufacturing implementation

Structo's 3D printed nasopharyngeal swabs went from design to development, clinical trials and manufacturing in under two months

NAMIC was established in 2015 as the national platform to accelerate the translation of AM technologies from public research performers to enterprises. To date, NAMIC has engaged over 1,800 organisations, orchestrated 23 international partnerships, curated over 230 projects, and supported 68 startups that have collectively raised more than US$140 million.

As part of Singapore's COVID-19 response, NAMIC partnered Temasek Holdings, the Economic Development Board, Health Sciences Authority, clinicians, researchers and 3D printing enterprises to design, develop, and mass-manufacture millions of 3D printed nasopharyngeal swabs to meet our national needs. NAMIC has also joined the ASTM International Global AM Manufacturing Centre of Excellence as a strategic partner. This marks global standards leader ASTM International's first partnership in Asia, and will support R&D and technology standardisation activities to help drive the commercialisation of cutting-edge AM technologies across sectors such as aerospace, maritime, and logistics. In RIE2025, NAMIC will drive the test-bedding and commercialisation of AM platforms, including solutions incorporating AI as well as robotics, to help local Small and Medium Enterprises transform from system integrators into solution providers.

Human Health and Potential

The Human Health and Potential (HHP) domain has its origins in the Singapore Biomedical Sciences (BMS) initiative, which was launched in 2000 to develop the life sciences as a pillar of Singapore's economy. Its initial focus was on establishing strong biomedical research capabilities, critical human capital and research infrastructure. Subsequently, there was a greater focus on translational and clinical research to derive both health and economic outcomes.

Under the RIE2020 plan, the BMS efforts were driven under the Health and Biomedical Sciences (HBMS) domain. Its key strategies included focusing on five disease areas with greater prevalence in Singapore and Asia (including various cancers and cardiovascular disease); establishing new pathways to support the translation of research discoveries into improved health outcomes and economic value; and developing a vibrant Innovation and Enterprise (I&E) ecosystem for pharmbio and medtech.

BMS: driving our COVID-19 response

Our strong HBMS capabilities have contributed substantially to Singapore's response to the COVID-19 epidemic. Following the SARS outbreak in 2003, Singapore invested in infectious diseases, diagnostics and therapeutics research, and built a critical mass of basic scientists, engineers and clinician-scientists through research grants and talent development schemes. This strong foundation enabled Singapore to be among the first to culture the SARS-CoV-2 virus, and develop diagnostic kits and first-in-class serological tests. Three local initiatives were implemented to develop novel therapeutic monoclonal antibodies, and a joint vaccine development effort was launched. Environmental transmission studies provided important data to inform public health policies and action. Furthermore, Singapore participated in several multicentre trials on novel therapeutics that ensured that patients here had access to promising new treatments.

Fortitude kit:
From Singapore to the world

Each Fortitude Kit comes complete with all the necessary reagents prepared in the right quantities, and quality-controlled tubes

Co-developed by A*STAR and Tan Tock Seng Hospital, the Fortitude Kit was the first "ready-made" hospital lab diagnostic test kit to receive Provisional Authorisation from the Singapore Health Sciences Authority for clinical use. This diagnostic test kit detects the presence of the novel coronavirus (SARS-CoV-2) with high accuracy, and was developed within a month thanks to close collaboration between scientists and the public health community. The Diagnostics Development (DxD) Hub at A*STAR also worked with the National Centre for Infectious Diseases to optimise and validate the tests before it was rolled out for production. To ensure that healthcare institutions could make the most of this research, A*STAR worked with biotech companies, such as local firm MiRXES, to transfer the technology know-how, and scale up production to meet local and international demand.

Today, the Fortitude Kit has been deployed to over 40 countries.

RIE2025 Strategies

In RIE2025, the HHP domain will build on our existing HBMS capabilities and incorporate a new emphasis on furthering human potential. Our vision is to make Singapore a leading hub that transforms and protects health, advances human potential and creates economic value through excellence in research and its application for Singapore, Asia and the world.

We will maintain our strong commitment to research excellence and building a diversified base of high-quality research talent. Funding for investigator-led research and human capital development will be increased. Our pool of clinician-scientists, as key drivers of translational research, will be expanded and diversified. New expertise will be developed in Health Tech, Population Health and Health Services Research. We will also intensify our efforts to attract and grow I&E talent through schemes and initiatives like the new I&E Fellowship, which will provide on-the-job training opportunities in private sector bio-accelerators and national translation platforms, and the Singapore Biodesign programme, which will groom Health Tech innovation talent.

1 Transform and protect health

Singapore is transforming its health system to deliver better health and healthcare outcomes for Singaporeans. Our rapidly ageing population and rising chronic disease burden require very different approaches. A fundamental shift towards health promotion and disease prevention is critical, and we need to empower individuals to better manage their own health and chronic conditions. The health system must become more data-driven and patient-centric to deliver value-based care, and will need innovative use of technology and digital solutions at scale. COVID-19 has highlighted that it is possible to move rapidly and decisively to use data analytics to support public health actions, and telemedicine to deliver quality care to the wider population.

In RIE2025, we will expand our national Precision Medicine (PM) research programme, and develop the infrastructure and capabilities to use data in a trusted, confidential and secure way to improve public health, enhance disease prevention, and deliver more targeted treatment for better outcomes.

WHAT IS PRECISION MEDICINE?

As opposed to a "one-size-fits-all" approach, PM uses relevant biological, medical, behavioural, genetic and environmental information about a person or a population to predict disease risk, diagnose medical conditions, and develop targeted treatments with reduced clinical complications. At the individual level, PM could provide more effective healthcare; at the societal level, PM could allow early interventions, thereby reducing the incidence of late-stage diseases and improving overall population health.

PREPARE:
Our response to epidemics

To better prevent, prepare for and respond to future epidemics, we will develop a National **P**rogramme for **R**esearch in **E**pidemic **P**reparedness **A**nd **RE**sponse: PREPARE. It will build upon our experiences with the management of infectious diseases, to strengthen essential research capabilities and expertise for epidemic control and prevention, as well as enhance our detection capabilities, so that we are better prepared against future public health crises.

PREPARE will strengthen diagnostics, therapeutics and vaccine development platforms, to ensure that these can be quickly deployed to address new or re-emerging infectious disease threats. We will also develop a regional infectious disease collaboration network, as well as exchange programmes for researchers, students trand public health experts. This will facilitate the cross-border sharing of resources and capabilities during peacetime, and allow us to expedite urgent clinical studies during an epidemic.

PRECISE:
Coordinating our precision medicine strategy

PRECIsion Health Research, **S**ingapor**E** (PRECISE) is the central entity coordinating whole-of-government efforts to implement Singapore's national PM research strategy. It brings together key institutions across Singapore to drive the clinical application and commercialisation of basic research outcomes in PM.

PRECISE aims to integrate large-scale genomic, phenotypic, lifestyle and clinical data to understand how these factors contribute to health and disease in our population. This would help identify higher-risk groups for whom the implementation of early prevention measures or timely treatments will result in better outcomes and lower costs. Besides facilitating data-enabled innovations across healthcare, PRECISE will catalyse the growth of the genomics industry, as well as biotech companies offering PM approaches and solutions. By leveraging Singapore's cutting-edge R&D activities and competitive strengths, PM will allow us to develop new products, solutions and treatments, creating new opportunities for Singaporean companies.

