A*STAR YEARBOOK 08/09
AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH

Fostering world-class scientific research and talent for a vibrant knowledge-based Singapore
Origami, the motif that runs through the yearbook, captures the very spirit of A*STAR in nurturing the scientific community. Just as one would creatively craft a piece of origami art and fold it into a beautiful shape, so does A*STAR take pains to build an ideal environment to nurture its community of talent and allow them to develop to their fullest potential and create impact.
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HOW FAR WE HAVE COME AND WHERE WE ARE HEADED

Taking Stock & Setting the Direction
Reflecting on the Past...

STATEMENT FROM MR LIM CHUAN POH
CHAIRMAN, A*STAR

The opening of Fusionopolis – the science and engineering powerhouse – marked the beginning of a new chapter in Singapore's R&D landscape. It promised to enhance the collaboration and cooperation across scientific disciplines, agencies and sectors in our drive towards a knowledge-based, innovation-driven economy. That this celebration took place in the face of the most severe global financial meltdown in the last 70 years was no mean achievement.

At Fusionopolis, Prime Minister Lee Hsien Loong reaffirmed the Singapore government’s commitment to R&D, in spite of the economic downturn. He said, “…our R&D programme takes a longer term perspective. It will proceed despite these immediate economic downturns. It will continue despite the uncertainties that confront us in the future.

This period also saw a marked increase in Singapore’s gross domestic expenditure on R&D (GERD). In 2007, the GERD was above $6.3 billion – more than double that of $3.1 billion in 2000. The compounded annual growth rate (CAGR) for the period 2000 to 2007 was 9.1%. Of note also is that of the $6.3 billion spent on R&D, $4.2 billion was spent by the private sector and $2.1 billion by the public sector. That means that for every dollar that the government put into research, it attracted twice that amount from the private sector.

Fuelling Up the R&D Engine

The growth of R&D in Singapore from early 2000 to end of FY2008 was exponential. This period saw A*STAR ramping up our biomedical research capabilities at Biopolis while realigning the science and engineering research landscape with the opening of Fusionopolis in Oct 2008. Together, A*STAR has 14 research institutes, six consortia and three centres. The capabilities of A*STAR’s research units span the spectrum of scientific disciplines from developmental and cell biology to engineering and informatics technology. These capabilities, when integrated, will enable us to create knowledge and develop technologies to deal with the complexities and multi-faceted challenges that will confront us in the future.

During the same period, the number of Full Time Equivalent (FTE) Research Scientists and Engineers (RSE) employed in both the public and private sectors had also increased. In 2007, the private sector employed about 13,639 FTE RSEs, about double that of the public sector’s 6,883. This was an increase of 160% on the number of PhD students trained during the five-year period from FY2001 to FY2005. In addition, 636 of the RSEs from A*STAR research institutes have been also “spun-out” to locally-based companies over the three-year period. This was 90% of the number of PhDs that were significant as they were more than 90% of what was achieved in the five-year period from FY2001 – FY2005.

A total of 655 primary patents have also been filed, and 9668 papers were published. The number of papers published during this five-year period was almost double the number published from FY2001 – FY2005. A*STAR has performed very well in terms of growing research activities and the vibrant environment we have created together, the R&D spending and employment figures show the growth of private sector R&D, thereby creating many meaningful and challenging jobs for Singaporeans.

Revvving It Up

A*STAR has performed very well in terms of growing research and fostering talent in Singapore for the period FY2006 to FY2008. The total number of PhD students trained by research units in A*STAR over the three-year period was 143. This was an increase of 160% on the number of PhD students trained during the five-year period from FY2001 to FY2005. In addition, 636 of the RSEs from A*STAR research institutes have been also “spun-out” to locally-based companies over the three-year period. This was 90% of the number of PhDs trained during the five-year period from FY2001 – FY2005.

A total of 655 primary patents have also been filed, and 9668 papers were published. The number of papers published during this five-year period was almost double the number published from FY2001 – FY2005.

From FY2006 to FY2008, A*STAR had been involved in 876 industry projects with companies such as Rolls Royce and Nito Denko. Industry funding also reached $134m. This included capital injected by the private sector into large-scale projects such as the A*STAR Aerospace Consortium and the A*STAR Capabilities in Automotive Research (ACAR). Both the total number of industry projects and amount of industry funding over the three-year period were significant as they were more than 90% of what was achieved in the five-year period from FY2001 – FY2005.

More than just numbers, it is the breakthroughs in our laboratories that have been truly impactful. An excellent example is the microfluidic device and chemical kit developed in 2007 by a team of scientists from the Institute of Bioengineering and Nanotechnology (IBN). The kit could detect influenza A virus (H1N1) or swine flu simply by taking a swab sample from the throat. This Microkit is especially pertinent now at it is being adapted to detect Influenza A virus (H1N1) within two hours – significantly reducing the time for testing by several hours.

Indeed, we have achieved meaningful impact through knowledge creation. New enterprises have been spun-out of our research institutes and new partnerships and research collaborations have been forged with companies large and small, international and local. Our world-class R&D activities and the vibrant environment we have created have succeeded in attracting and anchoring a wide range of corporate research activities here.

Setting the Direction
To align with industry needs, we have established and forged many strategic industrial collaborations with the MNCs. We are transforming the local small and medium-size enterprises (SMEs) landscape through our GET-UP programme, which aims to raise the R&D capability in this sector. We are also fostering a more technopreneurial environment with our Angel Investment Management (AIM) initiative, which provides seed funds, mentorship and advice to local science-based technology start-ups. Furthermore, we have set up the Technology Transfer Network (TTN), currently the largest global alliance of its kind with 25 international and local members, to enhance the transfer of technology to industry and promote collaborations for commercialisation among its members.

Taking Flight

Moving forward, we have identified areas that we want to do better, to create even greater impact as we continue this journey. First, it is to intensify the knowledge creation and innovation activities; second, to better facilitate knowledge transfer and enhance the commercialisation of innovations; and third, to attract more corporate R&D while raising the overall R&D capabilities of local companies.

We have to constantly innovate so as to remain relevant to the highly dynamic and competitive R&D landscape. Together with our partner agencies such as A*STAR, we will need to vigilantly scan for emerging global trends and respond swiftly to new market opportunities or shifts in existing markets. In every market segment or industry that we want our R&D to make an impact, we will have to sharpen our focus and define our niche to ensure our competitiveness and relevance. This focus and differentiated approach will help us to concentrate our limited resources to better achieve impact where it matters.

In terms of doing world-class impactful research, we are focusing on research that will not only make a tangible contribution to Singapore’s environment, society and security, but will also serve the wider international community. These include research in sustainable development, renewable energy, clean energy, climate change, ageing, health and wellness, infectious diseases, green manufacturing, urban solutions, water, and information. As an example, our research in health and wellness aims to harness the advances in infocomm and biomedical sciences to deliver “personalised” medicine, which will be more “precise”, “preventive” and “participatory” in nature. This will give individuals greater awareness and empowerment in managing their own health, and ultimately, avoid a sharp rise in health care costs over time.

To achieve greater innovation and impact, we have created a rich space between BMRC and SeRc to bring researchers from the different disciplines within the two councils together for collaborative research. The A*STAR Joint Council was set up to facilitate this and is intended to complement the research efforts of the two Councils. Collaboration across disciplines is the way to go to fuel an innovation driven economy. A good many research-intensive universities, including Harvard and MIT, are heading the same way to integrate scientific research. The knowledge creation and innovation race will be won by those who can better integrate, collaborate and cooperate.

We have an advantage here at A*STAR. We not only have a wide spectrum of capabilities in biomedical sciences, and science and engineering in one organisation, but we have them in one compact location, which will greatly facilitate such cross-disciplinary research collaborations.

On talent attraction and development, we have already done well in creating a conducive environment to nurture and attract talent, and we strive to do even better. Our vision remains to create a world-class international research hub in Asia. We want our researchers to be able to focus on doing excellent research for a vibrant research community equipped with state of the art technologies and platforms. We have also developed multiple pathways for our returning scholars to pursue their passion and realise their potential in research, academia, administration, and even entrepreneurial activities.

The world today is in flux. We see established and successful economies reducing their R&D investments and at the same time, we also witness the emergence of new scientific hubs and new research centres in the world, especially in Asia. Whatever form the research landscape may take, we can be rest assured that A*STAR and Singapore are well poised to meet any challenge. We will continue with our successful approach to R&D, and remain focused on achieving the desired outcomes.

