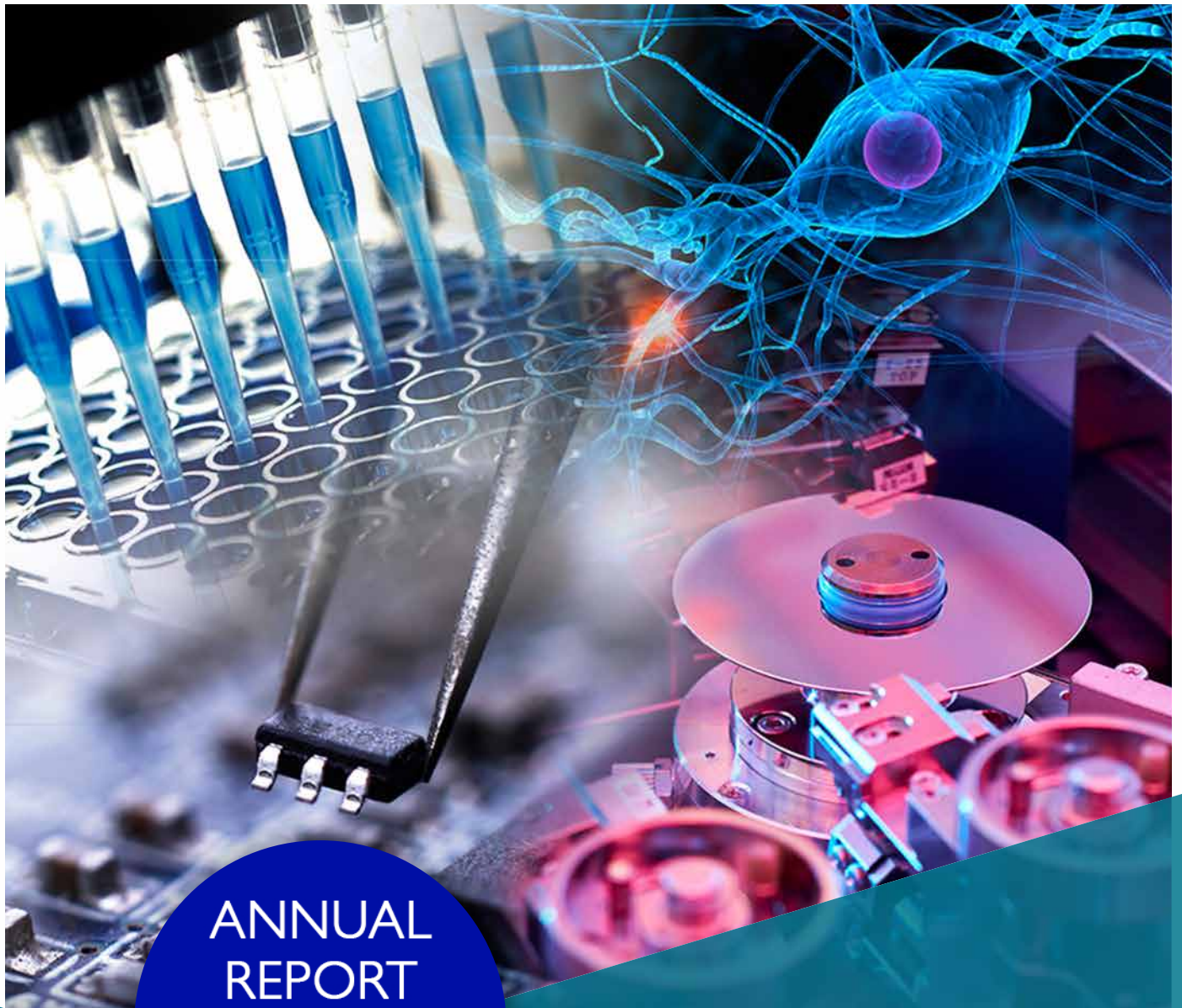




Agency for  
Science, Technology  
and Research



# ANNUAL REPORT

April 2016  
to  
March 2017

Creating Growth, Enhancing Lives



# CONTENTS

---

## A\*STAR Annual Report 2016 - 2017

### About A\*STAR

- 06** Message from the Chairman
- 08** Board Members
- 10** Key Management
- 11** A\*STAR Organisation Chart
- 12** Subsidiary Companies
- 13** Our Community

### Key Achievements

- 14** Summary of Key Achievements
- 15** Leveraging Technology to Drive Industry Success
- 21** Impacting Lives Through Discovery
- 23** Awards and Accolades

### Positioning for the Future

- 29** Innovating for the Future

### Annex

- 32** Key Performance Indicators

## ORGANISATION DETAILS

**Board Secretary:** Ms Emily Liew  
Director, Planning & Policy Department  
Agency for Science, Technology and Research

**Address:** 1 Fusionopolis Way,  
#20-10 Connexis North  
Singapore 138632

**Telephone:** 6826 6385  
**Fax:** 6777 1711  
**Email:** [Emily\\_Liew@a-star.edu.sg](mailto:Emily_Liew@a-star.edu.sg)

---

## **Vision**

A global leader in science, technology and open innovation

## **Mission**

We advance science and develop innovative technology to further economic growth and improve lives

---

The Agency for Science, Technology and Research (A\*STAR) drives mission-oriented research that advances scientific discovery and technological innovation. We play a key role in nurturing and developing talent and leaders for our research institutes, the wider research community, and industry.

Our research creates economic growth and jobs for Singapore. As a Science and Technology organisation, we bridge the gap between academia and industry in terms of research and development. In these endeavours, we seek to integrate the relevant capabilities of our research institutes and collaborate with the wider research community as well as other public sector agencies towards meaningful and impactful outcomes. Together with the other public sector entities, we develop industry sectors by:

- integrating our capabilities to create impact with Multi-National Corporations and Globally Competitive Companies;
- partnering Local Enterprises for productivity and gearing them for growth; and
- nurturing R&D-driven Start-ups by seeding for surprises and shaping for success.

Our research, in addition, also contributes to societal benefits such as improving outcomes in healthcare, urban living, and sustainability. These serve to enhance lives in Singapore and beyond.

We are a catalyst, enabler and convener of significant research initiatives among the research community in Singapore and beyond. Through open innovation, we collaborate with our partners in both the public and private sectors, and bring science and technology to benefit the economy and society.

We aspire to be a global leader in Science, Technology and Open Innovation.