② Maximise economic value

Smaller-scale biotech companies, supported by global venture capital, are the new engines of innovation. Multinational pharmaceutical corporations have adopted new models to build their therapeutic pipelines – including technology co-development or licensing from smaller-scale biotechs, and through corporate acquisitions. In line with these trends, we aim to grow a vibrant mix of startups and scale-ups in Singapore, with a strong clinical translational ecosystem that provides multiple effective pathways to rapidly bring innovations to market.

We will further strengthen our major I&E platforms and enablers, enhance public and private sector I&E financing, and harness bio-accelerators to strengthen the local ecosystem. This will create clear end-to-end commercialisation pathways for ecosystem users, such as startups, clinicians, researchers and companies. For example, the DxD Hub will be the major commercialisation pathway for productisation, market access and adoption of new medical devices and diagnostics.
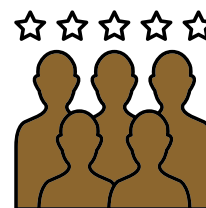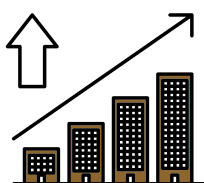
Economic value capture
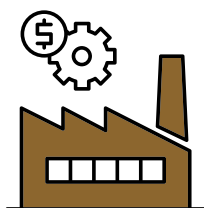
$32B manufacturing output from the BMS sector in 2019

4% contribution to SG's GDP from pharmbio and medtech in 2019

>24,000 workforce in 2019

>330 BMS startups in SG (x2 since 2014)

>US$250M raised by BMS startups in 2019

5x increase in industry R&D spending from 2013-2018

3 Advance human potential

Advancing human potential is absolutely critical for Singapore, as human capital is our principal and most valuable resource, especially given the challenges we face such as a rapidly ageing population. We will drive R&D and translation activities to support improvements in health, productivity, and learning capacity across an individual's life course.

The key focus is to build on our existing research strengths in prenatal and early childhood development, to identify, pilot and evaluate evidence-based interventions that may improve long-term health and learning capacity. Effective interventions will be progressively scaled. In addition, we will build on the Science of Learning initiative and neurocognitive science research and apply these to support programmes to improve learning outcomes for children and re-skilling in adult workers. We will also expand basic and translational research relating to healthy and meaningful longevity to enhance the health and wellness of older Singaporeans, and build on existing research capabilities in disease prevention, cognitive health, regenerative medicine, nutrition and rehabilitation.

WHAT IS HUMAN POTENTIAL?

Human potential refers to the capacity for individuals to develop to the fullest of their abilities. As the scope of human potential research is vast, we will focus on the three most critical junctures of an individual's life course: (i) prenatal and early childhood development, (ii) learning capacity in childhood and adulthood, and (iii) healthy and meaningful longevity.

GUSTO:
Singapore's largest birth cohort study

A researcher (in white) attending to a GUSTO baby

GUSTO (Growing Up in Singapore Towards health Outcomes) is Singapore's largest birth cohort study (over 1,200 Singaporean women enrolled since its initiation in 2009).

Led by researchers from the National University Health System, A*STAR, and KK Women's and Children's Hospital, the study focuses on local mothers and their children, tracking them from early pregnancy until the children reach the age of 10. The goal is to gain deep insights on what it takes to give Singaporeans the best start to life, and facilitate their optimal development across a long, healthy, and meaningful life.

Insights from GUSTO have informed the review and implementation of new health policies, including universal screening for gestational diabetes mellitus for all pregnant mums across public healthcare institutions. GUSTO data had showed that it manifested in around one in five pregnant women.

In RIE2025, GUSTO will continue to support our objective of advancing human potential. One key priority is follow-on studies of GUSTO children as they progress towards adolescence, to understand the links between early development and subsequent maturity of the individual. Other research areas include deepening our understanding of how sleep and digital media use may affect cognitive development and growth.

Urban Solutions and Sustainability

The Urban Solutions and Sustainability (USS) domain has its roots in two Strategic Research Programmes that were started under the Science & Technology 2010 plan back in 2006. These aimed to turn our water and energy constraints into economic opportunities and establish Singapore as a global hydrohub and clean energy hub. National Innovation Challenges in Energy, and Land & Liveability, were also launched in RIE2015 to kickstart R&D programmes to address our national energy and land constraints while maintaining liveability respectively. These initiatives have enabled us to grow a strong base of scientific capabilities that support our national priorities of water, energy, and land.

In RIE2020, we expanded the scope of the USS domain to address other national imperatives related to the sustainability and liveability of our future city. These include food, waste, urban design and mobility, as well as climate science.

Key achievements

Our RIE investments have contributed to helping Singapore overcome our resource constraints, while improving our liveability and sustainability. For example, we are on track to meeting our national water supply targets, at a lower energy and waste footprint. R&D outcomes in areas such as membrane bioreactor technology, have also allowed us to enhance the water filtration process to reap a cumulative ~$800M in cost savings as of 2015, as compared to using the conventional filtration process.

We are also making progress in meeting Singapore's carbon emissions reduction targets. For example, our R&D programmes have supported energy savings of up to 60% in our best-in-class buildings. We have also developed models and tools to improve our liveability. One example is the Integrated Environmental Modeller, a 3D simulation model that can map estates virtually. A collaboration between A*STAR and the Housing & Development Board, the model can forecast how environmental factors can affect heat comfort for residents. Another example is a wearable soundscape evaluation system that leverages augmented reality to improve the way city planners design our environment to aural comfort.

RIE2025 Strategies

In RIE2025, the USS domain will further strengthen our capabilities in building Singapore as a liveable, resilient, sustainable and economically vibrant city.

We will build on our efforts and increase funding support to three areas: (i) understanding, mitigating and adapting to climate change, (ii) developing Singapore as a city that nurtures citizens' health and well-being, and (iii) transforming our built environment to become more sustainable, while optimising our limited manpower and resources.

In addition, we will position ourselves as a leading centre for green services and solutions to transform and develop sustainable industries and enterprises. This will be done through the development of more industry R&D platforms and innovative enterprise support schemes, to catalyse the translation, deployment and commercialisation of research outcomes.

① Understanding, mitigating and adapting to climate change

As a small, dense, low-lying city, our geographical constraints mean limited access to renewable or alternative energy sources, in addition to a perennial battle against rising sea levels and rising urban heat island effects.

USS will adopt a multi-pronged approach to prepare Singapore for the impact of climate change. We will invest in research that deepens our understanding of climate change impact, such as in sea-level rise and changing weather patterns. We will also develop cheaper solutions to reduce our greenhouse gas emissions, and increase our use of renewables and low carbon technologies such as low-carbon hydrogen and novel carbon capture, utilisation and storage (CCUS) technologies. We will also ensure that we are able to adapt and build resiliency to the impact of climate change by protecting our coasts, resources and people against rising sea levels and temperatures. Given Singapore's strategic location in a region of rich biodiversity, there are also opportunities to conserve and leverage our natural assets to meet our sustainability goals. This includes developing multi-functional greenery and exploring nature-based solutions for climate change mitigation and adaptation.

WHAT IS THE "COLOUR" OF HYDROGEN?

Hydrogen has an important role to play as the world transitions to a cleaner energy landscape. But not all hydrogen is created in the same way.

Traditional production of hydrogen through the breakdown of fossil fuels releases carbon dioxide into the atmosphere, resulting in what is known as "grey" hydrogen. "Blue" hydrogen is produced the same way, but the resultant carbon dioxide is captured, stored and utilised – lending a hand in the global fight against climate change. Lastly, "green" hydrogen is produced via the electrolysis of water, powered by renewable energy sources such as solar or wind.