We have made remarkable achievements over the past eight years. I believe we are well positioned for the incredible opportunities that lie ahead, to break even more new ground for Singapore.
A Community of Talent

A*STAR has attracted many talented individuals from around the world – it has scientific leaders, researchers, post-docs and PhD students from over 50 countries working in 23 research institutes (RIs), consortia and centres. As of June 2009, the total size of the A*STAR community was 3,930, comprising 233 (6%) at A*STAR, 3,345 (85%) at the A*STAR RIs, 83 (2%) at eTPL, and 269 (7%) providing corporate services at the shared business centres to the research community.

A*STAR continues to be a talent magnet because of the top quality research that is being performed at the RIs, the world-class infrastructure and facilities at Biopolis and Fusionopolis, and a strategic and focused framework for bringing research outcomes to market in an innovative and enterprising manner.

Members of the A*STAR community won many accolades in recognition of their excellent contributions to science and technology. Chairman of A*STAR, Mr Lim Chuan Poh, was conferred the Honorary Degree of Doctor of Science by Loughborough University, UK in recognition of his outstanding contributions to science and technology in Singapore. Professor Tan Chorh Chuan, Deputy Chairman of A*STAR and President of the National University of Singapore, was awarded the National Science and Technology Medal, which is the highest award in Singapore for science and technology. Professor Sir David Lane, Chief Scientist of A*STAR, received the Royal Gold Medal from the Royal Society of Edinburgh, which is one of its highest accolades given to individuals whose intellectual endeavour made an impact on people’s lives worldwide. Professor Neil Copeland and Nancy Jenkins, Executive Director and Deputy Director respectively at the Institute of Molecular and Cell Biology (IMCB), accepted their election into the prestigious National Academy of Sciences in the United States for their outstanding contributions to genetic research. Professor Philippe Kourilsky, Chairman of the Singapore Immunology Network (SIGN) received the rank of Commander of the Legion of Honour from the French Republic for his work in science at both national and international levels. Professor Paola Castagnoli, Scientific Director of Sf&g was elected to the German Academy for Sciences Leopoldina, which is the world’s oldest academy for medicine and traditional sciences. Professor Jean-Paul Thiery, Chief Scientific Officer of the Experimental Therapeutics Centre and Deputy Director at IMCB received the French Legion of Honour (Chevalier) Medal for his work in cell biology research.

Dr Li Huaizhi from the Institute for Infocomm Research (I2R) was awarded the prestigious NOKIA Visiting Professor Award 2009 in recognition of his excellent contributions to speakers and language recognition research; he was also elected to the Board of the International Speech communication Association (IScA), which is the largest professional organisation in the areas of speech communication, science and technology. Dr Victor Tong, another researcher from I2R was conferred the TRUSS Award by MIT’s Technology Review for his work on Personalized Vaccin Design. Dr Lisa Rig from Sf&g won the ASIAN Young Scientist and Technologist Award 2008 for her work on Infectious Diseases, particularly in the development of diagnostic kits for the SARS-cov and Avian Influenza (H5n1) viruses.

2008 was a busy and exciting year for A*STAR. We marked a major milestone in the development of the national R&D landscape by opening Fusionopolis on 17 October 2008. The launch was attended by over 400 distinguished guests, comprising leaders from government, business, academia, and science and technology, and graced by the guest-of-honour, Prime Minister Lee Hsien Loong.

Fusionopolis was conceived as the science and technology hub in Singapore that would bring together scientists, research engineers and technology experts from a variety of science and engineering disciplines, to tackle complex challenges facing industry, and to find innovative solutions for technological and lifestyle problems facing society. Researchers would come from a broad spectrum of capabilities, ranging from high performance computing to inomics research, data storage, materials research and engineering, microelectronics, and manufacturing technology.

More importantly, Fusionopolis, with its close proximity to Biopolis, opens up opportunities for multi-disciplinary research. We recognise that a large part of knowledge creation is likely to happen at the boundary of inter-disciplinary collaboration. The juxtaposition of different disciplines and different approaches from the biomedical community and the physical science and engineering fields offers untapped prospect for discoveries in high quality and innovative solutions. This integrated approach to R&D gives Singapore a unique competitive advantage to create future industries. A*STAR established the Joint Council Office in November 2008 to drive this effort to strengthen and exploit the integration of research capabilities across the research community.
WHAT WE ARE DOING

Nurturing the Community
WHEN BIOPOLIS MEETS FUSIONOPOLIS

More than mortar and bricks, Biopolis and Fusionopolis, the biomedical sciences hub and science and engineering powerhouse respectively, are the emblems of community, collaboration and cooperation. With private sector companies, public sector agencies and scientific talent from the A*STAR research institutes and corporate laboratories in one compact location, Biopolis and Fusionopolis are able to create opportunities for talent to come together and contribute their capabilities as a vibrant and collaborative community, to impact lives and the world.
What We are doing

A*STAR Scientific conference

“The A*STAR Scientific Conference is truly a melting pot of ideas and from it, new concepts are distilled and collaborations forged. I hope BMRC and SERC scientists see merit in this exchange and mutually benefit from this interaction.”

Prof Lam Kong Peng, Scientific director, Bioprocessing technology institute

The inaugural A*STAR scientific conference, attended by about 500 A*STAR scientists, was held in Nov 2008. It aimed to be a catalyst for impactful research across the full spectrum of capabilities within A*STAR, from the biomedical sciences to physical science and engineering. It showcased the joint-council collaborations that have been initiated, including the Stem Cell Imaging System and Home-Based Medical Diagnosis System.

Venturing beyond borders - taking a leaf from the firefly

“Biology and nature can provide sophisticated solutions to problems in engineering. Take for example, the humble firefly. It is the undisputed master of converting energy from one form to another, with an efficiency of 96 percent!” says Prof Sir George Radda, Chairman of A*STAR’s Biomedical Research Council (BMRC).

Articulated by the distinguished scientist, who has been involved with Singapore’s biomedical sciences initiative since 2003, this quip captures the spirit of collaboration that unifies A*STAR’s biomedical sciences, and physical science & engineering research institutes, consortia and centres. It is this spirit to venture beyond borders that drives the creation of an unparalleled environment, where collaboration across scientific disciplines are possible.

“There is an atmosphere of excitement that here in Singapore we can achieve something that seems to be more difficult elsewhere,” says Sir George.

Prof Charles Zukoski, Chairman of A*STAR’s Science and Engineering Research Council (SERC) shares the same sentiments on the importance of cross-disciplinary collaborations.

Building a Culture of Collaboration

“The problems society faces are complex,” he says. “Technologies that improve our daily lives cannot stand alone but must enmesh themselves in the workings of our day to day lives. Brilliant discoveries in the lab require equally spectacular manufacturing concepts if they are to reach people and improve our lives,” adds Prof Zukoski.

Reflecting on the advantage that Singapore offers, Sir George says, “Collaboration is made easy by the proximity and interaction of scientists at all levels, but it also requires a desire and will to set up programmes and partnerships to facilitate research across the entire value chain.”

Prof Zukoski elaborates, “Much of the value chain revolves around the impact we deliver to industry. This involves a willingness to partner. To the partnership A*STAR brings world class capabilities and the ability to attract research staff to solve significant problems.”

“Consider a high temperature metal oxide fuel cell,” he explains. “A company is interested in a fuel cell. They need to know the basics of how the chemistry takes place on the anode surface and how to make ceramic metal seals that can survive temperatures from 0°C to 1000°C. They can work with IMRE and ICES on the electrochemistry and SIMTech on the manufacturing technology.”

“A*STAR brings together all the elements required to create this value chain - superb facilities across a vast array of disciplines; scientists and engineers at the very cutting edge motivated to discover, create and implement world changing technologies; and connections with the global market place of ideas and products to enable commercialisation,” adds Prof Zukoski.

Sir George agrees, “Singapore has a great opportunity to build the future on the achievements of its research institutes, universities, hospitals and the infrastructure it has generated. We are now in a very strong position to integrate our capabilities in the biomedical and clinical sciences with the engineering and physical sciences in the spirit of collaboration that has steadily increased in the last few years.”
Graduate students have a goal — they must acquire a PhD degree to enter the business of being a scientist. Postdoctoral fellows and early career scientists have a more nebulous goal, to develop their career paths — uncharted territory that is unique to each individual. We, as established scientists, should support their career development by — providing wide-ranging problems on which they can work to develop their expertise; advising, critiquing and supporting them in their progress; helping them to establish a peer-interactive community; and ensuring development of their communication and networking skills through attending courses and conferences.