# Message from the Chairman



**T**his year, we mark the beginning of Singapore's sixth Five-Year plan, known as the Research, Innovation and Enterprise (RIE) 2020 plan. From 2016 to 2020, a total of S\$19 billion, approximately 1% of Singapore's GDP, has been set aside for public sector research with the aim of discovering new knowledge and innovation to benefit both the economy and society along the four domains of Advanced Manufacturing and Engineering; Health and Biomedical Sciences; Services and Digital Economy and Urban Solutions and Sustainability.

The RIE2020 plan is integral to the strategies outlined in the Committee on the Future Economy (CFE) for Singapore to remain relevant and competitive against the backdrop of greater uncertainty and slower growth globally.

Singapore remains a global leader in innovation, consistently ranking within the Top 10 globally and tops in the Asia-Pacific regions. In recent surveys, INSEAD's Global Innovation Index,

ranked Singapore first in the Asia and Oceania regions, and seventh globally. Similarly, the 2017 edition of the Bloomberg Innovation Index had placed Singapore as the sixth most innovative economy in the world, and second in the Asia Pacific region.

As a mission-oriented Science and Technology Organisation, A\*STAR continues to play the distinctive role in Singapore's RIE landscape by fostering opening innovation and bridging the gap between academia and industry, bringing together public and private sector to drive R&D for economic and societal outcomes.

Building on the successes achieved in RIE2015 and in line with CFE recommendations, A\*STAR has maintained the momentum of delivering innovation in 2016 and laid the foundation for more impactful outcomes for Singapore's future economy.

In 2016, we engaged in 1,800 industry projects. Through our engagements, we have deepened partnerships with multinational corporations. For example, Nestlé will expand research and innovation activities in Asia with the establishment of the Nestlé Research Centre (NRC) Asia in Biopolis. The expansion builds on Nestlé's strategic innovation partnership with A\*STAR and further anchors the company's presence in Singapore. We have also intensified our efforts to help local enterprises adopt technology to create new products and services, and differentiate themselves. For instance, local company Dou Yee Enterprises Pte Ltd adopted novel composite materials technology from A\*STAR and plans to leverage this to enter the food packaging market.

We have also added to the entrepreneurial ecosystem in Singapore, spinning out exciting biotech start-ups such as Euchloe Bio and ImmunoSCAPE. Additionally, our launch of A\*StartCentral, offers a valuable platform for talent development. This is coupled with organised programmes with our partners to equip researcher-entrepreneurs with business skills, expertise and mentorships to engender a more vibrant start-up ecosystem. Scientists-turned-entrepreneurs such as Drs Benjamin Tee (Privi Medical), Tan Yann Chong (Atreca) and Teo Zhiyuan (IronStack) have also made waves by taking their own discoveries downstream to market, generating breakthroughs in biotechnology and data systems.

Through our close partnership with public agencies such as the Ministry of Health, researchers discovered that the Zika strains from local transmissions had been caused by strains originating from Southeast Asia and were not the strains circulating in South America.

2016 also saw the inaugural one-north Festival, which brought together over 40 partners, to inform, inspire and enthuse the public into discovery, innovation and enterprise. The event drew over 6,000 people to one-north to participate in talks, science demonstrations, lab tours, and arts and music activities.

This year, several of our scientists and engineers received international recognition for their achievements in scientific breakthroughs. Just to mention a few: Prof Ng Huck Hui (ED GIS) was elected as an Associate Member of the European Molecular Biology Organisation (EMBO), making him the only Singaporean associate member. Dr Seh Zhi Wei was named one of the top ten recipients of MIT Technology Review's "Innovators Under 35 Asia", while Dr Florent Ginhoux was named one of 2016's most

Highly Cited Researchers by Thomson Reuters.

We would also like to take this opportunity to thank our board members, Professor Sir George Radda, Professor Jonathan Knowles, Mr Lam Yi Young and Dr Sun Shih Wei, who stepped down from their positions, for their guidance and contributions to A\*STAR during their term. At the same time, we welcome Professor Barry Halliwell, Professor Siegfried Russwurm, Dr Omkaram Nalamasu, Mr William A. Hawkins III and Professor Lily Kong to our board.

As we forge ahead on our RIE2020 journey, A\*STAR will continue to advance science and develop innovative technology to further economic growth and improve lives in Singapore and beyond.

**Mr Lim Chuan Poh**  
**Chairman**

**July 2017**



# Board Members



Mr Lim Chuan Poh  
Chairman A\*STAR



Prof Tan Chor Chuan  
Deputy Chairman  
President, National  
University of Singapore



Prof Bertil Andersson  
President  
Nanyang Technological  
University



Professor Chong Tow Chong  
Provost  
Singapore University of  
Technology and Design



Prof Isaac Ben-Israel  
Chairman, Israel Space Agency  
Chairman, Israel National  
Council for R&D



Mr Bruce Brown  
Retired Chief Technology  
Officer  
Procter & Gamble



Dr William Chin  
Executive Vice President  
Scientific and Regulatory  
Affairs (PhRMA)



Prof Barry Halliwell  
Chairman, Biomedical  
Research Council  
Senior Advisor to the  
President, NUS  
Tan Chin Tuan Centennial  
Professor



Mr William A. Hawkins III  
Senior Advisor Essex  
Woodlands Capital, Corporate  
Director, and Retired  
Chairman and Chief Executive  
Officer, Medtronic



Prof Lily Kong  
Provost  
Singapore Management  
University





Dr Omkaram Nalamasu  
Senior Vice President and Chief  
Technology Officer, Applied  
Materials and President, Applied  
Ventures LLC



Prof Sir Keith O'Nions  
Chairman, Cambridge  
Enterprise



Prof Sir John O'Reilly  
Chairman, Science and  
Engineering Council  
Chairman, NICC(Standards) Ltd



Mr Ong Boon Hwee  
Chief Executive Officer  
Stewardship Asia Centre Pte Ltd



Mr Quek Gim Pew  
Chief Defence Scientist  
Ministry of Defence



Prof Siegfried Russwurm  
Executive Vice President  
Siemens AG



Ms Tan Li San  
Deputy Secretary (Industry &  
Information)  
Ministry of Communications  
and Information



Dr Raj. Thampuran  
Managing Director, A\*STAR



Dr Tatsumi Yamazaki  
Distinguished Advisor  
Chugai Pharmaceutical Co., Ltd



Mr Yee Ping Yi  
Deputy Secretary (Policy)  
Ministry of Finance



Mr Yeo Keat Chuan  
Managing Director  
Economic Development Board

# Key Management



Mr Lim Chuan Poh  
Chairman



Prof Tan Chor Chuan  
Deputy Chairman



Dr Raj. Thampuran  
Managing Director



Dr Sydney Brenner  
Scientific Advisor to Chairman



Prof Barry Halliwell  
Chairman, Biomedical Research  
Council



Prof Sir John O'Reilly  
Chairman, Science and  
Engineering Council



Prof Sir David Lane  
Chief Scientist



Mr Suresh Sachi  
Deputy Managing Director  
(Corporate & Legal), A\*STAR  
and General-Counsel