The Singapore energy story:
Clean, affordable and reliable

One of the "4 switches", solar power plays a key role in Singapore's energy strategy (Photo credit: SERIS, NUS)

Over the past 50 years, Singapore's energy sector has evolved towards cleaner power generation and implemented renewables like solar to address the challenges of climate change. We must change how we produce and use energy to grow sustainably.

The Energy Story sets the vision for a clean, affordable and reliable energy future through the "4 switches":

1. More efficient use of natural gas in power generation
2. Deploy 1.5 gigawatt-peak of solar power by 2025 and 2 gigawatt-peak by 2030
3. Leverage regional power grids for cost-competitive energy
4. Explore emerging low-carbon fuel alternatives to reduce our carbon footprint

We will fund R&D to support the Singapore Energy Story, as well as meet the targets of Singapore's Long-Term Low-Emissions Development Strategy. These include supporting projects in low-carbon energy technologies such as hydrogen and CCUS; and developing capabilities and solutions to support a future grid with a higher level of renewable energy deployment.

② Build a healthy, safe and resilient city

Good urban planning has allowed Singapore to enjoy strong economic growth and social cohesion, while addressing our resource and land constraints. Going forward, we will deepen our understanding of how urban planning can improve the health, well-being and quality of life in our community.

In RIE2025, we will develop new paradigms for city planning, design and operations to support the needs of the economy and industry, while addressing the health and well-being of the community. In addition to furthering our vision of a City in Nature, we will also deepen our understanding of how city design and urban planning can improve our prediction and monitoring of community health risks. This will strengthen our pandemic response capabilities.

In addition, we will enhance Singapore's resource resilience, such as in energy, water, and food. This will support our national strategies, such as the 30-by-30 goal to produce 30% of Singapore's nutritional needs locally by 2030, as part of the Singapore Food Story.

WHAT IS A CITY IN NATURE?

Singapore is today one of the world's greenest cities. This has been a journey of more than 50 years – to integrate nature into the urban fabric and create a better quality of life for our people.

The initial objective was to build a Garden City, with ample and accessible green spaces. Our vision then evolved to become a City in a Garden, with pervasive greenery across our urban landscape, leveraging biophilic design to restore natural habitats, and engaging the community in sustaining greening efforts.

The City in Nature takes this vision further, by enhancing and extending our natural capital across the island. This includes reconnecting natural ecosystems to enhance biodiversity, re-incorporating nature in our urban landscape, and leveraging nature-based solutions to solve urban challenges.

The Singapore food story:
Safeguarding Singapore's food supply

Growing our own food supply will safeguard us against disruptions and increase our resilience

Singapore imports more than 90% of our food from more than 170 countries and regions. While import source diversification is a core principle in our strategies to safeguard Singapore's food supply, we are vulnerable to disruptions and changes in the global supply chain.

RIE efforts will support the Singapore Food Agency's strategies to strengthen food security. Initially, this will focus on developing the capability and capacity of the local agri-food industry to grow local and increase our resilience to supply disruptions, as well as supporting our local companies to expand abroad and export produce back to Singapore. Our R&D objectives include increasing the amount of food produced per unit area by 100% over the current best-in-class solutions and lowering the energy cost of indoor farming by 90%.

③ Transform the built environment sector

The built environment comprises our homes, offices, national infrastructures, leisure spaces and green areas. To ensure that Singapore continues to harness global trends in this space, we aim to foster a highly productive, integrated and advanced built environment sector that can build and maintain our infrastructure in a more sustainable and resource-efficient manner.

USS will continue to drive R&D for new solutions that will value-add to our construction, facilities management and transport industries. This includes advanced robotics and automation technologies for onsite and offsite operations, additive manufacturing, as well as developing new cost-effective and sustainable construction materials. In addition, we will harness digital technologies to improve project management in the construction sector, and enhance operational productivity, as well as building maintenance and durability.

BETA:
Catalysing industry transformation in the built environment cluster

The BE-AMP platform aims to build up a vibrant ecosystem of built environment innovators through adoption of new technologies

The Built Environment Technology Alliance (BETA) is an RIE initiative to enables enterprises in the built environment sector to access new technologies that can increase their capabilities, value-add to their operations and maintain their international competitiveness. It is a membership-based Research and Innovation (R&I) platform that pools resources to co-create ideas, catalyses industry-led innovations, and translates results into economic value.

In RIE2025, BETA will also serve as the one-stop portal for companies to tap on the Built Environment Living Lab Framework, which facilitates industrial test-bedding of innovative proposals in our urban spaces and living environment, such as at Punggol Town and Jurong Lake Gardens. This will offer opportunities for companies to trial new and innovative technologies, facilitate translation to bring products to market, and support companies via regulatory sandboxes to validate their innovations at scale and address regulatory considerations.

Smart Nation and Digital Economy

RIE efforts in the digital realm started in 2006, with investments in the Interactive Digital Media Strategic Research Programme to build core technologies to support the growth of our digital economy and industries. Over the years, the domain has evolved to achieve closer alignment with national priorities, and focus on R&D and translation efforts to meet industry demand. Our research investments have enhanced Singapore's core digital capabilities across technology areas including artificial intelligence (AI), cybersecurity, quantum, trust technologies and communications.

In RIE2025, the Smart Nation and Digital Economy (SNDE) domain will continue to support the development of strategic and emerging technologies and enhance the translation of digital capabilities to industry. The aim is to achieve Singapore's Smart Nation ambitions, and leverage growth opportunities in the digital economy.

Key achievements

Singapore has internationally-recognised strengths in digital technologies, and we have made good progress in positioning ourselves as a Global-Asia R&D hub. Singapore's research publications in AI, quantum, and trust technologies (e.g. privacy preservation technologies, distributed ledger technologies) are amongst the world's most highly cited today.

Earlier investments in digital technologies and innovation activities supported the development of a vibrant and attractive start-up ecosystem in Singapore. Many digital start-ups have emerged across a diverse range of sectors, including fintech, digital health and e-commerce, with some such as Razer and Sea (Garena) achieving unicorn status. In addition, global digital companies like Google and Salesforce continue to make major investments in Singapore, expanding their R&D or engineering activities here and creating good jobs for our people. Our public research capabilities across multiple technology areas have also resulted in several spin-offs, including six cybersecurity startups that grew from the National Cybersecurity R&D Programme (NCRP).

In support of Singapore's Smart Nation ambitions, RIE investments have also enhanced the government's digital capabilities and strengthened the delivery of government digital services to the public, including services for language translation customised for Singapore.

SG Translate:
A translation engine for Singapore, made in Singapore

The SG Translate engine can capture Singapore's unique linguistic context

To serve the needs of the diverse Singaporean population, the government produces policies and information material in English, Chinese, Malay and Tamil. Translating such material from English into the mother tongues was manually intensive, since there were no market-available translation tools that adequately reflected Singapore's unique linguistic context.

Since 2016, A*STAR has worked with the Ministry of Communications and Information on the Customised Machine Translation Engine project, to develop a machine translation engine that can better reflect the local context, at higher accuracy and speed than other market-available engines.

This engine has been put to good use with over 100,000 first-cut translations produced for government agencies. It facilitated government communications with the public during the national COVID-19 response, reducing the time taken to translate each Gov.sg WhatsApp message by 25-50% as translation requests soared. Moving forward, the SG Translate engine will be integrated into the 'SG Translate Together' web portal and progressively rolled out to the whole of Singapore.

RIE2025 Strategies

The global digital landscape continues to evolve rapidly. Digitalisation across sectors has been accelerated by the recent COVID-19 pandemic, bringing to the fore increased demand for digital platforms, software, hardware, and services.