Professor Barbara Knowles
Senior Mentor, A*STAR Graduate Academy
Senior Principal Investigator, Institute of Medical Biology
“Research needs teamwork. Researchers from different research institutes have different expertise and strengths. Collaborating and working with researchers from other RIs creates synergy which advances our research goals.”

Dr Zhang Xinhai
Institute of Materials Research and Engineering
The beauty about doing research at A*STAR is that there are no ‘walls’ between a basic biology lab like ours and a bioengineering lab,” says Dr Uttam Surana from the Institute of Molecular and Cell Biology (IMCB). Dr Surana’s research into the regulation of the cell division cycle holds exciting possibilities in producing an anti-cancer drug that could prevent tumour growth. Having successfully genetically engineered a strain of yeast that he used as a tool to screen over 10,000 compounds, he identified an anti-proliferative drug compound which suppresses uncontrolled cell division. The next challenge he faced was effective delivery of the drug.

“Our findings suggested that the compound might be metabolised rapidly in the animal body. So we looked for ways to increase its half-life in the animal body. That is where IBn comes in.” The two groups of scientists from IMCB and the Institute of Bioengineering and Nanotechnology (IBn) entered into a partnership, facilitated by A*STAR’s exploit Technologies, to develop a strategy for the effective delivery of this anti-cancer compound into cancerous cells.

The IBn group, led by Dr Yang Yi Yan, specialises in the design and use of nanoparticles for effective drug and gene delivery. IBn has encased the anti-cancer compound in nanoparticles created using a novel polymer composition that can facilitate stronger drug-polymer interaction. This allows the drug to exert its effect without being easily broken down by the animal body. The two labs are now preparing to bring their research to the next stage by testing the efficiency of anti-cancer drug delivery in animals.

Says Dr Yang, “Even though Uttam and I conduct research in different fields, our partnership enables us to tap on each other’s expertise. Our collaboration has facilitated the transformation of our research findings into what might be a groundbreaking outcome for cancer patients around the world.”

Providing Plentiful Opportunities for Growth within the Council

"I am particularly impressed with the diversity of the Council’s research capabilities and the opportunities it provides for young scientists," said Dr Uttam Surana. "The Council’s support has allowed me to pursue my research on cell division and cancer, and I am excited about the potential impact of our findings on treating the disease. I am grateful for the Council’s support and look forward to continuing our work in this field.”
Two award-winning researchers at A*STAR are working on a project that could create a breakthrough in the treatment for chikungunya, a mosquito-borne disease that has emerged as an increasingly serious international health threat.

The collaboration between Dr Lisa Ng, who is heading the chikungunya research team at the Singapore Immunology Network (SIgN), and Dr Victor Tong from the Institute for Infocomm Research (I2R) is just one of many cutting-edge projects that cross the fields of biomedical sciences and physical science and engineering.

Both researchers are excited at the potential impact of their research on an infection which as yet has no known cure.

"Working with I2R gave us the opportunity to interact with non-biologists – it wasn’t easy at first because we speak totally different languages and see scientific questions with different perspectives. However once trust was built, the project was off to a great start," says Dr Lisa Ng.

She adds, "Looking at virtual models of the chikungunya virus generated by I2R’s computational algorithms will allow us to better predict how the body’s immune system reacts to the virus."

Nodding, Dr Tong says, "I2R will contribute mathematical, computational and theoretical expertise to help accelerate the discovery of B-cell antigens that are most effective for the design of antibody therapeutics for chikungunya."

"The proximity of I2R and SIgN in Fusionopolis and Biopolis respectively allows us easy access not only to a wide range of resources, but also to a diverse array of expertise across the fields of life sciences, physical sciences and engineering. These factors are critical to the success of the project," adds Dr Tong.

Providing Plentiful Opportunities for Growth across Councils
Speaking a common language... at long last

The scientific vocabulary used by a chemist and a biologist is so vastly different that when Xiaodi and I had our first meetings back in 2005, the scientific outcome was almost nil as most of the conversation was lost in translation," says Dr. Jane Sohn Thomsen from the Genome Institute of Singapore (GIS), as she recounts the start of her collaboration with Dr. Su Xiaodi from the Institute of Materials Research and Engineering (IMRE).

The project has since come a long way. Success from this collaboration on protein-DNA binding interactions led to funding for a cross-council collaboration between GIS, IMRE, and the Institute of Microelectronics (IME), which taps on the strengths of the whole team to advance each institution's research goals.

Dr. Thomsen explains, "Since 2008, I have also been collaborating with Dr. Zhang Guojun from IME, where he and Xiaodi are using two different innovative approaches to develop nanosensor platforms for rapid screening of protein-DNA binding interactions."

Understanding these binding interactions between DNA and proteins may hold the key to developing a genetic model that allows researchers to predict human responses to drugs, for example in the treatment of breast cancer.

Dr. Zhang explains how IME's strong capabilities in Silicon Nanowires (SNW) contributes to the project's need for a rapid, multiplexing sensitive detection system to screen protein-DNA interactions that GIS has identified.

"GIS is supporting IME with the information on protein-DNA interactions and providing us with real samples for testing. In addition, IMRE is working with IME closely on quantitative analysis of protein-DNA binding, which will assist IME’s SNW biosensor development. Such interactions with GIS and IMRE are helping to advance our research goals."

The project also draws on IMRE's expertise in optical sensors to develop an alternative screening platform for studying protein-DNA interactions.

"IMRE has developed a gold nanoparticle-based method for instantaneous detection of binding interactions between DNA and proteins. This method is simple, fast and can measure many important parameters of protein-DNA interactions," says IMRE's Dr. Su.

Dr. Thomsen values the expertise that her colleagues bring to the table. "In the scientific quest for truth, the complexity of nature demands a convergence of a broad spectrum of scientific disciplines," she explains.

Agreeing on the need for researchers to venture beyond their own disciplines to solve complex problems, Dr. Su says, "I feel proud that I can now follow the discussions of critical hormone receptor biology research with GIS colleagues."

"Also, it is great that Dr. Jane Thomsen, my research partner at GIS, can now interpret engineering techniques in a way that can be easily understood by biologists!" adds Dr. Su.

Providing Plentiful Opportunities for Growth across Councils
Forging Strategic Partnerships with Industry

Soaring High

This unique consortium offers a win-win arrangement: It provides an excellent platform for companies in the aerospace industry and their partners to work closely together on customer specific needs," says Dr Andreas Fichtenkoetter of BASF Global Research Centre in Singapore.

In Feb 2009, BASF, the world’s leading chemical company joined A*STAR’s Aerospace Programme, along with seven other multi-national aerospace-related powerhouses and Singapore enterprises, bringing the total membership of the consortium to 16. Boasting stellar industry names including Boeing, EADS, Pratt & Whitney and Rolls-Royce, the consortium was the first of its kind in Asia to bring together such giants of the industry, creating a unique platform for A*STAR research institutes to work with MNCs and local companies on cutting-edge aerospace technologies.

The programme aims to strengthen the value-chain among the key industries of aviation, maintenance, repair and overhaul and precision engineering, so as to accelerate overall growth in the industry and increase the proportion of aerospace manufacturing activities in Singapore. Together with industry, A*STAR’s Aerospace Programme has invested S$14 million for 10 R&D projects involving 40 scientists from the science and engineering research institutes. The six new projects which were launched in the programme’s second cycle include research which aims to develop new, low cost erosion resistant coating materials to improve the durability of aircraft structures, and devising a cost-effective methodology to repair defective aero engine components.

A*STAR’s outstanding contribution to the industry was recognised when it won the 2009 Frost & Sullivan Asia Pacific Aerospace & Defence Award for Aerospace R&D Institution of the Year, becoming the first local public research agency to receive this honour.

Dr Zhu Chuangui, General Manager, Sunny Instruments Singapore, echoes Dr Fichtenkoetter’s confidence in the benefits of A*STAR’s leadership in developing cutting-edge technologies and the collaborative network of the Aerospace Programme.

“Our aim is to foster closer ties with esteemed members of the Singapore Aerospace community, so as to establish co-operation, or partnerships that will bring about mutual benefits,” Dr Zhu says.

As a pioneer member of the SERC AP, Rolls-Royce is very pleased with the research programmes and actions developed in the first year. This programme is ideally placed to address many of the unique challenges and opportunities facing our industry. As such, we are looking forward to working with the SERC team to develop and implement step change technology-driven manufacturing and repair solutions.”