Dr Benjamin Seet  
Executive Director, Biomedical  
Research Council



Prof Tan Sze Wee  
Executive Director, Science and  
Engineering Council

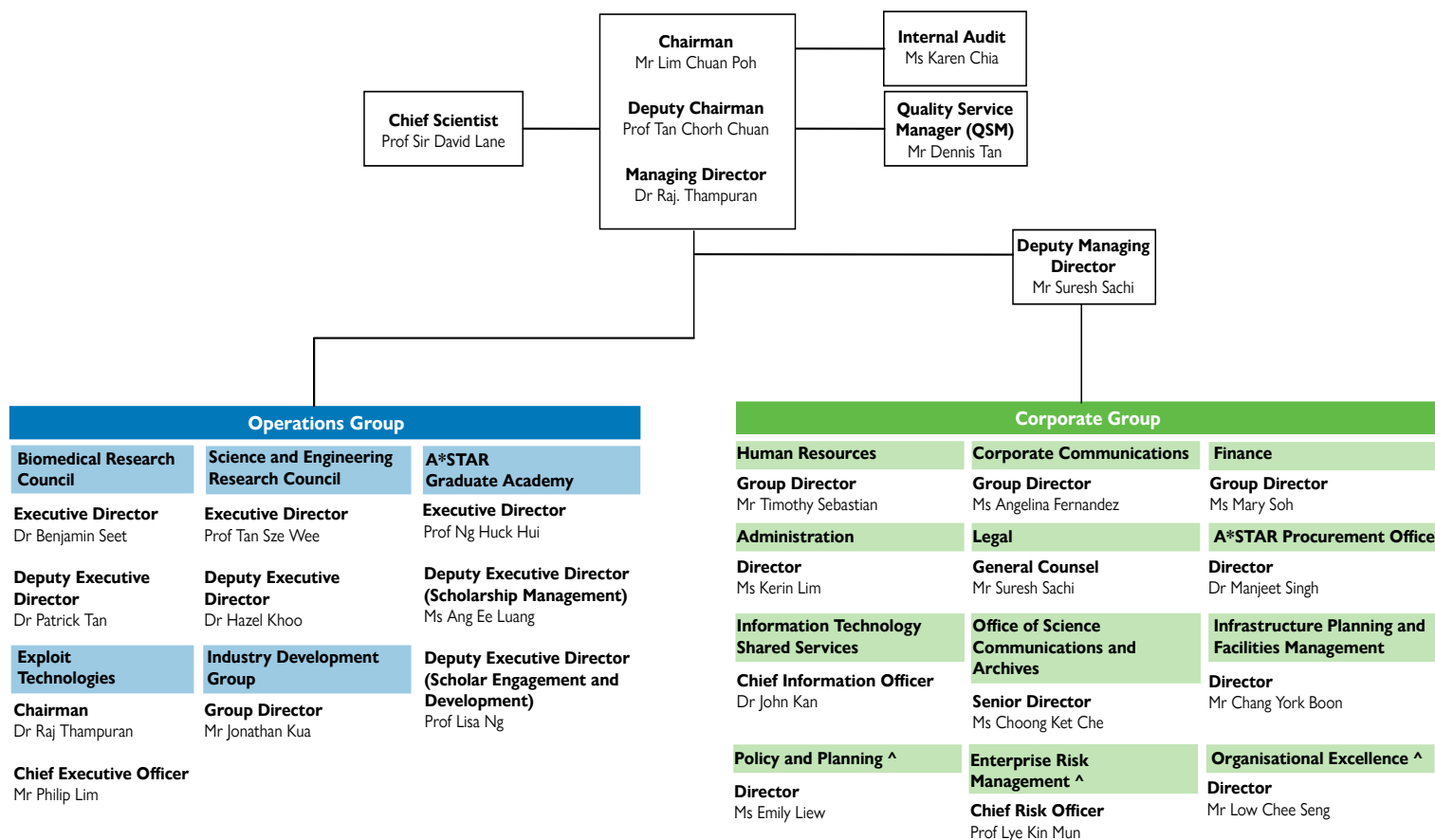


Mr Philip Lim  
CEO, Exploit Technologies



Prof Ng Huck Hui  
Executive Director,  
A\*STAR Graduate Academy

# Organisation Chart



^ Policy and Planning, Enterprise Risk Management and Organisational Excellence report directly to the Managing Director

# Subsidiary Companies

**Name of subsidiary company:** Exploit Technologies Pte Ltd

**% shareholdings in company:** 100%

ETPL is the technology transfer arm of the Agency for Science, Technology and Research (A\*STAR), Singapore's lead agency for fostering world-class scientific research and talent. A\*STAR oversees 18 biomedical sciences, physical sciences and engineering research institutes and consortia. As a one-stop resource, ETPL supports A\*STAR in the arenas of IP management, licensing and entrepreneurship.

For more information, please visit: <http://etpl.sg>

# Our Community

The A\*STAR community consists of 18 research institutes and consortia. They span a broad range of research areas from the biomedical sciences to the physical sciences and engineering.

The community of scientists and researchers, technical and non-technical staff, and industry development and commercialisation staff, was 5,262 strong as at 31 March 2017.

## **Biomedical Research Institutes and Consortia**

Bioinformatics Institute (BII)

Bioprocessing Technology Institute (BTI)

Experimental Therapeutics Centre – Drug Development and Discovery (ETC-D3)

Genome Institute of Singapore (GIS)

Institute of Bioengineering and Nanotechnology (IBN)

Institute of Medical Biology (IMB)

Institute of Molecular and Cell Biology (IMCB)

Singapore Bioimaging Consortium – Clinical Imaging Research Centre (SBIC-CIRC)

Singapore Institute for Clinical Sciences (SICS)

Singapore Immunology Network (SIgN)

## **Science and Engineering Research Institutes and Consortia**

Data Storage Institute (DSI)

Institute of Chemical and Engineering Sciences (ICES)

Institute of High Performance Computing (IHPC)

Institute for Infocomm Research (I<sup>2</sup>R)

Institute of Materials Research and Engineering (IMRE)

Institute of Microelectronics (IME)

National Metrology Centre (NMC)


Singapore Institute of Manufacturing Technology (SIMTech)

# 2016


## KEY ACHIEVEMENTS

Deployed over  
**200**  
**Licenses**  
to companies  
*60% of the companies are  
in the manufacturing sector*

**17**   
**Spin-offs**

Undertaken  
  
**1,800**  
**projects**  
**with industry**  
*More than 50% are  
related to manufacturing*

Seconded  
over **60**   
**RSEs to local enterprises**  
to support their R&D efforts

Over  
**\$220**  
**million** in industry  
R&D spending  


**CATALYSING INDUSTRY**  
THROUGH TECHNOLOGY

**STRENGTHENING LOCAL ENTERPRISES**  
THROUGH INNOVATION



# Leveraging Science & Technology To Drive Success



The Committee on the Future Economy (CFE) has outlined seven key strategies that would guide the growth of Singapore's economy. Among which were recommendations for Singapore to continue on her path to strengthening and enabling innovation across and within industry sectors as well as to encourage companies to build strong digital capabilities.