Amidst these changes, we must continue to prioritise efficient development and application of digital technologies across the public and private sectors. We will also have to continue to translate our R&D quickly into commercial benefits for industry.

As global supply chains continue to shift, and services and interactions move online, greater emphasis will be placed on strengthening the assurance of supply and provenance for items such as food, medicine and technology components. Singapore can play a role as a trusted innovator and value-adding intermediary, through the development of digital technologies, such as blockchain, to provide assurance of supply and provenance. We will develop new capabilities to strengthen the trusted Singapore brand, and build new partnerships that will bring us new knowledge and markets. Digital talent will underpin these efforts, and SNDE will continue to build a strong local base of scientists, engineers and product managers in key technology areas.

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Develop technology leadership to drive our Smart Nation ambitions

P. 34

Reinforce Singapore's position as a trusted digital innovation hub

P. 35

Enhance local capabilities and build new partnerships

1 Develop technology leadership to drive our Smart Nation ambitions

Singapore's Smart Nation strategy aims to build a digital economy, digital government and digital society, with every industry, business and government agency driving whole-of-nation digitalisation.

To support these ambitions, SNDE will continue funding efforts to develop, apply and scale high-tech digital solutions, to meet industry needs and demand. This includes enhancing Singapore's attractiveness as a testbed and springboard for deploying new technology solutions. We will also strengthen our technology translation strategies in RIE2025 to meet the varying levels of digital capability across enterprise segments. SNDE efforts will also support the work of the Future Economy Council to grow leading local companies and hone their competitive advantage in the global digital economy.

Given the short time-to-market for digital technologies, technology translation vehicles will be scaled up to facilitate greater co-creation of intellectual property, and strengthen capability transfer between our public research institutes and enterprises. Government lead demand will also be a key mechanism to trial and validate new technology solutions.

We will also explore and invest in the development of innovative inter-disciplinary technology solutions that have the potential to address complex challenges. For example, AI can be deployed in cybersecurity algorithms to learn from past attacks and better predict and defend against future attacks.

2 Reinforce Singapore's position as a trusted digital innovation hub

Digital trust will become increasingly valuable as businesses and lives continue to move into the digital space. To strengthen Singapore as a trusted digital innovation hub, we will leverage R&D to develop trust capabilities and new trust technology applications, such as "trust marks", which can be used to certify and brand trusted solutions and services for export in critical sectors such as food and healthcare.

As new norms of security, privacy and trust emerge, we will also strengthen technology-policy integration to guide technological developments in this fast-moving space. This includes creating platforms like the Centre for AI and Data Governance at the Singapore Management University that was established to conduct research to inform and guide AI and data governance in Singapore.

③ Enhance local capabilities and build new partnerships

We will continue to attract and nurture researchers and talents who can bolster our national capabilities in digital technologies, and build a broad base of scientists, engineers, entrepreneurs and product managers who will drive translation and adoption in key technology focus areas. In RIE2025, we will ramp up talent development initiatives like the Singapore Digital (SG:D) Scholarship, and AI Singapore's (AI.SG) PhD Programme to equip local talents with the skills and knowledge to take on managerial and technology leadership roles in enterprises, as key drivers of the next phase of economic growth.

RIE will continue to strengthen and build international partnerships for new knowledge, business capabilities, talent networks and markets. For instance, we will tap on the international reach of MNCs based in Singapore, and leverage their global R&D talent to transfer knowledge and provide our local engineering talents with new opportunities for meaningful work and to develop valuable cross-domain skills.

Artificial intelligence

AI is considered one of the most important technologies of the 21st century, and there is stiff global competition for the best AI capabilities and research talents, both in the public and private sectors. To set the national agenda for AI, Singapore published the National AI Strategy in 2019 and established the National AI Office under the Smart Nation and Digital Government Office.

As of 2019, Singapore's AI researchers rank top in the world in terms of field-weighted citation impact, and in AI research output (journals and conference papers) per capita. Four out of the IEEE Intelligent Systems journal's ranking of AI's '10 (researchers) to watch in 2018' are also based in Singapore.

In RIE2025, SNDE will continue to build on our AI R&D strengths and invest in new areas to support our national imperatives, including the objectives of the National AI Strategy. This includes fundamental research in potentially game-changing areas such as explainable AI, small data techniques and federated learning; strengthening our speed to market through technology translation labs and creating foundational building blocks for AI capabilities; as well as orchestrating the research and innovation ecosystem to address national needs and industry demand in sectors such as trade and connectivity, built environment, and professional services.

AI Singapore:
Kick-starting our national AI journey

AI.SG's establishment in 2017 was a signal to industry that AI was a national priority. It is structured as a national programme spanning the entire spectrum of research, to innovation and enterprise, and is designed to be nimble and agile to respond to the fast clock speed of digital technologies.

AI.SG has since engaged over 300 companies and started more than 60 projects under the 100 Experiments initiative that focuses on sectors such as healthcare, finance, and fast-moving consumer goods. AI.SG also launched the AI Makerspace in 2019, a platform comprising open data sets, AI tools, and pre-built solutions that Small and Medium Enterprises and startups can download to jumpstart their AI journey.

AI.SG's "AI for Industry" (AI4I) programme continues to train company employees in AI techniques that can be used for their companies' projects. AI4I has trained over 4,000 learners, and plans to train 8,000 more over the next three years. Other talent development schemes include the AI Apprenticeship Programme, which placed 166 apprentices in a full-time structured training programme under the supervision of companies for real-world practical experience, as well as the AI.SG PhD Programme to grow Singapore's pipeline of AI PhD talent.

In RIE2025, AI.SG's efforts will include setting up a federated learning AI ecosystem to drive economy-wide AI model building and sharing between academia, industry and government. AI.SG will also explore setting up a formal AI Professional society that will bring together talents for knowledge sharing and drive collaborations across the AI ecosystem.

Tech Areas
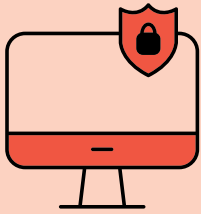
Cybersecurity

The World Economic Forum Global Risk Report 2020 cited cybersecurity as one of the top ten risks over the next decade. Our ability to strengthen and evolve our cybersecurity capabilities will become even more critical, as cyber threats and challenges grow in scale and complexity.

The National Cybersecurity R&D Programme (NCRP) was established in 2013 to leverage R&D to grow cybersecurity expertise and address national needs. Since then, the NCRP has launched three National Satellites of Excellence to drive development of local cybersecurity capabilities for trustworthy software systems, mobile systems and cloud, as well as to secure critical infrastructure. It has also co-funded 12 translational R&D projects with industry, and generated six spin-offs to bring the research outcomes to market. In addition, 67 SG:D Scholarships were awarded to grow the pipeline of local cybersecurity talent.

The Singapore Cybersecurity Consortium, set up in 2016, has also brought together public research institutes, government agencies and businesses to promote R&D, develop new cybersecurity solutions for commercialisation, and promote upskilling and reskilling. In RIE2025, RIE efforts will focus on further strengthening the cybersecurity ecosystem, and raising capabilities across our research institutes, industry and government.
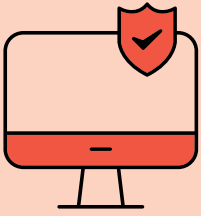
Trust technologies

The increase in consumer demand for privacy has driven the enactment of privacy and data protection laws in more than 60 jurisdictions around the world[2]. These concerns are reflected in Singapore as well, with growing imperative to develop trust and privacy preserving technologies for data protection and instil trust in digital transactions, to engender a privacy-aware Smart Nation for Singapore.