Dr Hamid Mughal
Executive Vice-President
Manufacturing Engineering, Rolls-Royce Plc
Creating the next blockbuster

“Good start-ups that are funded now will be well-poised to take advantage of the improved market conditions when the crisis is over, and the economy picks up. We would like to urge more Angel investors to step forward to invest in Singapore startups and to mentor the next wave of blockbusters for Singapore.”

Mr Boon Swan Foo, Executive Chairman of Exploit Technologies Pte Ltd

In today’s economies, smart investment dollars are flowing into countries and organisations with a strong focus on commercialisation and innovation,” says Mr Boon Swan Foo, Executive Chairman of Exploit Technologies Pte Ltd (ETPL).

The commercialisation arm of A*STAR, ETPL helps researchers convert their discoveries in the lab into value propositions for the market. ETPL drives the whole process, from incubating a pool of market-ready technologies for commercial applications, providing intellectual property (IP) portfolio management, to supporting budding technopreneurs from A*STAR’s research institutes who wish to spin-off.

To date, ETPL manages a portfolio of close to 3000 active patents, has granted more than 250 licenses for A*STAR technologies and created a portfolio of 24 spin-off companies. Estimated business revenue to be generated from products and services using or incorporating A*STAR’s technologies is projected to be over $500m. The total market value created through A*STAR startups amounts to about $100m.

ETPL’s initiatives to boost investments in new technologies include the Technology Transfer Network (TTN) and Angel Investment Management (AIM).

Facilitating networking, innovation and entrepreneurship

“Angel investors provide invaluable investment, advice, mentoring and business networks to start-ups. We will be able to facilitate a pipeline of start-ups from A*STAR and TTN partners to tap on such Angel-networks,” says Mr Boon.

Bringing R&D from bench to market

The Technology Transfer Network (TTN) seeks to form the vital link between the research community and industry, allowing members to leverage on the expertise and experiences of a diverse range of partners to enhance their technology commercialisation and innovation efforts.

Within less than a year of its founding, the collaborative alliance has grown into a global network of 25 members ranging from multi-national companies as well as universities and polytechnics in Asia, Australia, Europe, New Zealand and North America.

Delighted with the enthusiasm and commitment of its members, Mr Boon Swan Foo, Executive Chairman of ETPL and Chairman of TTN says, “We are confident that this collaboration will stimulate positive vibes in the technology transfer industry and further Singapore’s position as a world class research and technology transfer hub. We foresee great potential in this alliance of local and international institutions.”

Mr Tan Hang Cheong, Principal of Singapore Polytechnic, encourages his staff and students to be actively involved in applied R&D work, and is confident of the benefits of joining TTN. “Some of the technologies resulting from our applied R&D projects have the potential to be commercialised. Our experience has shown that bringing applied R&D technologies into the marketplace has been a main challenge for our staff and students,” he explains.

“They TTN will provide the platform for Singapore Polytechnic staff involved in technology transfer to share expertise and best practices with colleagues from other institutions of higher learning and research institutes,” adds Mr Tan.

Forging Strategic Partnerships With Industry

WHAT WE ARE DOING

NURTURING THE COMMUNITY

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30
Combating H1N1

When the H1N1 global pandemic erupted, A*STAR’s researchers immediately activated expertise and resources across its institutes, as well as public and private sector agencies, to battle the virus. Our researchers’ collaborative efforts have helped Singapore make its mark on international efforts to combat the outbreak, through discoveries that have attracted the attention of the international research community.

Detecting the H1N1 virus quickly

Prof Jackie Ying and her team of scientists from the Institute of Bioengineering and Nanotechnology (IBN) literally sprang into action and set up a dedicated H1N1 lab within days, in their quest to discover a speedier way to detect the virus.

Their drive, resourcefulness and collaborative efforts led to the adaptation of IBN’s portable, diagnostic kit (or MicroKit); previously designed for fast and accurate detection of infectious diseases, to detect the H1N1 virus. The Microkit can photocopy a virus’ genetic material through a polymerase chain reaction within two hours, creating a quantum leap in the time taken to detect the virus.

IBN’s collaboration with the National University Hospital and DYNAM Biotech Pte Ltd on the Microkit to provide affordable, accurate and effective detection of infectious diseases such as H1N1 and the avian flu, is a model of how research, medicine and entrepreneurial spirit combine to bring innovative products to market,” says Prof Ying, Executive Director, IBN.

As the sample preparation system is automated, the time taken for testing by the Microkit is also significantly faster compared to conventional methods. IBN is currently working with the National University Hospital to validate the system for clinical studies, while the diagnostic system is licensed to SG Molecular Diagnostics, a spin-off company of DYNAM for commercialisation.

“Such collaborations are essential for developing a vibrant and strong biomedical industry in Singapore,” adds Prof Ying.

Sequencing genomes of H1N1 virus

Scientists at the Genome Institute of Singapore (GIS), led by Dr Christopher Wong, Chief Scientific Officer for Biomarker Development at GIS, have developed a novel approach to uncover the complete sequence of the H1N1 virus with just a quick nasal swab.

Using multi-plex microarrays manufactured by industry partner Roche NimbleGens, in combination with laboratory protocols developed by GIS, the entire genome of the virus sequence can be sequenced within a day. The more efficient process means that a lab technician can now process virus samples more quickly, allowing for rapid monitoring if the strain has changed to become more dangerous.

Prof Edison Liu, Executive Director of GIS, says, “The significance of this tracking process can be better appreciated in that it provides vital information that can be used to prevent or combat a pandemic.”

Dr Wong explains how working with local hospitals was critical to the project.

“In order to apply the important findings from research labs into clinical practice, collaborations between researchers and clinicians are necessary. Often, the technology platform used would need to be enhanced so that it could be used in a hospital setting,” says Dr Wong.

“Collaborations expand the scope of expertise available to the project team, enabling progress in a timely fashion,” adds Dr Wong.

This approach is a useful tool for surveillance by clinicians and public health officials to monitor changes in the virus as it evolves, and rapidly detect any viral mutation that may cause its resistance to anti-viral drugs, allow it to escape the vaccine response, or cause it to become more virulent. Serogroups are underway to make this product widely available before the second wave of H1N1 infections.

Testing for H1N1 virus

The trust and respect between Mr Masafumi Inoue, Principal Coordinator from the Institute of Molecular and Cell Biology (IMCB) and Dr Tim Barkham, a Clinical Microbiologist at Tan Tock Seng Hospital (TTSH), who had worked closely together during the SARS outbreak, allowed them to deal with the pressures and demands of their project when H1N1 erupted.

The enormous effort put in by Mr Inoue and his team, who worked late into the night seven days a week, matched that of the staff at TTSH. The strength of the relationship enabled each to make high demands of the other and to speak openly about difficulties and problems.

This teamwork has delivered results in the form of the “Multiplex One-Step Real-time RT-PCR Kit”, which is now used for the detection of H1N1 flu in hospitals. More than 5000 such kits produced by IMCB are being used by the hospital. The technology was also licensed to an industry partner to manufacture the diagnostic kits.

The collaboration between both parties have also delivered other products that have been put into routine daily use at TTSH: an earlier influenza kit that had been in use for four years before this latest outbreak, as well as a SARS kit, a kit for tuberculosis and a combined kit for detecting chikungunya and dengue.
**3-D structural model of critical viral protein**

Dr. Sebastian Maurer-Stroh's team of scientists from the Bioinformatics Institute (BII) was the world's first to demonstrate that bioinformatics and computational biology have a role in managing the H1N1 virus. Their analysis and a three-dimensional (3-D) structural model of a critical protein produced by the H1N1 virus strain were accepted for publication by Biology Direct, a peer-reviewed journal, only two weeks from the time the first patient virus samples were made available. The analysis has been the subject of intense interest by international researchers, with the published article receiving more than 7,000 hits within the first two months of the H1N1 outbreak. BII is working closely with the Genome Institute of Singapore and Ministry of Health (MOH) to develop strategies to monitor and manage the spread of the H1N1 virus in Singapore. The collaboration has been extended to research institutes and health authorities in Mexico.

**Contact network model**

Scientists at the Institute of High Performance Computing (IHPC) have developed a model that can effectively map the spread of infectious diseases via contact networks amongst individuals. Using supercomputers and high performance techniques, the IHPC researchers, in collaboration with the National University of Singapore, Nanyang Technological University and MOH, speeded up the modelling and simulation process significantly, while maintaining the flexibility to incorporate new data that takes into account the demographic, geographic and social contact patterns of Singapore. The results generated can provide quantitative evaluation on containment strategies to healthcare workers and policy-makers when dealing with a pandemic situation in Singapore.