Through our research programmes, commercialisation and industry facing initiatives, A\*STAR catalyses cutting edge technology development and facilitates industry R&D. In 2016 alone, we have worked on more than 1,800 industry projects, transferred over 200 licences to companies and seconded over 60 researchers to local enterprises.

A globally competitive and high-value manufacturing industry is important for Singapore's economic growth. To anchor high-value manufacturing activities in Singapore, and drive growth, the CFE had emphasised the need to develop deeper innovation and

## **Cutting Edge Technologies: Artificial Intelligence (AI)**

Artificial Intelligence has been advancing rapidly and has the potential to greatly affect the way we work, live and play. Taking Big Data further, AI will enable companies to develop more human-centric processes and thus further differentiating themselves from their competition. For example, new areas like "Instructable AI" aims to allow machines to be programmed by non-experts and can present companies with novel value-creation opportunities.

A\*STAR has built up significant foundational capabilities in Machine Learning, Speech and Language, Image and Video processing, Data Analytics and Social Cognitive Computing. These capabilities have successfully been integrated into several local retail businesses to help boost their productivity and competitiveness in their respective industries.



Minister for Industry, Mr S. Iswaran and A\*STAR Chairman, Mr Lim Chuan Poh touring Addvalue Technologies, a leading local company specialising in digital, wireless and broadband communication technology products. Addvalue Technologies has tapped on A\*STAR's expertise through programmes such as the Technology for Enterprise Capability Upgrading (T-Up) scheme where A\*STAR's scientists, engineers or researchers are seconded to build the companies' in-house technology capabilities.

digital capabilities as well as for the industry to adopt Future of Manufacturing methods and technologies.

The Future of Manufacturing (FoM) is the deep permeating influence on every facet of the manufacturing continuum. It involves the seamless integration of advanced technologies like artificial intelligence and data analytics into highly-efficient processes that will allow industry to be responsive to customer demands. To better enable companies to capture these growth opportunities, we launched three new initiatives; Model Factories, Tech Access and Tech Depot. These initiatives, which were announced at the Committee of Supply Debates in March 2016, will allow companies to adopt new technologies and experiment with them before investing in and incorporating them into existing operations.

In addition to helping enterprises to adopt these new technologies and enhance growth opportunities, we also collaborate with multinational companies to develop innovative

solutions. In 2016, Applied Materials announced a five-year extension of their R&D collaboration in Fan-Out Wafer-level Packaging (FWOLP), valued at \$188 million. This joint R&D centre will meet the growing demand of smaller, faster, and more power efficient devices. Likewise, Rolls-Royce partnered A\*STAR to set up a technology centre that will allow companies to exploit and adopt *Industrie 4.0* technologies.

Incorporating new technologies into existing process is a daunting task for the uninitiated. A\*STAR has several programmes available that lowers the barrier to entry and allows companies to easier access to newer technologies. For example, we started the Growing Enterprises through Technology Upgrade (GET-Up) initiative in 2003 to help SMEs upgrade their technological capabilities and respond to market demands and challenges through operational technology roadmapping (OTR) and the expertise of seconded Research Scientists and Engineers (RSEs). Since its inception, a total of 570 companies have

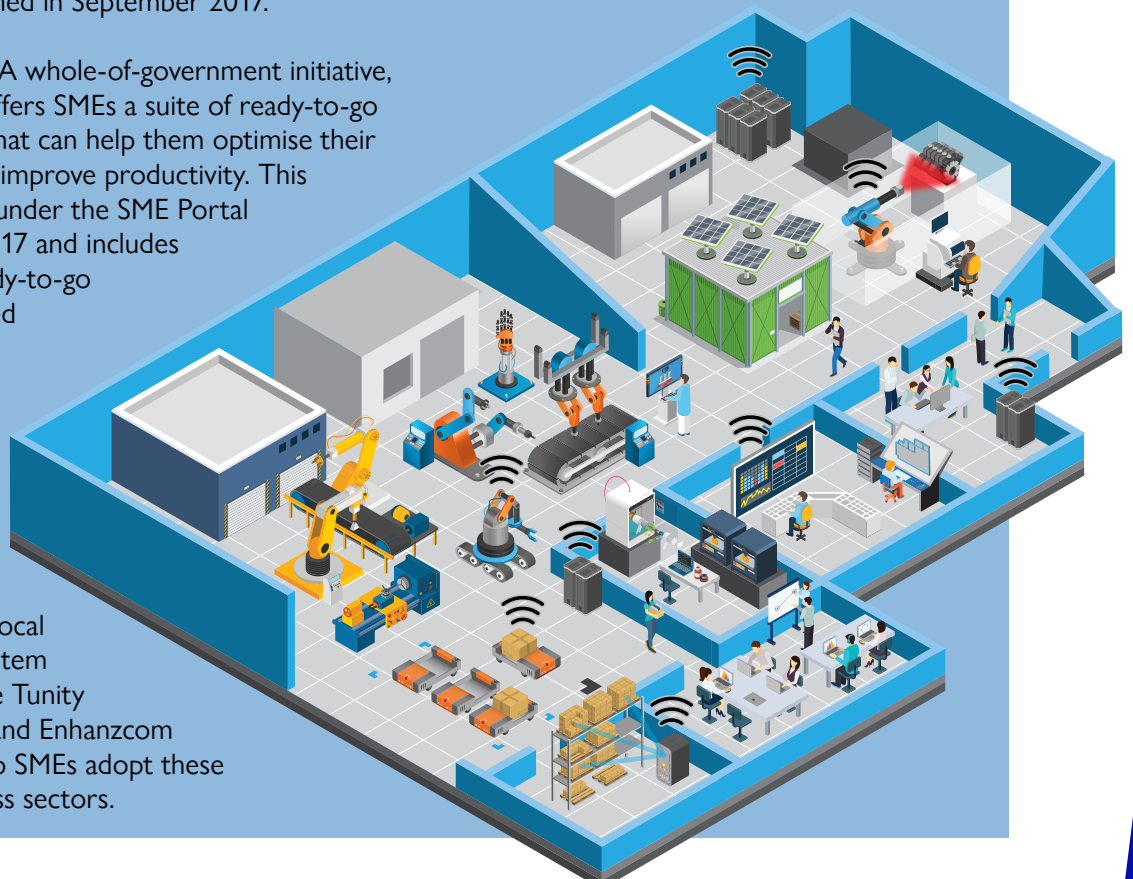
## **New Initiatives for Manufacturing**

**Model Factories:** A★STAR has set up two model factories, Model Factory@ARTC and Model Factory@SIMTech which allow companies to experience the latest manufacturing technologies first-hand in a learning environment, and collaborate with stakeholders to test-bed and jointly develop innovative solutions for their processes. We hope to work with 500 SMEs over the next five years.