Research centres, such as the NUS Centre for Research in Privacy Technologies and NTU's Strategic Centre for Research in Privacy-Preserving Technologies and Systems, will drive our national capabilities in privacy preserving technologies. Initiatives such as the Singapore Blockchain Innovation Programme will also continue to support local businesses in enhancing their supply chains and operations through adopting new solutions like blockchain.

Going into RIE2025, SNDE will focus on developing new technology solutions that will underpin the security of digital transactions and entrench Singapore as a trusted digital node. These include fair and explainable privacy preserving technologies to obtain data insights in a secure and transparent manner, and platforms to facilitate interoperability between the various blockchain technology solutions available on the market.

Trust as a strategic competitive advantage for Singapore enterprises

With increasing emphasis on certified sources, the ability to provide assurance of provenance of every product or component will be valued at a premium. Trust technologies will be a key enabler to achieve this; for instance, blockchain technology could be deployed to certify the provenance of food products, giving consumers a peace of mind.

Due to our progressive regulatory environment and neutral governance platforms, Singapore has cultivated a strong reputation as an honest broker. We are well-positioned to build trust technologies, especially given the leading researchers in this area based here. We have also built enterprises that have reaped early success in trust-related products and services.

In RIE2025, a Digital Trust Centre will be established to work with RIs/IHLs and industry to develop trust technologies, trust certification, and governance frameworks to address sector-level needs. It will facilitate the translation of research outputs to accelerate industry adoption of new solutions in emerging technologies. For instance, Singapore-backed trust technologies or "trust marks" can be a strategic competitive advantage for Singapore and our businesses, reflecting quality of the goods and services sold.

[2] Gartner 2020 report.

Tech Areas
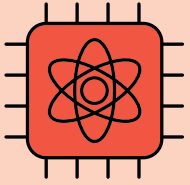
Quantum

The quantum technology boom is dominated by large international players, who have announced plans for major investments in quantum technologies. To ensure that Singapore harnesses the opportunities in this emerging area, the Centre for Quantum Technologies (CQT) was established in 2007. Hosted in the National University of Singapore, CQT has since grown into a world-class research centre for quantum technologies, and built capabilities in the areas of quantum information, optics, communication, cryptography and simulation.

In 2018, the Quantum Engineering Programme was set up to help researchers translate quantum R&D into commercial and industrial products. It then evolved to focus on ecosystem development and to build up the capacity of our talents and various enterprise segments to harness new solutions such as quantum computing.

Singapore will continue to build on its quantum capabilities and keep abreast of international developments. This includes new areas of focus, such as quantum communications and quantum key distribution, quantum sensing and imaging, as well as quantum algorithms.

WHAT IS QUANTUM COMPUTING?

Unlike classical computing, which stores information as binary 0 and 1 bits, quantum computing leverages quantum mechanics to store information as subatomic particles known as quantum bits, or qubits. Qubits exist as both 1 and 0 simultaneously, and can hence hold more values than traditional bits, and process exponentially more information than a classical computer.

Quantum computers are expected to deliver tremendous speed improvements over classical computers in solving problems such as optimisation, which play a key role in sectors such as finance and transport. These mighty computers are also expected to reduce power consumption by 100-1000 times.

Communications and connectivity

5G (and beyond) communications is globally touted as the next big leap in wireless communications. The potential speed and bandwidth capacity of 5G can enable paradigm-shifting digital applications such as autonomous vehicles, telemedicine, and smart factories. The World Economic Forum 2020 report estimates that by 2035, 22.3 million jobs will be generated in the global 5G value chain alone.

Singapore is on track to be amongst the first nations to deploy full-fledged 5G networks, and our research institutes have grown strong capabilities in this area – including the Singapore University of Technology and Design, which is ranked the 5th most influential scientific research institution in telecommunications worldwide[3].

RIE efforts will continue to grow our communications and connectivity capabilities, such as in telecoms security, management and optimisation. We will invest in communications research, innovation and translation, and develop new consumer and business applications to encourage widespread adoption of future communication technologies, and support our Smart Nation ambitions.

Tech Areas

HOW FAST IS 5G ANYWAY?

If you thought 4G was fast – think again. 5G technology will allow you to download a two-hour movie in fewer than ten seconds, as compared to seven minutes over 4G.

5G will also have greater bandwidth – which means it can handle many more connected devices, and maintain stable mobile service even in crowded areas. Its ultra-reliable and low latency capabilities will also enable new applications like self-driving cars, which means even more time to watch those movies on your mobile devices.

[3] Clarivate Analytics 2017 State of Innovation Report

Academic Research

Strong, sustained support for academic research is a fundamental tenet of RIE. We aim to:

- Develop a robust base of research capabilities and to grow our global research competitiveness, research quality, and intensity.
- Achieve global recognition of Singapore as a hub for high-quality research that has societal impact.
- Grow peaks of excellence in selected scientific areas.
- Sustain a vibrant, diverse and globally-connected research ecosystem that will attract and retain top research talent.

Sustained investments in academic research since the start of the RIE journey in 1991 have enabled Singapore to build up a foundation of research capabilities across many critical disciplinary areas.

Our Institutes of Higher Learning and Research Institutes are internationally recognised, and we have achieved leading edge capabilities in several peaks of excellence, such as materials science, quantum technologies and infectious diseases.

The proportion of Singapore's research publications amongst the world's most highly cited publications has grown steadily. The Field Weighted Citation Impact[4], a weighted measure of citations, for Singapore publications is now 50% above the world average, which is comparable to that of other small, advanced economies such as Switzerland and Israel.

RIE2025 Strategies

As in earlier RIE plans, RIE2025 adopts a portfolio approach for academic research funding, supporting a range of projects from smaller-scale, investigator-led research, to larger programmes and research centres.

In RIE2025, we will increase the proportion of academic research funding set aside for investigator-led research via schemes such as the MOE Academic Research Fund Tier 1 and 2 and NRF Fellowship and Investigator schemes. This will nurture and sustain a healthy ecosystem with a critical mass of research-active faculty and allow for greater agility in their pursuit of the best ideas.

We will increase funding that goes towards mid-sized grants. This will bring together capabilities within and outside our ecosystem, at a scale that could evolve to become future peaks of excellence.

The mid-sized grants will complement existing grants such as the NRF Competitive Research Programme (CRP) and the Campus for Research Excellence and Technological Enterprise (CREATE) initiative, which are geared toward encouraging multi-disciplinary research. The CRP fosters collaborations among researchers to work on use-inspired problems at the intersection of multiple disciplines, while CREATE facilitates collaborations at the institution-level for inter-disciplinary research in science and technology with strong societal dimensions.

A portfolio approach to academic research funding

BUILDING NEW PEAKS OF EXCELLENCE

Research Centres of Excellence

Mid-sized Grants

DEVELOPING EXCELLENT SCIENCE IN STRATEGIC AREAS

MOE Academic Research Fund Tier 3
NRF Competitive Research Programme
CREATE

MOE Academic Research Fund Tier 2
NRF Fellowship
NRF Investigatorship
Returning Singaporean Scientist Scheme

BUILDING A ROBUST RESEARCH BASE

MOE Academic Research Fund Tier 1

Investigator-led grants:
Nurturing young research talents

*Dr Andy Tay studies senescent cells at NUS*

By 2030, one in four Singaporeans will be aged 65 years and above. Ageing increases the proportion of senescent cells – which refers to cells that age and permanently stop dividing, but do not die. Ongoing research shows that senescence is itself a fundamental contributor of ailments and diseases correlated to late life.