**Other Collaborative Efforts Against H1N1**

**Fishy business: Pioneering an intelligent monitoring technology**

Fish play an important role in ensuring Singapore's water quality. PUB, Singapore's national water agency, monitors the health of fish in tanks at its water facilities for sudden declines in their population – an indication of possible decline in water quality. For years, monitoring was done manually, but the inefficiency of maintaining such a decentralised system in remote locations led PUB to approach the Institute for Infocomm Research (I’R) for a more effective solution.

The result: an automated and centralised video monitoring system which serves as electronic eyes that look out for abnormal fish activity patterns. Jointly pioneered by researchers, biologists and engineers from I’R and PUB, the Fish Activity Monitoring System (FAMS) has transformed the management of water quality by PUB. The team from I’R won the Institution of Engineers Singapore Prestigious Engineering Achievement Award 2008 for their work on this project. FAMS makes use of inexpensive video cameras and off-the-shelf equipment to process the images of fish movements by a PC based system and generates alerts, via an existing telemetry system, so that operators will be notified by an audio alarm in the event of a sharp decline in the number of live fish. A set of image processing and computer vision algorithms have been developed to automatically track and interpret fish activity. The automated detection technology increased the reliability and efficiency of FAMS as an early warning system. FAMS also provides an edge over certain commercially available solutions as it allows fish to be monitored in a less stressful environment within a standard fish tank.
Pushing technological frontiers

From research on converting microalgae to bioenergy, to transforming electric power grids to ‘smart grids’, A*STAR researchers are driving research on multiple platforms with a range of local partners, from universities and polytechnics, to government agencies and private companies. Their mission: to develop innovative solutions to manage environment deterioration, pressures on natural resources and climate change.

The funding from A*STAR’s Science and Engineering Research Council (SeRc) to support research in next generation technologies, in collaboration with local partners and companies, reflects A*STAR’s will to take the lead in creating a sustainable future for Singapore and the international community.

Current projects where A*STAR institutes are working in partnership with researchers from universities and polytechnics include SeRc’s Bioenergy programme, which explores ways to maximise the conversion of non-edible biomass resources into biofuels; the Carbon Capture & Utilisation programme which aims to enhance capabilities for efficient capture, storage and conversion of atmospheric carbon dioxide; and the Sustainable Materials programme that focuses on the development of composites and lightweight materials for targeted industries such as the aerospace, automotive and electronics sectors.

Beyond the institutes of higher learning, A*STAR researchers are also working closely with local government agencies on a range of projects. This includes Singapore Institute of Manufacturing Technology (SIMTech)’s initiatives to promote awareness and training in sustainable manufacturing technologies through collaborative efforts with IE Singapore, Spring Singapore, Singapore Environment Council, Singapore Manufacturers’ Federation and Singapore Polytechnic.

In another pioneering initiative, an experimental power grid will be set-up at Jurong Island to test-bed and demonstrate integration of emerging alternative and renewable energy sources to address the issues of energy storage, distribution, optimisation and efficiency to support energy diversifications efforts in Singapore.

One area which could harness the benefits of this ‘smart grid’ technology is the electric vehicle test-bedding study, spearheaded by a multi-agency taskforce including A*STAR, the Economic Development Board, National Environment Agency, Ministry of the Environment and Water Resources, Ministry of Trade and Industry, and led by the Energy Market Authority and the Land Transport Authority. Researchers at A*STAR are also actively partnering companies to explore new areas of research - such as the second life of lithium ion batteries, the design and manufacturing of battery management system and charging technologies – and to test these products and ideas in prototypes of electric vehicles.

Emphasising A*STAR’s commitment in working with companies to create next generation technologies, Prof Charles Zukoski, Chairman of SeRc, adds, “This is part of SERC’s efforts to convert leading edge discoveries into next generation technologies that are commercialised for the good of the community at large.”
Advancing scientific research in Singapore

The Experimental Therapeutics Centre (ETC) has forged several collaborations with companies in the pharmaceuticals and biotechnology industry including Curiox Biosystems Pte Ltd on the development of DropArray (TM) system for running ELISA and cell-based assays in high-throughput screening; Forma Therapeutics on building a diversity-oriented chemical library to support the ongoing screening efforts by ETC; and Merlion Pharma on the development of an anti-bacterial drug.

To improve the quality of life for diabetic patients, the Institute of Microelectronics (IME) is collaborating with GlucoStats System Pte Ltd, a Singapore start-up medical device company, to develop key enabling technologies for a non-invasive glucose monitoring device.

Separately, IME is also spearheading the Electronic Packaging Research Consortium with 16 companies to address key integration challenges for three-dimensional (3-D) Packaging and Embedded Module technologies. The members include local companies such as ASM Technology Singapore Pte Ltd, Chartered Semiconductor Manufacturing Ltd, Disco Hi-Tec Singapore Pte Ltd, Ibiden Singapore Pte Ltd, Infineon Technologies Asia Pacific Pte Ltd, Kinergy Ltd, Nepes Pte Ltd, NXP Semiconductors Singapore Pte Ltd, and Sumitomo Bakelite Singapore Pte Ltd.
A*STAR has put Singapore on a firm footing on the global scientific research landscape by forging partnerships with research establishments across the globe, to advance new areas of research, and creating opportunities to nurture the next generation of scientists.

**Making global connections**

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**North America**

- **Canada**
  - BC Cancer Agency
  - MaRS
- **United States of America**
  - Binghamton University, State University of New York
  - Boeing
  - Carnegie Mellon University
  - Compass Technology Company Ltd
  - CONNECT, University of California San Diego
  - Comag Incorporated
  - Finisar Corporation
  - Global CONNECT
  - GT Industrial LLC Co.
  - Hewlett Packard
  - IPC Photonics
  - Larta Institute, Los Angeles
  - Motorola
  - National Science Foundation
  - Northwestern University
  - Office of Technology Alliances, University of California, Irvine
  - Pratt & Whitney
  - Procter & Gamble
  - Roche NimbleGen
  - Rochester Institute of Technology
  - Seagate Technology International
  - Stanford University
  - Tangos Systems Inc
  - Technology Transfer Tactics
  - University of California, Los Angeles
  - University of Illinois at Urbana-Champaign
  - Van Andel Institute

**South America**

- **Mexico**
  - National Institute of Genomic Medicine (INNVEGEN)

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**Europe**

- **Austria**
  - Avir Green Hills Biotechnology Research and Development Trade AG
  - EVG Group
- **Belgium**
  - GlaeselSchmiterline Biologics SA
  - Ludwig Institute of Cancer Research
- **Denmark**
  - University of Southern Denmark
- **Finland**
  - Silva Oy
  - Telia
  - VTT Technical Research Centre
- **France**
  - Alcatel-Lucent
  - Centre National de la Recherche Scientifique (CNRS)
  - Humayus SAS
  - Université Joseph Fourier
- **Germany**
  - BASF Corporation
  - Bosch
  - Carl Zeiss MicroImaging
  - Infineon
  - INI-GraphicNet
  - Siemens Medical Solutions
  - Siemens Water Technologies

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**Hungary**

- **Italy**
  - Accent S.P.A
  - European Institute of Oncology (IEO)
  - European School of Molecular Medicine (SEMM)
  - FIRC institute of Molecular Oncology (IFOM)
  - Lombardy Region (Regione Lombardia)
  - University of Milano-Bicocca
- **Netherlands**
  - European Aeronautic Defence and Space Company (EADS)
  - Netherlands Proteomics Centre, Utrecht
  - University
  - Philips
  - Shell Hydrogen BV
- **Poland**
  - Ministry of Science and Higher Education
  - Poznan University of Medical Sciences
- **Spain**
  - Translational Oncology Unit, Consejo Superior de Investigaciones Científicas (CSIC)
  - Vall d’Hebron Hospital
Some new collaborations with research institutes

From July 2008 to June 2009, some new partnerships established with leading global research establishments include:

A*STAR-New Zealand Health Research Council

A*STAR and the New Zealand Health Research Council (NZ HRC) signed a Memorandum of Understanding in October 2008, for a three year period, to promote collaborative research and development activities between the two countries. Under the agreement, A*STAR and NZ HRC will jointly organize two symposia and two joint grant calls in metabolic diseases and cancer, and a $3.48 million fund was set up to support collaborative research projects between Singapore and NZ researchers.