Several companies have expressed interest in adopting these new technologies. One such company is CKE Manufacturing. CKE has implemented several technologies from the Model Factory@SIMTech to monitor the performance of its shop-floor machines in real time. With the use of a mobile app, staff are able to track the performance of the machines without having to physically inspect them. This has enabled CKE to improve its manpower deployment by about 50% and optimise the use of its machines. The precision engineering company is now exploring connectivity of all its machines to this platform.

**Tech Access:** This initiative will allow companies to tap into A★STAR's base of advanced manufacturing equipment and expertise. The aim is to help local enterprises, especially SMEs, build capabilities in advanced manufacturing through the use of advanced machine tools, new processes, prototyping and testing, by providing user training and advice. With these capabilities, the companies can then go on to acquire its own equipment to scale-up and capture new business opportunities. A★STAR is working with local trade associations such as the Singapore Precision Engineering and Technology Association (SPETA) and the Singapore Manufacturing Federation (SMF) to promote Tech Access to their network of members. Tech Access will be officially launched in September 2017.

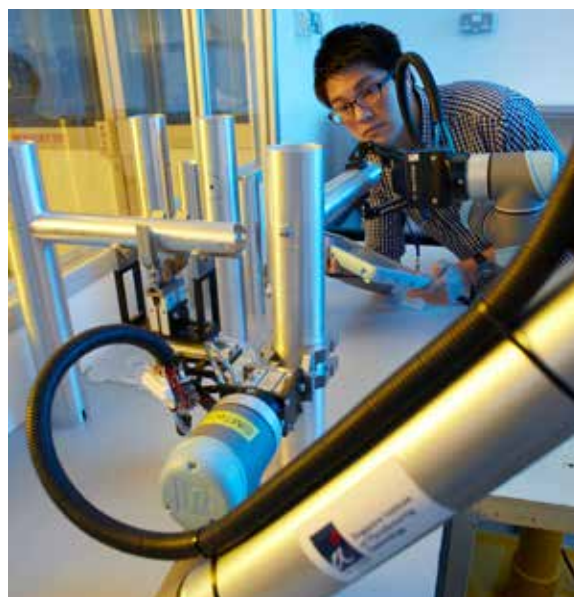
**Tech Depot:** A whole-of-government initiative, Tech Depot offers SMEs a suite of ready-to-go technologies that can help them optimise their workflow and improve productivity. This was launched under the SME Portal on 20 April 2017 and includes A★STAR's ready-to-go (RTG) packaged solutions such as inventory management and business process automation systems. A★STAR is working with local technology system integrators like Tunity Technologies and Enhanzcom Pte Ltd to help SMEs adopt these solutions across sectors.





participated in GET-Up, with over 693 A\*STAR RSEs having been seconded to 603 companies. We hope to assist another 400 companies through OTR projects and second another 275 RSE over the next four years to help companies better innovate and compete.

Over the years, we have seen the innovation capacity of SMEs grow significantly, with over 60% of our licenses having been adopted by SMEs. For example, Dou Yee Enterprises Pte Ltd signed a license for IMRE's Nanoclay Composite technology. The company plans to leverage this to enter the food packaging market by co-developing the scale-up process to produce its own high-oxygen and ultra-violet barrier composite films. If successful, the company will work on a commercial license to move into volume production and product sales.



*Cobots or Collaborative robots are intended to physically interact with humans in a shared workspace. Cobots maybe autonomous robots capable of working together with humans in an office environment or industrial robots having their protective guards removed as they can react to human presence.*

### **Giving SMEs an Edge**

Component Technology Pte Ltd, a local semiconductor equipment distributor, partnered A\*STAR's SIMTech to develop an image analysis and high-precision optics platform that aimed to better current processes when measuring of wire interconnections in an integrated circuit. The result from the partnership was an integrated system that was superior to the currently employed traditional inspection methods. This allowed Component Technology to penetrate the wire bond inspection market.

In a similar vein, LHT Holdings co-developed two purpose-built tools that were based on SIMTech's Integrated Track-and Trace Solution Platform. LHT was able to reduce their annual operational costs by \$130,000 per year. Through other projects with A\*STAR, LHT was also able to grow in-house capabilities in Eco-design and Product Knowledge Management. This enabled LHT to increase its business stream revenue from \$1.2 million to \$1.6 million.



*Finance Minister Mr Heng Swee Keat was briefed by LHT Holdings on how technology from A\*STAR's SIMTech has helped improve productivity and competitiveness for the company.*

Additionally, at this year's Committee of Supply Debate, Minister for Finance Mr Heng Swee Keat announced enhancements to our Headstart Programme. Companies can now access a 36-month exclusive and royalty-free license – up from 18 months – to co-develop intellectual property with A★STAR. This will help boost companies' competitive advantage as they bring their products and services into the market.

### **Deep Capabilities: Big Data and Data Analytics**

Data is affecting every aspect of the global economy. Companies are generating unprecedented amounts of data, and the in-depth analysis of which can give companies valuable insights to their operations and customers. Data Analytics has thus become the foundation of new data-driven processes and a key driver of innovation across every sector and industry. It is therefore important that companies, especially local enterprises, are able to maximize the use of data sets or be able to collect the relevant data to add value to their current operations and offerings.

Our research programmes in Big Data and Data Analytics have benefitted several industry partners, including local SME aSpecial Media Pte Ltd. They had, with A★STAR's I²R, co-developed a text analytics software engines for content profiling and intent classification. Through the use of the technology, aSpecial Media is now able to build interest profiles of online users based on their browsing patterns and history over multiple websites, and provide time-relevant advertisements tailored to the needs of each user. With this feature, aSpecial Media envisions that the improved content and new interest profiles will secure 200 new contracts for the company over the next 4 years.