Dr Andy Tay Kah Ping, Assistant Professor, National University of Singapore (NUS), is working hard to profile the bio-molecular and bio-physical properties of such senescent cells, to identify key biomarkers that could open doors to meaningful health interventions.

RIE schemes like the MOE Academic Research Fund Tier 1 and Tier 2 nurture young talented researchers like Dr Tay, and will continue to support their pursuit of the best ideas.

NRF investigatorships:
Supporting research excellence and recognising talent
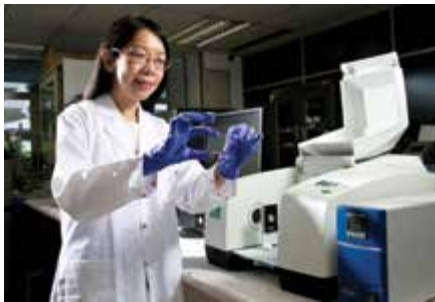
Prof Lee works with haptic and tactile technologies that have strong industry potential

Traditional electronic components are usually rigid, heavy, fragile and costly. For the next-generation of electronic devices, researchers like Professor Lee Pooi See, a Professor of Materials Science and Engineering at the Nanyang Technological University (NTU), aim to develop soft, stretchable and deformable electronics that can be incorporated in interactive and responsive devices. Professor Lee, an NRF investigator, and her team have developed electronic and energy devices that can be 2D or 3D printed onto various substrates to augment the human-machine interface, such as for haptic and tactile technologies. These have strong industry potential.

The NRF Investigatorship scheme will continue to support excellent researchers like Prof Lee, in building a track record of research achievements that will enable them to become leaders in their fields of research.

Mid-sized grants:
Developing peaks of excellence

SHINE will advance the adoption of new technologies and solutions in the microelectronics sector

Accelerating digitalisation has raised the demand for technologies such as the Internet of Things and artificial intelligence – all of which are powered through increasingly sophisticated electronics. Microelectronics are an integral part of Singapore's strategy to transform our semiconductor industry to meet this demand, to enhance the competitiveness of our enterprises, and cultivate a robust talent pool that can inject new knowledge into industry.

In partnership with their local industry partners and the DSO National Laboratories, the new **S**ingapore **H**ybrid-**I**ntegrated **N**ext-Generation μ-**E**lectronics Centre (SHINE) will build up R&D capabilities to advance the adoption of new technologies and solutions in materials engineering, soft sensors, and energy management across the microelectronics supply chain. This will enable the centre to advance and manufacture flexible devices in the area of materials engineering, soft sensors, and energy management. The mid-sized grants will support more of such world-class research centres.

CREATE:
Building strong partnerships with the international research community

SinBerBEST boasts cyber physical testbed rooms that provide environments for testing of lighting, facades, thermal comfort and Indoor Air Quality, amongst other measurements

In Singapore, buildings contribute to about half of the country's electricity consumption. It is essential that buildings be energy efficient, while ensuring occupant comfort.

The Singapore-Berkeley Building Efficiency and Sustainability in the Tropics (SinBerBEST) joint programme was established between the University of California, Berkeley, NTU and NUS. The interdisciplinary programme aims to develop innovative energy efficient and sustainable technologies for buildings in the tropics.

SinBerBEST has partnered with the Building and Construction Authority (BCA) to build an "Office of the Future". State-of-the-art technologies, such as occupancy positioning systems and demand control ventilation will be deployed, to provide comfort, safety and functionality while minimising energy cost. More than 1,000 sensors and monitoring devices have been installed. The overall energy efficiency is expected to increase by at least 20% while maintaining high levels of occupant satisfaction. In RIE2025, SinBerBEST will work with building developers to deploy its developed technology solutions in new buildings.

SinBerBEST is one of the interdisciplinary research programmes housed at CREATE. Today, researchers from nine partner universities – Massachusetts Institute of Technology (MIT), University of California Berkeley (UCB), Cambridge University, ETH Zurich, Technical University of Munich (TUM), Hebrew University of Jerusalem (HUJ), Shanghai Jiao Tong University (SJTU), University of Illinois at Urbana-Champaign (UIUC) and Centre national de la researche scientifique (CNRS) – are co-located in CREATE, working on 15 interdisciplinary research programmes in collaboration with researchers at our local universities.

Manpower

The Manpower horizontal aims to sustain a robust RIE manpower pipeline that can contribute to Singapore's research excellence, help to grow our economic sectors, and meet the needs of an increasingly knowledge-based society.

Over the years, we have adopted a three-pronged approach:

- Sustain the research talent pipeline to support evolving public sector and industry research needs;

- Nurture entrepreneurial skills and grow a strong pool of Innovation and Enterprise (I&E) talent, who can help capture value from research outcomes and bring new ideas to market; and

- Increase RIE manpower circulation between the RIE ecosystem and industry to enhance knowledge transfer and build strong networks of expertise

① Sustaining our research talent pipeline

We have developed strategies to grow a robust research manpower pool to support evolving public sector and industry needs.

To attract and groom talent, we will continue to provide funding and training opportunities to support researchers throughout the different stages of their careers. For example, we will sustain our investments in MOE research scholarships, increase the number of A*STAR scholarships for postgraduate studies, and support more talent through the Singapore International Pre-Graduate/Graduate Award and ASEAN Postdoctoral Fellowships. These will diversify our RIE ecosystem and maintain Singapore's attractiveness to international talent.

It is crucial that we continue to encourage our youth's interest in STEM. We will introduce Research Internship Awards for undergraduate students to undertake STEM internships at A*STAR Research Institutes and university-sited corporate labs, while continuing the wide range of STEM outreach efforts targeted at youths of various ages.

The COVID-19 situation has highlighted the need to strengthen the resilience of our research ecosystem against disruptions to research activities and manpower flows. As such, we will increase traineeships for fresh graduates at A*STAR Research Institutes and university-sited corporate labs to build up the local RIE ecosystem, while continuing to maintain the inflow of quality international PhD students in critical sectors such as the health and biomedical sciences, as well as computing and information sciences.

② Nurture I&E talent

With technological disruption and digitalisation, our next bound of economic growth will depend on our innovative abilities. To empower our companies to generate new business streams and improve productivity – through globally competitive products/services/business models – we will expand our I&E talent development strategies to raise a strong Innovation and Enterprise (I&E) talent pool to harness emerging opportunities and reap benefits from RIE investments.

This includes enhancing support for experiential training through schemes such as A*STAR's **T**echnology for Enterprise Capability **Up**grading Programme, also known as T-Up, which seconds researchers, scientists and engineers to companies to support product development and/or commercialisation. In addition, we will expand the Singapore Biodesign and SGInnovate Summation programmes to develop talent in the respective focus areas of medtech innovation and deep tech, such as in the fields of AI, cybersecurity and robotics.

In RIE2025, we will launch a new I&E Fellowship Programme (IFP). This will grow the pool of local talent with both technology and business development expertise, via apprenticeships/on-the-job-training in R&D translational work through corporate laboratories, private sector incubators, and accelerators.

Singapore biodesign programme:
Empowering Asia's healthtech innovators of tomorrow

Launch of the Singapore Biodesign Programme in Dec 2018. SB's leadership comprises key members of the ecosystem looking to bring a difference to health/medtech in SG

Biodesign applies design thinking to healthcare to: (i) identify unmet healthcare needs, (ii) innovate novel technologies to address these needs, and (iii) develop and implement business and commercialisation plans to bring new solutions into patient care.