A*STAR-Lombardy

In April 2009, A*STAR signed a Memorandum of Intent (MOI) on General Cooperation with the Region of Lombardia to expand scientific collaborative activities between scientists from A*STAR and Lombardia, in areas including Biotechnology, New Materials, Energy-Environment and Health. This MOI builds on the relationships established between Singapore and Lombardia since 2007, in particular research and training agreements with the University of Milano-Bicocca and top research institutes including the FIRC Institute of Molecular Oncology, the European Institute of Oncology and the European School of Molecular Medicine.
Partnerships around the world to groom young talent

**A*STAR Research Attachment Programme**
Launched in October 2008, A*STAR’s Research Attachment Programme (ARAP) has grown to a stable of seven partners from Europe and Australia. ARAP provides PhD students from the partner universities the opportunity to experience doing research in a distinctly international environment at A*STAR. These post-graduate students who receive half their PhD training at A*STAR laboratories and the other half at their respective universities will act as bridges, forging ties between different research communities and building linkages between Singapore and the world.

**A*STAR Graduate Scholarships Programme**
The University of Oxford’s partnership with A*STAR in July 2008 to offer the A*STAR-University of Oxford DPhil Programme was the latest addition to the portfolio of scholarships under the A*STAR Graduate Scholarships (AGS) Programme. AGS gives top university graduates an opportunity to work with renowned A*STAR researchers and pursue a PhD with A*STAR’s partner universities, including the National University of Singapore and Nanyang Technological University. Scholars spend approximately two years each in an A*STAR research institute and a partner university respectively, and earn a doctorate conferred by the university upon completion of their studies. These scholars eventually return to join the globally connected community of research talent in Singapore.

**Science competitions and public events**
Science competitions such as the Sony Creative Science Award and the Tan Kah Kee Young Inventors’ Award (Junior Student Section) provide an early platform for primary school students to explore science in a fun way. Other competitions organised for secondary school to junior college (JC) students which include the A*STAR Talent Search, National Junior Robotics Competition, National Science Challenge, Singapore Science and Engineering Fair and the Tan Kah Kee Young Inventors’ Award allow them to apply their textbook knowledge of science to solving real problems in fun and innovative ways.

Through Science-themed activities organised by A*STAR and Science Centre such as the annual Science in the Mall event and the six-week long science 08 festival (which includes a three-day science carnival X-periment!), young children and the general public get to touch and explore science in a relaxed and informal environment. Events such as Meet the Scientist sessions, Science Buskers festival and Science Month also provide dynamic and engaging platforms to postgraduate students and beyond, to engage in fun-filled science activities.

**Attachments and awards**
Students from the upper secondary to post-doctoral level with a deep interest in science have numerous opportunities to experience independent research under the mentorship of researchers at A*STAR institutes. Under programmes such as the A*STAR-Ministry of Education R&D Attachment, H3 Research Attachment and Young Researchers’ Attachment Programme, secondary school and JC students get to participate in research projects and interact with researchers in labs. The A*STAR Science Award (Upper Secondary), also give out stipends for up to two years of study to secondary school students, the period during which they visit research institutes and attend talks. Additionally, JC students who receive the A*STAR Science Award (JC) have the opportunity to participate in research projects.

Under the Singapore International Pre-Graduate Award, international students doing undergraduate or Masters courses are mentored by the best scientists at A*STAR for a two to six month attachment period, while international PhD students who receive the Singapore International Graduate Award undergo their PhD training in A*STAR institutes or the local universities.

**Scholarships**
A*STAR also offers a range of scholarships to outstanding international and local students from undergraduate to post-doctoral level. These include the National Science Scholarships (NSS BS) and A*STAR Pre-Graduate Scholarship for undergraduate studies, the NSS (MBBS-PhD) for undergraduate and MBBS or PhD studies respectively, and the NSS (PhD) for PhD studies.

Talented post-doctoral fellows may also enrich their research experience at internationally renowned labs under the A*STAR Graduate Scholarships (Post-Doctoral Fellowship) or the A*STAR International Fellowship.
HOW WE ARE DOING
Creating Impact
PM Lee officially opens Fusionopolis by inserting the Fusionopolis Device onto the launch podium.

The Fusionopolis Device, in the shape of an asterisk, symbolises the integration of capabilities at Fusionopolis to create the future and impact the world.

More than 400 scientific and industry leaders listen in rapt attention.

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OpenInG OF Fusionopolis

17 OCTOBER 2008

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FusionFest
20 – 24 October 2008

A*STAR researchers perform an original composition by Iskandar Ismail

PM Lee ‘dots the eye’ of the robotic lion remotely

Robotic lion awakes to perform for guests

Robotic butler serves drinks

PM Lee surveys A*STAR technologies

Minister of State (Trade and Industry) Mr Lee Yi Shyan officially opens FusionWorld

NUS team beats four other international teams to win STAR Challenge@Fusionopolis

Deputy Prime Minister Prof S Jayakumar delivers opening address at Futuropolis 2058

A*STAR scientist explains A*STAR technology to Ms Grace Fu, Senior Minister of State for Education & National Development, at the Science Gala
Creating Impact

July 2008

101 National Science Scholarships and A*STAR Graduate Scholarships were presented to recipients at A*STAR’s Scholarship Award Ceremony 2008. During the ceremony, the A*STAR International Fellowship to support PhD graduates in their post-doctoral training in top overseas universities and private sector labs was launched.

The Biomedical Imaging Lab from the Singapore Immunology Network won the Summa Cum Laude (Gold) award for its exhibit at the American Society of Neuroradiology 2008 meeting in New Orleans, USA.

Dr Lisa Ng from the Singapore Immunology Network was conferred the Young Scientist Award of the council of new Zealand set up the A*STAR-NZ investigators’ network won the Young Scientist Award 2008. A*STAR launched the A*STAR Research Council and Prof Jackie Ying, Executive Director of IBiO were named amongst "One Hundred Engineers of the Modern Era" at the American Institute of Chemical Engineers Centennial Celebrations.

August 2008

At the National Science and Technology Awards 2008, Prof Tan Chorh Chuan, Deputy Chairman of A*STAR was honoured with the National Science and Technology Medal - Singapore’s highest award for outstanding contributions to science and technology. Two teams from the Institute of Microelectronics and Singapore Institute of Manufacturing Technology also received the National Technology Awards and a researcher from the Institute of Chemical and Engineering Sciences won the Young Scientist Award.

Mr Lim Chuan Poh, Chairman of A*STAR was conferred the Honorary Degree of Doctor of Science by Loughborough University, UK for his outstanding contribution to science and technology in Singapore.

The Director-General for Research of the European Commission, Mr Jose Manuel Silva Rodrguez, visited A*STAR to better understand research developments in Singapore.

September 2008

A*STAR launched the A*STAR Graduate Scholarships were national Science Scholarships and A*STAR's Graduate Scholarships were developed by its research institutes at the European Commission’s Director-General for Research of the European Commission.

The 13th Biomedical Sciences International Advisory Council meeting commended the speed at which the integration of both basic and clinical sciences had taken place and applauded Singapore’s commitment to R&D.

Dr Sir David Lane was honoured with the Royal Gold Medal by Royal Society of Edinburgh, for his outstanding contribution to cancer research through his discovery of the p53 tumour suppressor gene.

The Director-General for Research of the European Commission, Mr Jose Manuel Silva Rodrguez, visited A*STAR.

October 2008

At the opening of Fusionopolis, Singapore’s science and technology powerhouse, Prime Minister Lee Hsien Loong affirmed the Singapore government’s commitment to R&D investment in spite of the global financial crisis.

Scientists from the Institute for Infocomm Research won the Institution of Engineers Singapore Prestigious Engineering Achievement Award for the fourth consecutive year for their work on Fish Activity Monitoring System, a collaborative project with PUB.

Prof Paola Castagnoli, Scientific Director of the Singapore Immunology Network, was elected to the German Academy for Sciences Leopoldina, the world’s oldest academy for medicine and traditional sciences.

During his visit to A*STAR, Hon. Anthony Byrne, MP Parliamentary Secretary to the Australian Prime Minister, expressed his desire to strengthen science and technology ties between Singapore and Australia.

November 2008

Research collaborations between Institute of Materials Research and Engineering and the Data Storage Institute were launched at the opening of Nitto Denko’s First Asia Technical Centre at Fusionopolis.