*Finance Minister Mr Heng Swee Keat, PS National Research Foundation Ms Yong Ying-I, and A\*STAR Managing Director Dr Raj. Thampuran, trying various strawberry-flavoured beverages that were developed at A\*STAR's Clinical Nutrition Research Centre. The drinks were sweetened by different kinds of nutritive and non-nutritive sweeteners.*

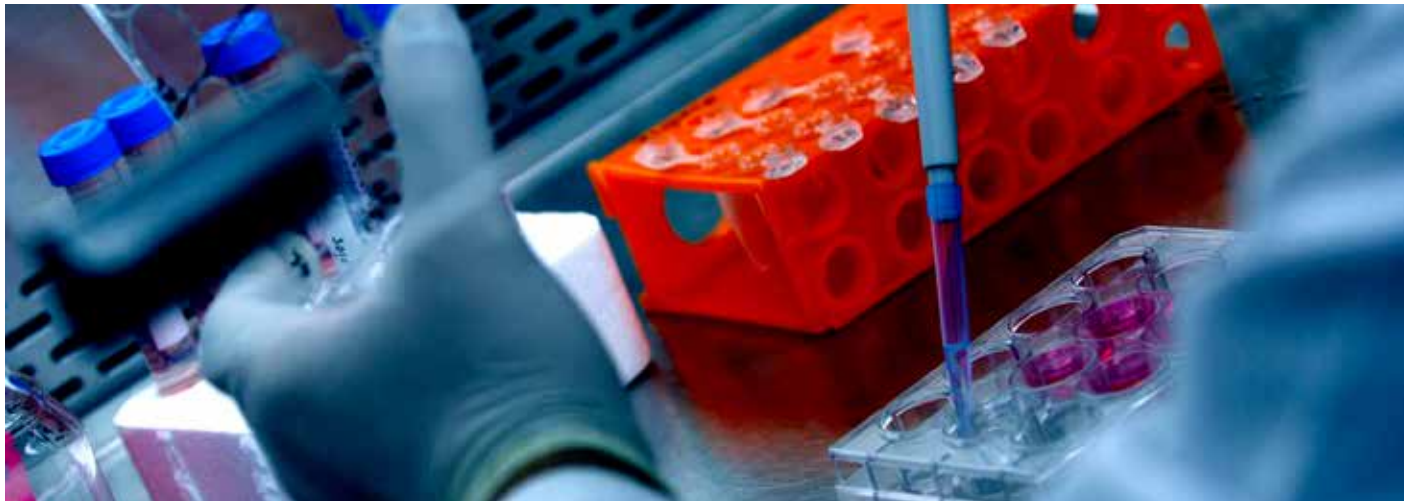
### **Catalysing the growth of Singapore's Food and Nutrition cluster**

Singapore investment in Biomedical Sciences R&D has helped with the growth of high value-added activities in industries like the Food and Nutrition (F&N) cluster. One of Singapore's successes over the last five years has been in growing an R&D ecosystem for the industry. Since 2010, Business Expenditure on R&D attributed to the cluster has increased from approximately \$100 million to reach over \$240 million in 2015, at a CAGR of 19%.

A\*STAR's capabilities in the biomedical sciences have drawn several F&N heavyweights like Nestle and Mondelez innovate and pursue R&D activities in Singapore. Nestle announced the establishment of the Nestlé Research Centre (NRC) Asia in partnership with A\*STAR at Biopolis. NRC Asia, with a focus on geriatric nutrition and healthy ageing, will complement Nestlé's existing facility for applied research and product development. In a similar vein, Mondelez International has invested \$10 million to expand its existing R&D facility and built a Centre of Excellence for Gum and Candy. Slated to be opened in the second half of 2017, the centre will include a two-storey building and a headcount of 75 R&D staff.

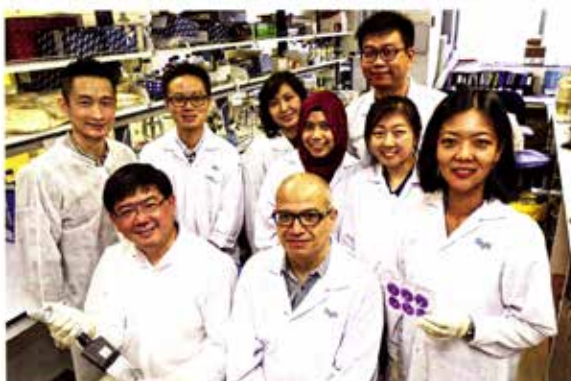


# Making A Difference Through Discovery



A\*STAR has also continued to focus on R&D that can make a difference to the lives of Singaporeans. We have embarked on various collaborations and projects with public agencies and institutions that can deliver significant societal benefits. A good example is the Zika Virus Consortium.

## Zika Infections WARRIORS IN LAB COATS



Members of A\*STAR's Zika Alliance featured in *The Straits Times*, 2/9/2016.

When Zika became a global epidemic, A\*STAR formed the Zika Virus Consortium comprising scientists from our RIs, the hospitals, the Ministry of Health's National Public Health Laboratories (NPHL) and companies to understand the virus pathology and co-develop companion diagnostics and antibody therapeutics against the virus. Scientists at ETC and BII developed a diagnostic kit that was able to test for Dengue, Chikungunya and Zika at the same time and within two hours. This made-in-Singapore kit has attracted interest from other countries and the World Health Organisation. Researchers from the Consortium were also able to identify that the strains of the virus that were diagnosed in Singapore were specific to the region and had not originated from Brazil where it was linked to a condition that affects unborn children.

Our efforts in drug development are also bearing fruit. In March 2016, we announced that our second publicly-funded cancer drug candidate, ETC-206, had entered first-in-man trials.

**Integrated Platforms: Drug and Biologic Discovery and Development**

Singapore's drug discovery and development community is one of the most mature in Asia. Drug and Biologic Discovery and Development efforts at A\*STAR are spearheaded by the Experimental Therapeutics Centre (ETC), which translates early-stage scientific discoveries into drug candidates, diagnostics and innovative research tools, as well as the Drug Discovery & Development (D3) platform, which facilitates preclinical development and early clinical trials up to proof-of-concept in man.

Developed by ETC and D3, with the Duke-NUS Medical School and the Singapore Clinical Research Institute, ETC-206 targets blood cancers. This comes after ETC-159, A\*STAR's first drug candidate that targets a number of cancers including colorectal, ovarian and pancreatic cancers, had gone to first-in-man trials in 2015. These developments are testament to Singapore's growing drug innovation capabilities with the potential to improve healthcare outcomes.