Jointly launched by A*STAR, the Economic Development Board and Stanford University, the Singapore Biodesign (SB) Programme is a national biomedical talent development and innovation platform that trains and nurtures the next generation of medtech innovators for Singapore and Asia, to deliver greater economic value and healthcare impact through healthtech innovation. To date, SB has trained more than 795 talents who have gone on to become company founders, project managers and clinician innovators, working on more than 28 projects that raised $50M of private and public sector funding.

In RIE2025, SB will continue its mission to build a strong pipeline of I&E talent for Singapore's healthcare domains. It will expand its offerings to cater to different levels of expertise across academia, healthcare institutes and industry, train more students and professionals, and increase support for more projects. This includes expanding the SB Innovation Fellowship programme with more opportunities for on-the-job training and greater industry involvement, anchoring the Faculty Fellowship in Singapore universities and Research Institutes to drive upstream biodesign-inspired research and teaching, and creating accessible, stackable training modules customisable to participants' needs. SB will also continue to expand its network of regional partners to grow the Asian medtech ecosystem.

I&E fellowship programme:
Building deep-tech talent to meet industry needs

SGInnovate launched Power X (Robotics) as part of the IFP, and welcomed the inaugural batch of trainees in Nov 2020

The I&E Fellowship programme (IFP) is a new initiative launched by NRF and ESG to expand the pool of deep-tech technical talent who are engaged in I&E activities. The IFP leverages successful public and private sector I&E platforms to provide individuals with on-the-job training in tech commercialisation, and opportunities to learn about business and product development from industry stakeholders and mentors.

For example, SGInnovate, an IFP partner, runs the Power X (Robotics) Programme to train individuals for in-demand robotics engineering and tech translation roles. IFP trainees will undergo structured training in advanced robotics-related computational topics, before taking on attachments with Singapore-based deep-tech startups and SMEs for on-the-job training and exposure. This opens up a wide range of opportunities, both within the host companies and in future careers to leverage robotics for industry needs.

③ Improve talent flow between public institutions, industry and the wider economy

We will improve talent flow to strengthen transfer of knowledge and build strong talent networks between public institutions, industry and the wider economy.

In RIE2025, we will further strengthen industry linkages by growing industry-oriented programmes such as the EDB Industrial Postgraduate Programme and the SIT Industrial Doctorate / Masters programmes. Our efforts also include talent engagement schemes such as the Research Internship Award, which offer internship opportunities to local STEM undergraduates in A*STAR Research Institutes, Corporate Labs, and academic medical centres, so as to expose them to STEM careers. We will also work with the Singapore Global Network and the Global Innovation Alliance to grow our overseas talent networks and increase awareness of exciting opportunities across the RIE ecosystem in Singapore.

EDB's industrial postgraduate programme
Flowing R&D talents to industry

Salesforce Research Asia researchers with EDB IPP students

The Industrial Postgraduate Programme (IPP) trains industry-ready R&D talent by co-funding PhD training with industry. Under this scheme, fresh graduates and employees of partnering locally-based companies can undertake research projects with a deeper industrial focus within a corporate R&D environment, co-supervised by the company and their university.

This has given PhD students more opportunities to work on industry-relevant research projects. For example, NUS has partnered with Salesforce Research Asia under the IPP to investigate novel techniques to increase the robustness of language AI systems to linguistic variation and adversarial attacks. These techniques are crucial to securing deployed language AI systems against malicious parties, while ensuring equal service to all users regardless of competency in English. In just one year, this project has resulted in two research publications in top international AI conferences, and one patent application. These can eventually realise improvements for bot services at Salesforce to better support customers, especially those who may speak English infrequently or as a second language.

Innovation and Enterprise

Innovation and Enterprise (I&E) – the translation of research outcomes into products, processes and services that generate economic and societal payoffs for Singapore – is a crucial component of the RIE value chain. In the late 2000s, it became clear that while Singapore's R&D investments were starting to bear fruit, the nexus between academic research and enterprise value had to be strengthened.

This marked the start of our I&E journey, to support Singapore's transition towards an innovation-driven economy. We have since invested steadily to:

- Increase R&D activity in enterprises;
- Build a vibrant local startup ecosystem; and
- Develop entrepreneurial mindsets and capabilities in our researchers, and build up the translational capacity of our public research institutes.

Key achievements

These have contributed to Singapore's reputation as a leading innovation ecosystem. Businesses are not only investing and engaging more in R&D, but also forming innovation partnerships across the ecosystem.

No.1 innovative nation in Asia Pacific (as ranked by the 2020 Global Innovation Index)
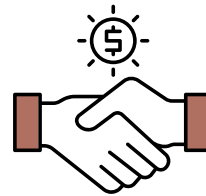
~3,000 tech startups supported by the government, during 2015-2019 (3x growth since 2011-2015)
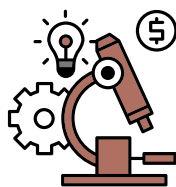
Annual business expenditure on R&D in 2018 (5.4% CAGR since 2013)

$10.9B annual venture capital investment in 2019 (5x growth since 2015)

Alchemy foodtech:
Developing healthy carbohydrates

Alchemy Foodtech develops functional ingredients that contributes to the global fight against diabetes

Set up in 2015, Alchemy Foodtech is a Singapore foodtech startup that is developing functional ingredients to incorporate into carb-based staple foods for the global fight against diabetes. Its flagship product, Alchemy Fibre, is made from plant fibres and extracts (gluten-free and vegan) and can be added to flour or moulded into rice grains (FibreGrain). Consuming refined white carbohydrate-based staples blended with Alchemy Fibre reduces the release of glucose within the body without compromising on taste, texture or colour.

Alchemy Foodtech was incubated by NUS Enterprise and was one of the first companies to move into NUS Enterprise's co-working space at the Singapore Science Park dedicated to deep tech startups. In 2019, Alchemy Foodtech established a foodtech laboratory at the Singapore Science Park. "CookLab@Alchemy" will facilitate development of new ingredient blends and deeper research on digestion rates of carbohydrates and the impact of carbohydrates on food textures.

Alchemy Foodtech has partnerships with over 20 local and international food manufacturers and food service companies to create products and menu items that slow the release of glucose, including companies like Gardenia, Lim Kee, Boon Tong Kee and Yum Cha Dim Sum Restaurant. They are also planning to expand into new markets like China and Thailand.

Evonik:
Supporting chemicals innovation
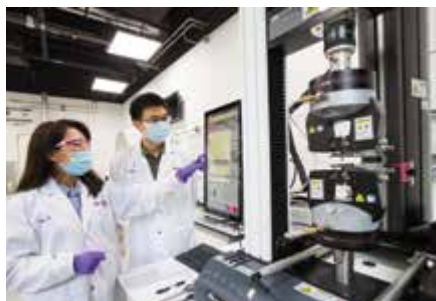
Evonik's Asia Research Hub is supported by more than 50 research scientists and engineers

Evonik, a German specialty chemicals firm, established its Asia Research Hub (ARH) in Singapore in April 2018 as an integral part of the company's growth strategy in Asia-Pacific. The ARH focuses on research in functional surfaces, additive manufacturing, as well as biotechnology, as it ventures into the field of tissue engineering. This involves scientists from various Evonik units working on pre-identified cross-functional mid- to long-term innovation projects.

The ARH, supported by more than 50 research scientists and engineers, has developed novel technologies in additive manufacturing for industrial applications. Evonik also collaborates closely with public and private research institutes in Singapore. An example is the partnership with HDB to adapt an innovation used in Germany to keep the cold out of buildings, to instead keep the heat out of buildings in Singapore. Evonik has also recently established its silica innovation centre in Singapore, demonstrating the company's strong commitment to deepen their R&D presence here.