Six new members from New Zealand, US, Canada and Germany joined the Technology Transfer Network, the collaborative alliance initiated by ETPL to promote innovation and the commercialisation of technology.

The Institute for Infocomm Research signed a MOU with industry partners, namely, Philips, Motorida, PKG Media, EVV Media and Zentek Technology, to collaborate on NextGen TV programmes.

The Indian Minister of Science and Technology and Earth Sciences, H.E. Kapil Sibal, and the President of Stevens Institute of Technology, Dr Harold Raveché, visited A*STAR.

December 2008

Prof Charles Zukoski, Chairman of A*STAR’s Science and Engineering Council and Prof Jackie Ying, Executive Director of IBiO were named amongst the ‘One Hundred Engineers of the Modern Era’ at the American Institute of Chemical Engineers Centennial Celebrations.

Researchers from the Brain-Computer Interface (BCI) team at the Institute for Infocomm Research edged out 34 other international teams to win first place in the BCI Competition IV.

A*STAR introduced 13 new technologies developed by its research institutes at the Special Interest Group on GRAPHICs and Interactive Techniques Asia 2008.

The Costa Rican President and 1987 Nobel Peace Prize Laureate, H.E. Dr Oscar Arias Sanchez as well as the Kaufman Foundation President Dr Carl Schramm and Vice-President Ms Lea Mitchell made separate visits to A*STAR.

YEAR IN REVIEW

July 2008

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During the ceremony, the A*STAR International Fellowship to support PhD graduates in their post-doctoral training in top overseas universities and private sector labs was launched.

Dr Lisa Ng from the Singapore Immunology Network won the ASEAN Young Scientist and Technologist Award 2008 for her work on infectious diseases, particularly in the development of diagnostic kits for the SARS-CoV and Avian Influenza (H5n1) viruses.

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Mr Lim Chuan Poh, Chairman of A*STAR, was named among the “People to Watch in 2009” by Science magazine, becoming the first Singaporean to gain a mention in the prestigious magazine’s annual list of influential global leaders and policy makers.

Dr Li Hazhou, a researcher from the Institute for Infocomm Research, was one of two distinguished professors to be conferred the Nokia Visiting Professor Award by the Board of Nokia Foundation for his contributions to Speech and Language Recognition research.

The Singapore Immunology Network collaborated with HumAlyx SAS, a French biopharmaceutical company to develop antibody-based therapies for viral diseases prevalent in Asia and Singapore.

Partnerships were also established between the BioProcessing Institute and GlaxoSmithKline Biologicals SA Belgium to collaborate on vaccine development projects and between the Institute of Bioengineering and the University of Milano-Bicocca, as well as with the FIRC Institute of Molecular Oncology for research collaborations between Japan and Europe.

A delegation from the World Premier International Research Centre, led by Program Director Dr Tedko Kusali, visited A*STAR.

A*STAR and the University of Illinois at Urbana-Champaign opened the Advanced Digital Sciences Centre, Illinois research centre outside of the United States.

Eight more leading multinational and local companies joined the SERIC Aerospace Programme, bringing the total number of members, which includes Boeing, EADS, Pratt & Whitney and Rolls-Royce, to 16. The consortium launched six new projects to develop advanced materials for aircraft bodies, improve MRO and manufacturing processes as well as intelligent sensors for structural health monitoring and diagnostics.

ETPI and the Hewlett-Packard Alumni signed a MoU under the Angel Investment Management initiative to enhance and accelerate angel networking activity, and to provide startups with greater access to angel investors in Singapore and in the region.

A*STAR and the Japan Science and Technology Agency signed a MoU to expand fund and research collaborations between Japan and Singapore on “International Applications in Physical Sciences”.

A*STAR hosted separate visits by Prof Alison Rutherford, Vice-Chancellor of the University of Cambridge, UK, a delegation from Denmark led by Dr Helle Uhrich, CEO of the Capital Region of Denmark; and 12 top officials from 7 countries participating in the first-ever meeting for BiologY organised the past winners of the prestigious European Molecular Biology Organisation Gold Medal award to discuss topics on developmental, cell and molecular biology. They were joined by 30 local researchers.

A*STAR hosted visits by Her Royal Highness Thai Princess Maha Chakri Sirindhorn; the Thai princess for her election into the prestigious French Legion of Honour for his work in Science at both national and international levels.

A Memorandum of Intent (MOI) was signed to expand collaborative activities between scientists from A*STAR and Lombardy, Italy. This was witnessed by Singapore’s Senior Minister of State Hock Chok Teng, Senior Minister of State (Trade and Industry) S. Iswaran and the President of the Lombarda region, Mr Roberto Fontana.

A*STAR and Hungary’s National Office for Research and Technology awarded grants to scientists from Singapore and Hungary to collaborate on four new research projects in cancer, biomaing for stem cell therapy, stroke rehabilitation and drug delivery.

A*STAR announced that Prof Sir David Lane and Prof Birgit Lane would resume full-time appointments as Chief Scientist of A*STAR and Executive Director of the Institute of Medical Biology respectively with effect from Sep 2009.

The Institute of Molecular and Cell Biology organised the first-ever meeting for past winners of the prestigious European Molecular Biology Organisation Gold Medal award to discuss topics on developmental, cell and molecular biology. They were joined by 30 local researchers.

Four companies under Explore Technologies outperformed over 200 proposals to each clinch the $5,000,000 grant under SPRING Singapore’s Technology Enterprise Commercialisation Scheme. The companies were founded by researchers from A*STAR research institutions and had leveraged A*STAR technologies in their businesses.

Twelve novel ready-for-market technologies developed by the Institute for Infocomm Research were showcased at the four-day CommunicationAsia 2009 Exhibition.
Researchers discover regulatory molecule involved in cancers

A multi-institution collaborative study involving researchers from the Genome Institute of Singapore (GIS), Institute of Molecular and Cell Biology, Singapore-MIT Alliance, MIT, Harvard Medical School and Whitehead Institute for Biomedical Research discovered that the molecule microRNA-125b has a novel role in regulating the tumour suppressor protein p53 which safeguards cells against cancers. The scientists found that microRNA-125b levels were elevated in many types of human cancers, suggesting that tumours could be caused by microRNA-125b suppressing the p53 protein. This finding had important implications on the diagnosis of treatment of cancers and was reported in the journal Genes & Development.

Voiceprint technology clinches top place in NIST 2008 Speaker Recognition Evaluation

Researchers from the Institute for Infocomm Research (I2R) invented a state-of-the-art technology which can identify, differentiate and analyse voices from a regular telephone system. With up to 97% accuracy, the technology allows for the verification of voiceprints for large scale deployment in adverse acoustic environments. The I2R team beat 45 other international institutions to emerge first in the National Institute of Standards and Technology (NIST) 2008 Speaker Recognition Evaluation. The results of NIST’s annual benchmarking, which provides a worldwide platform for the calibration of speech technology capabilities, distinguished I2R’s voiceprint technology as state-of-the-art technology in terms of accuracy.

New delivery system for effective delivery of active drug ingredients

Researchers from the Institute of Chemical and Engineering Sciences (ICES) invented a new delivery system to enhance the bioavailability and delivery of amphorous, active ingredients, by using mesoporous nanomaterials to improve both the aqueous solubility and long-term stability of the active ingredients. Some pharmaceutical companies have indicated interest in their research findings and ICES is in the process of identifying relevant industry partners for this project. ICES’ invention will also seed partnerships with multi-phase release systems with multi-phase release profiles to maximise the efficacy of active ingredients.

Uncovering different edge effects of graphene

Researchers from the Institute of High Performance Computing (IHPC) and Brown University have characterised the edge mechanical properties of finite-size graphene sheets, which influence their electronic properties and potential use in graphene-based electronic devices. Using molecular dynamics and continuum methods, the researchers demonstrated that the elastic properties of finite graphene were distinctly different from that of infinite graphene. At absolute zero temperature, a finite graphene sheet was warped near its edges while the atomic structure of infinite graphene was perfectly flat. Their proposed quantitative model was validated by both molecular dynamics simulation and continuum simulation results. These findings, reported in Physical Review Letters, offered significant insights into how the edge effect could affect the morphology of graphene membrane sheets.