Singapore's biotech ecosystem has also reached an inflexion point. From 2010 to 2016, at least 48 local drug development and related biotechs have been incorporated, doubling that of the preceding decade (2000-2009). In the past year, 7 of our 17 spin-offs were biotechs. We have also seen a jump in licensing deals in the bio-related fields with a record of over 200 licencing deals. For example, ASLAN Pharmaceuticals, an oncology-focused local biotech, licensed a novel immuno-oncology antibody developed by A\*STAR's p53 Laboratory to advance the treatment of certain cancer types prevalent in



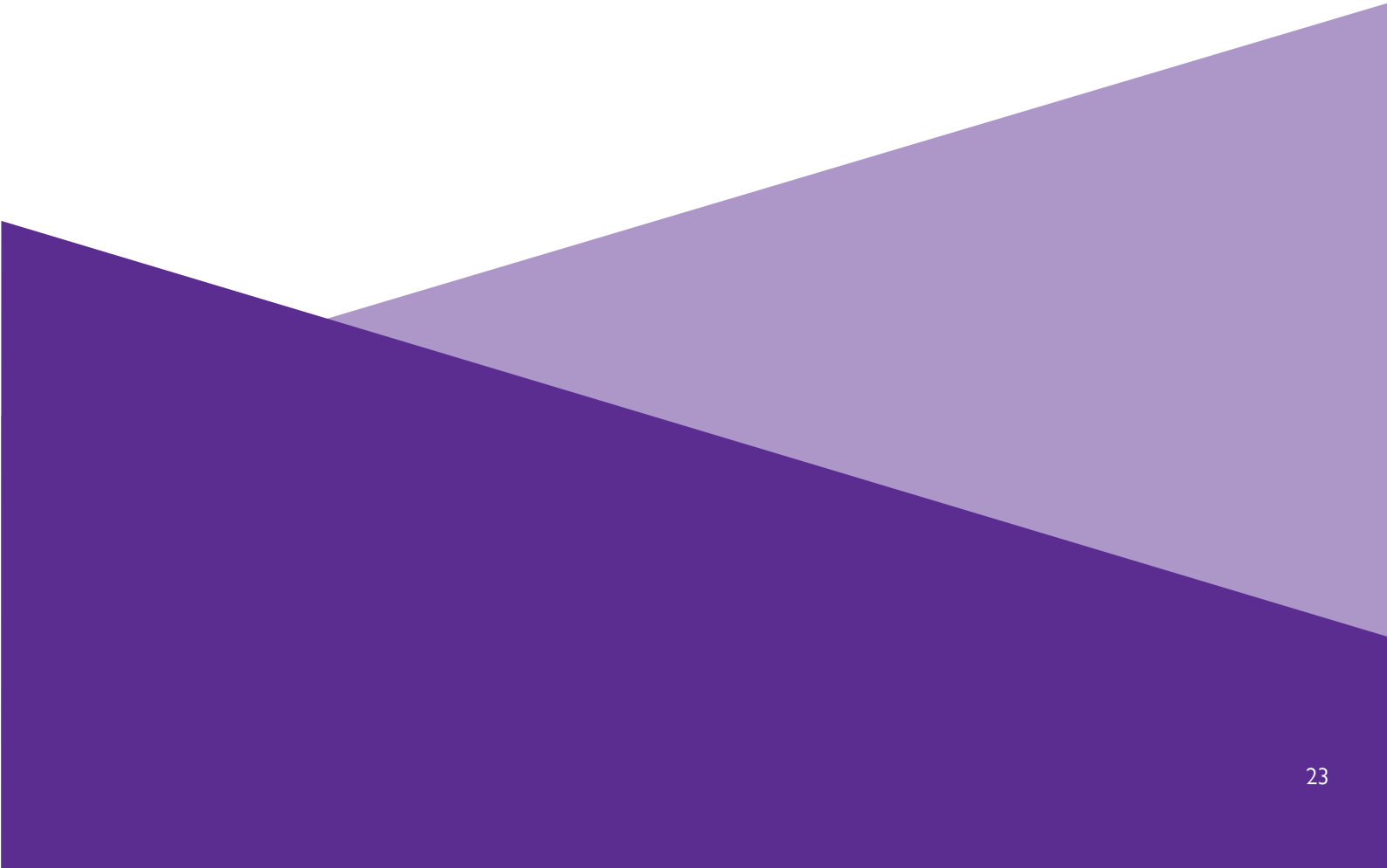
News on Zika findings as well as the diagnostic kit published in local media

Asia. To further advance the project towards clinical trials, A\*STAR entered into a three-year research collaboration with ASLAN.

A\*STAR spin-off Euchloe Bio which specialises in the development and commercialisation of antibodies to treat cancer also licensed SIgN's therapeutic immune checkpoint target antibodies for cancer treatment and combination therapy. Since its founding, Euchloe Bio has advanced several antibody drug candidates for clinical trials. Seeing strong potential in Euchloe Bio, Tessa Therapeutics acquired the local biotech in March 2017.



# Awards and Accolades



## Awards and Accolades

A\*STAR's start-ups made waves at local industry awards. I<sup>2</sup>R's Soundeye clinched the Singapore Infocomm Technology Federation (SiTF)'s Award for Best Innovation Start-Up (Early Stage) while Nanoveu and One BioMed took the prize for Best Tech and Best Pitch at the Applied Materials Ventures Day respectively. This year, we also celebrate our scholars who were recognised for the strides that they have made in their fields of research.

Our scientists also brought international recognition to A\*STAR by winning other prestigious international and local scientific awards in 2016.



## International Awards



Prof Ng Huck Hui, Executive Director of A\*STAR's Graduate Academy and the Genome Institute of Singapore, became elected as an associate member by EMBO. Prof Ng is the only associate member outside of Europe and its neighbouring countries. Election to EMBO Membership is based on exclusive nomination by existing members, and serves as a recognition of his research excellence and outstanding achievements in life science. Prof Ng's research focuses on using genome wide approaches to dissect the transcriptional regulatory networks in embryonic stem cells.

Dr Florent Ginhoux from SIgN was named 2016 Highly Cited Researcher by Thomson Reuters. The Thomson Reuters' Highly Cited Researchers list names nearly 3,000 scientists from around the world whose studies were among the top 1 percent most referenced in academic journals from 2003 to 2014. Dr Ginhoux's work is focused on the development and differentiation of macrophages and dendritic cells, and their functions within the human immune system. His research contributes to the understanding of immunity-related pathologies and may influence the development of any future intervention strategies.