RIE2025 Strategies

Innovation is an important driver for Singapore's long-term competitiveness. It will continue to be critical in a COVID world, where we must be able to innovate, adapt and apply technologies to address emerging challenges and opportunities for continued economic growth.

In RIE2025, we will strive towards expanding the base of innovative enterprises, and enable the creation of globally competitive products out of Singapore. We will help businesses access new avenues of growth, build differentiated market offerings, and accelerate time-to-market of their new solutions. In addition, we will facilitate open innovation partnerships across the local and international ecosystem for enterprises to tap on new markets and partners, to pool resources and expertise to address problem statements from corporates and public agencies.

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1 Strengthen enterprises' capability and capacity for market-oriented innovation

In RIE2025, we will work with enterprises to develop tailored innovation strategies, and scale up our efforts to build a vibrant innovation ecosystem.

We will customise our support to each enterprise segment to more effectively address their needs. Startup SG initiatives led by Enterprise Singapore (ESG) with support from other government agencies will continue to support startup growth, in Singapore and beyond. These will leverage ecosystem partnerships to catalyse the formation of new innovative start-ups, and provide capital, mentorship and talent to help them get their ideas to market. Initiatives such as the Innovation Advisors Programme led by ESG, in partnership with IPI, will strengthen the innovation capabilities of SMEs and address business gaps to catalyse the development of new products and solutions. These RIE efforts will complement other government initiatives, such as EDB's New Ventures group, to support enterprises that are more mature in their innovation journey to build and invest in Singapore-headquartered new ventures in opportunity areas beyond their core business. The group is actively supporting such enterprises with industry expertise, networks, validating ideas through incubation sprints, and risk-sharing capital to grow new ventures.

In RIE2025, we will also build on the Open Innovation Network (OIN) to scale up our open innovation efforts, to encourage ecosystem collaborations to address both complex industry challenges and enterprise-centric problem statements.

Open Innovation Network:
Enabling open innovation in Singapore

OPEN INNOVATION NETWORK

The Open Innovation Network (OIN) was launched to strengthen Singapore's open innovation ecosystem, with strong links to the global community. By bringing people and ideas together, open innovation helps companies access ideas, technologies and talent, and pool resources, to leapfrog the competition and sustain growth in the long-term.

The OIN is a one-stop portal for all open innovation challenges and community partners. Corporates and government agencies can share their pain points or business needs on the OIN; innovators can respond to, co-develop and test-bed new solutions with the problem statement owners. These ground-up efforts in open innovation are complemented by the National Innovation Challenges, which focus on developing solutions to address industry- or nation-wide challenges.

Visit: www.openinnovationnetwork.gov.sg

2 Scale up and strengthen technology translation platforms

To support companies on their innovation journey, we will scale up and strengthen technology translation platforms to enable enterprises to better tap on the ideas, expertise, and science and technology capabilities of our public research institutions and other innovation ecosystem players. We will also catalyse industry growth in sectors where we have developed R&D strengths, and build collaborative and synergistic ecosystems that will foster cross-pollination of knowledge.

The Diagnostics Development Hub and the National Additive Manufacturing Innovation Cluster are examples of successful technology translation platforms in the areas of clinical diagnostics and additive manufacturing respectively, which have accelerated enterprises' productisation efforts, and seeded the growth of startups. We will strengthen these existing platforms to ensure that they remain relevant and continue to support our national needs. Additionally, the Centres of Innovation in the polytechnics and other Institutes of Higher Learning will complement the work of the Future Economy Council, and continue to take a sector-specific and multi-disciplinary approach to supporting innovation priorities of enterprises.

Centres of innovation:
Translating technologies into commercialisable products

Founder of FIRMBASE Pte Ltd, Mr Pung Choong Theng, sharing about the company's proprietary polymer membrane technology with Minister Chan Chun Sing at SME Day 2019

FIRMBASE is a Singapore-based company which develops advanced polymeric materials for the water, energy and infrastructure sectors. FIRMBASE partnered with the Environmental & Water Technology Centre of Innovation (EWTCOI) at Ngee Ann Polytechnic, to develop a patented foulant-resistant polymeric membrane for the treatment of used water. The foulant-resistant property ensures that the membrane does not clog up easily, and can operate at a lower pressure, resulting in lower energy consumption.

EWTCOI helped FIRMBASE develop and test the membranes for used water treatment with high oil content of up to 100 parts per million, reducing the occurrence of fouling. This technology is 10 times more effective than similar technologies in the market today, reducing operating costs of water treatment plants by up to 25% and time required by 30%. The company is currently commercialising this proprietary oil-water separation product, which is expected to be ready for market by end-2021.

③ Forge strong connections to major innovation hubs and key demand markets

Given Singapore's resource constraints and small domestic markets, strong international networks and exposure for Singapore enterprises are key to maintaining and providing access to global and regional markets, innovation expertise and resources. In RIE2025, we will strengthen our linkages with global innovation nodes, and increase Singapore's attractiveness as a destination for global entrepreneurial talent and innovative, high-growth enterprises.

Global innovation alliance:
Connecting local enterprises to innovation communities overseas

GIA provides opportunities for Singapore-based students, entrepreneurs and businesses to gain overseas experience and networks

The Global Innovation Alliance (GIA) initiative was established in 2017 to strengthen Singapore's connections to major innovation hubs around the world. GIA exposes students to entrepreneurship activities through the Innovators Academy, and encourages the two-way exchange of technology enterprises between partner countries by assisting technology enterprises to access overseas ecosystems though the Innovation Launchpads. Partnership Forums also strengthen links between overseas technology companies with Singapore companies. All of these contribute towards the growth of the Singapore innovation ecosystem. In RIE2025, the GIA network will be expanded to create more opportunities for Singapore-based students, entrepreneurs and businesses to gain overseas experience, and connect and collaborate with their overseas counterparts.

Alongside these current programmes, GIA will integrate co-innovation programmes to support Singapore-based enterprises and their in-market partners in undertaking innovation collaborations. This will help our enterprises to develop new products or solutions, value-adding to the connections that have been previously made.

SFF x SWITCH:
Leading tech festival for the Global-Asia innovation ecosystem

SFF x SWITCH is Singapore's leading tech and innovation festival

The annual Singapore FinTech Festival (SFF) x Singapore Week of Innovation & TeCHnology (SWITCH) is Singapore's flagship I&E event. It brings together financial sector leaders, deep-tech entrepreneurs, investors, corporates and policy makers over conversations on technology and innovation. In 2019, SFF x SWITCH saw more than 60,000 participants from 140 countries. In 2020, despite the ongoing COVID-19 situation, SFF x SWITCH will be held as the world's first week-long, round-the-clock hybrid digital and physical event – and continue to serve as the foremost engagement platform for the global FinTech and deep-tech communities.

Research, innovation, and enterprise are key to Singapore's development as a knowledge-based, innovation-driven society and economy. In an uncertain world, our continued commitment to R&D will equip us with the knowledge and tools to secure Singapore's future, and drive innovations that will improve the quality of life for Singaporeans.

" The investments in RIE2025 are significant and underscore Singapore's commitment to investing in research, innovation and enterprise. These will drive economic recovery and growth, and address our broader national needs. RIE2025 will also strengthen Singapore's vision of being a Global-Asia node in technology, innovation and enterprise. By working together to realise RIE2025, we can emerge stronger and create more and better opportunities for our businesses and workers."

Mr Heng Swee Keat
Deputy Prime Minister
Chairman, National Research Foundation

NATIONAL RESEARCH FOUNDATION
PRIME MINISTER'S OFFICE
SINGAPORE