Ultra-high density storage achieved with ‘needle’ of longitudinally polarized light

A team of researchers from the Data Storage Institute (DSI) and the National University of Singapore (NUS) became the first in the scientific world to generate a needle of longitudinal light in free space, using binary optics. The tiny beam size of the needle of longitudinal light allows greater amounts of data to be packed into an optical medium, such as a DVD. This breakthrough technology, which was published in Nature Photonics, has an impact on many areas including 3-dimensional recording, laser manufacturing, biological and chemical sensing, medical diagnostics and therapy, and optical computing.

Colour perception in elephant sharks

Researchers from the Institute of Molecular and Cell Biology (IMCB) discovered that the elephant shark, a primitive deep-sea fish that belongs to the oldest living family of jawed vertebrates, can see colour like humans. In collaboration with the Institute of Ophthalmology at University College London, the IMCB group found that the elephant shark has three cone pigments for colour vision, which has evolved through gene duplication in parallel with humans. This finding, published and highlighted on the cover of the March 2009 issue of Genome Research, underscored the elephant shark as a valuable reference in understanding the evolution of the human genome.

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Creating Impact

Scientists transform carbon dioxide into methanol

A team of scientists from the Institute of Bioengineering and Nanotechnology (IBN) succeeded in converting carbon dioxide, a common greenhouse gas, into methanol, a widely-used industrial feedstock and clean-burning biofuel. This was done by using organocatalysts to activate carbon dioxide in a mild and non-toxic process. Their paper, which was published online in the leading international chemistry journal Angewandte Chemie, had been recognised by reviewers as “very important”. Their work was designated a ‘Hot Paper’ and was published in the highly coveted national chemistry journal.

Innovative liquid forging technology

Researchers from the Singapore Institute of Manufacturing Technology (SMITech) have developed a liquid forging technology that enables complex geometrical components to be fabricated with high precision and at lower cost than conventional methods. A fully integrated prototype module for the liquid forging process has been developed and is currently being commercialised. For their groundbreaking work in liquid forging technology, the SMITech team won the National Technology Award 2008.

Study shows heterogeneity in brain tumour cells

A group of researchers from the Singapore Institute for Clinical Sciences (SICS) and the National Neuroscience Institute (NNI) showed for the first time that primary brain tumours were caused by a minority group of cells that displayed a genetic profile distinct from that of the tumour bulk. The researchers also found that these differences in genetic profiles of tumour cells occurred in tumour tissues of different patients, which might explain the variability of treatment response in cancer patients. The researchers further developed a method of cryopreservation that facilitated the establishment of a brain tumour stem cell repository, which would allow for investigative efforts in drug screening. SICS and NNI are now collaborating with the Lilly Singapore Centre for Drug Discovery to advance drug discovery using the brain tumour stem cells they had discovered.

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SCIENTIFIC HIGHLIGHTS IN INDUSTRY

Lab-in-a-cartridge for fast and accurate detection of cancer and infectious diseases

The unique, all-in-one automated diagnostic system developed by the Institute of Bioengineering and Nanotechnology (IBN) was licensed by SG Molecular Diagnostics (SGMD), an Exploit Technologies portfolio company. Called the MicroKit, the technology holds great potential for the rapid detection of diseases due to its ability to perform automated and speedy gene extraction and gene detection on a wide variety of biological samples including tissues and body fluids. Compared to conventional laboratory testing, the MicroKit requires a shorter sample processing time and is presented in the form of self-contained, compact and disposable cartridges, translating to substantial cost savings.

By 2010, SGMD expects to roll out a molecular diagnostic real-time PCR (Polymerase Chain Reaction) platform as its first product for those who wish to benefit from the MicroKit’s capabilities. Patients with cancer or detection of these diseases can enhance portable and automated MicroKit can personnel to conduct mass health screenings as airports, in efforts to contain the spread of sensitive and accurate diagnostic infectious diseases, at the early chances of survival. IBN’s also used by non-clinical at strategic locations such infectious diseases.

Symbiotic simulation for operational decision-making in asset-intensive industries

D-SImLAB Technologies Pte Ltd, a spin-off company from the Singapore Institute of Manufacturing Technology (SIMTech) is developing a novel framework that could revolutionise operational decision-making in asset-intensive industries such as aerospace spare parts logistics or semiconductor manufacturing, where the availability of high-visibility and high-accuracy decision support tools is critical. D-SImLAB’s novel software suite combines simulation models that are synchronized to corresponding real-time operations, making possible continuous risk assessment and ensuring real and sustainable savings.

D-SImLAB expanded its operations in Oct 2008 with the establishment of a subsidiary based in the German city of Dresden, the heart of Europe’s semiconductor industry. Concurrently, D-SImLAB sealed an initial engagement with one of the leading European semiconductor manufacturers in Dresden, for a project aimed at studying the applicability of short-term simulation and optimisation for performance enhancement in semiconductor manufacturing.

A key MRO (Maintenance, Repair and Overhaul) player and semiconductor company have been secured as lead customers for this project. D-SImLAB also has agreements with its other Aerospace OEM (Original Equipment Manufacturers) customers, which places it in an excellent position to carry out this project and market the resulting novel technology.

Two-way firewall for fine-grained usage policy enforcement and data leak prevention

Niometrics, a potential spin-off company from the Institute for Infocomm Research (I2R), has developed a two-way firewall which could benefit organisations that require protection against bandwidth abuse, data leaks and insider threat mitigation. Niometrics’ technology is based on an innovative, high-performance deep packet inspection (DPI) engine from I2R that currently recognises more than 1500 applications, including those such as encrypted eMule and BitTorrent that rely on obfuscation to evade identification. Equipped with the ability to achieve traffic detection of close to 100%, Niometrics’ two-way firewall enables tighter control of data through “default-deny” policies without the risk of collateral damage. It also allows the simultaneous “quiet” monitoring of a much broader set of potential leak vectors, without requiring organisations to burden users with draconian blocking policies.

With strong emphasis on backend support to enable timely updates, Niometrics’ two-way firewall has been architected as a flexible system that re-invents DPI technology for the enterprise. A prototype of the firewall is in alpha trials on five sites including that of government, academic and industrial organisations in Asia, Europe and the US, with more than 50,000 users on their networks in total.
**Human Capital**

- **No. of PhD Students Trained and Graduated**
  - 2006: 96
  - 2007: 229
  - 2008: 343

- **No. of R&D Staff Spin-out to Locally-based Industry as RSEs**
  - 2006: 184
  - 2007: 440
  - 2008: 636

*The data presented here captures information from FY2006 to FY2008.*

**Intellectual Capital**

- **No. of Papers Published (in SCI and EI Journals)**
  - 2006: 3683
  - 2007: 6490
  - 2008: 9668

- **No. of Primary Patent Applications Filed**
  - 2006: 213
  - 2007: 416
  - 2008: 655

*The data presented here captures information from FY2006 to FY2008.*
INDUSTRIAL CAPITAL

No. of Industry Projects

- **ST谋 Cumulative:**
  - 239 in 2006
  - 604 in 2007
  - 876 in 2008

- **SEIRC. 255:**
  - 22 in 2006
  - 217 in 2007
  - - in 2008

 Industry Funding

- **ST谋 Cumulative:**
  - $3.56mil in 2006
  - $6.29mil in 2007
  - $13.20mil in 2008

- **SEIRC. 255:**
  - $157.7mil in 2006
  - $159.3mil in 2007
  - $136.2mil in 2008

R&D EXPENDITURE IN SINGAPORE

- **Private Sector R&D Expenditure as % of GDP:**
  - 2000: 5.2%
  - 2005: 5.0%
  - 2010: 5.3%
  - 2015: 5.7%

- **Public Sector R&D Expenditure as % of GDP:**
  - 2000: 1.3%
  - 2005: 2.1%
  - 2010: 2.4%
  - 2015: 2.7%

*The data presented here captures information from FY2006 to FY2008.*
WHO WE ARE
A*STAR
A WORD OF THANKS

This yearbook is the result of the efforts and contributions of many talented individuals. We would like to thank all our colleagues at A*STAR who have given their time, energy and insightful comments to make this book possible.

We would also like to thank Ms Li Xin Hui, without whose creativity and amazing talent, we would not have the lovely motifs and design. In addition, we would like to thank Ms Lau Wei Yi, who has skillfully brought life to some of the stories with her words, that succinctly capture the spark, spirit and energy of our talent, and the exciting environment in which they work.

Finally, we would like to thank you for your time and attention in reading the A*STAR Yearbook 2008/9. We hope that you now have more than a glimpse of our agency and are excited about our work.

Yours in partnership
A*STAR Corporate Communications

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