Dr Wan Yue and Dr Shao Huili, received the 2016 L'Oreal Women In Science Fellowships. Dr Wan Yue, a senior research scientist at GIS, was awarded the Life Science Fellowship for her work on developing and using new genomics technologies to study how RNA uses its structure and interacts with other cellular factors to perform its functions. Dr Shao Huilin, a joint investigator with IMCB, was awarded the Physical and Engineering Science Fellowship for her work on exosomes, nanoscale vesicles actively secreted by cancer cells into the circulation.



Dr Giulia Rancati from IMB was amongst three scientists based outside of Europe and its neighbouring countries to receive the Young Investigator Programme 2016 from EMBO. She was lauded for her work on adaptive evolution in eukaryotes, which will not only add to the fundamental understanding of the design principle of a cell, but will also enable her team of researchers to treat pathogenic cells and prevent them from becoming drug resistant.



Dr Seh Zhi Wei was a finalist for MIT's Innovators Under 35 TR35 award. The award recognises the development of new technology or the creative application of existing technologies to solve global problems in industries such as biomedicine, computing, communications, energy, materials, web, and transportation. Dr Seh was honoured for his pioneering work in the design of new materials for clean energy storage and conversion, such as next-generation lithium-sulphur batteries which have five times the energy density of lithium-ion batteries today.



Dr Arseniy Kuznetsov, Head of the Advanced Concept and Nanotechnology Division at the Data Storage Institute (DSI) was awarded the Institute of Engineering and Technology (IET) A F Harvey Engineering Research Prize 2016. He was selected as the sole winner from the international scientific community for his research contributions in the field of Lasers and Optoelectronics and on a new branch of nanophotonics: optically resonant dielectric nanostructures and dielectric nanoantennas.



Dr Liu Enxiao was recognised by the IEEE Electromagnetic Compatibility (EMC) Society through the Technical Achievement Award 2016. The Technical Achievement Award, first presented in 1968, recognises significant technical accomplishments in the field of EMC, and is the highest technical award of the IEEE EMC Society. Dr Liu received this award for his 'technical leadership in high-speed electronics, system level EMC, and computational electromagnetics'.

## National Awards

Drs Lim Xinhong, Guo Huili and Benjamin Tee were honoured as Young Scientist Award (YSA) winners at the President's Science and Technology Awards (PSTA) 2016. The Young Scientist Awards recognise the accomplishments of young researchers who have shown the potential to scale greater heights. Assistant Prof Lim Xinhong, principal investigator at IMB was awarded for his work on the molecular mechanisms that govern skin stem cells in development, maintenance and repair, while Dr Guo Huili, junior investigator at IMCB was lauded for her research in understanding how RNA translation, which produces protein to regulate the body's functions, impacts human health. Dr Benjamin Tee, scientist at IMRE, Scientist, IMRE) was commended for his research in artificial skin and next-generation sensor technologies for human-machine interfaces, robots and healthcare.





# Positioning for the Future



# Innovating for the Future



In the current economic climate, innovation has proven to be an increasing force for growth. Disruptive business models, digital convergence and technologies, and a shift towards technopreneurship among today's workforce have been some of the factors behind this innovation push. What is crucial is that we continue to be the disruptors, and not the disrupted.

A\*STAR's achievements in the first year of RIE2020 demonstrate our continued ability to translate research into impactful solutions and benefit the economy and society, and how we are continuing to help our local enterprises to grow industry-relevant capabilities and develop disruptive technologies.

The ongoing global shift towards digital economies presents us with new opportunities to transform our

local industries in traditional sectors like manufacturing. A\*STAR's Future of Manufacturing initiative aims to develop Singapore as a global leading manufacturing hub, through initiatives such as our cutting-edge Model Factories. These model factories will cater to companies looking to take advantage of the technological advances in manufacturing, in order to better innovate, develop new technology and seize new business opportunities.

We will intensify our R&D efforts in areas such as Artificial Intelligence (AI), Industrial Internet of Things (IIOT), robotics and automation. These are technologies that will benefit companies beyond the manufacturing sector – they will benefit key growth sectors like finance, hub services, logistics, and urban solutions. These are sectors with potential to change Singapore's economic landscape in the coming years.

In the area of health and biomedical sciences, we continue to develop expertise and technologies for faster, more efficient healthcare diagnosis and improved treatment outcomes. The Diagnostics Development Hub (DxD) and SIMTech Microfluidics Foundry are just two examples of how we are taking technologies to the prototyping and productisation phrases.

Our core drug development systems and capabilities have resulted in promising drug assets, and upcoming establishments such as the Experimental Biotherapeutics Centre (EBC) will develop a pipeline of biologics drug candidates, or large-molecule drugs such as macrocyclic peptides and antibodies.

We have also adapted our industry approach, recognising that a “one size fits all” approach cannot meet the needs of many companies seeking to stand out from increasing competition. This is where our differentiated IP strategy has made a difference, by allowing us to exercise flexibility in our approach when it comes to IP ownership, use and access rights. For example, in response to feedback and suggestions from the Singapore Business Federation’s SME Committee (SMEC), we introduced Headstart, a programme that grants royalty-free and exclusive intellectual property (IP) licenses to local SMEs that collaborate with A\*STAR. This also complements existing A\*STAR schemes that provide SMEs greater accessibility to practical and affordable technology.



We also value the power of collaboration and open innovation. Our current partnerships with other public agencies, trade associations and chambers, MNCs, and local companies have been instrumental in helping us to better understand the needs of the industries and economy. Through constant engagement and exchange of feedback, we have developed new initiatives that have helped to catalyse the growth of innovation capacity in the private sector. These multi-disciplinary, multi-institutional partnerships will continue to be important for us to take knowledge discovery into innovation to create value for Singapore.

It is critical that we draw on the impetus that we have created to push forward and seize the opportunities available, for meaningful outcomes in this current RIE tranche. The work we do in A\*STAR creates economic growth, value for industry, and helps to better the lives of Singaporeans. We will continue to remain focused on to our mission of advancing science and developing innovative technologies to further economic growth and improving lives.



# Annex





# Key Performance Indicators

In FY2016, A\*STAR has made good progress toward achieving its five-year targets for RIE2020.

S/N	Indicator	Achieved in Financial Year 2016	Targets for RIE2020
1	Industry R&D Projects	1800	3315
2	Industry R&D Spending (\$ mil)	233.61	1200
3	Licenses	235	450
4	Spin-offs	17	52
5	Industry Cash Funding Received (\$ mil) <i>(as a subset of indicator no. 2)</i>	107.10	313
6	Licensing Revenue (\$ mil)	9.05	15
7	RSEs from RIs seconded to industry	66	275
8	PhD Postgraduates trained or being trained	126	585

In addition to the indicators above, A\*STAR research was also published in 1787 high impact publications.

**BACK COVER**