ASTRI

Hong Kong Applied Science and Technology Research Institute Company Limited

Annual Report

2017 - 2018

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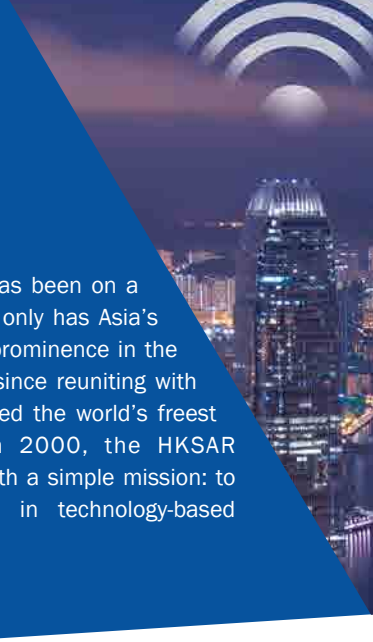
POWERED BY TECHNOLOGY

Table of Contents

The ASTRI story

Hong Kong's future and its continued global prominence rest on its ability to find new ways to grow and thrive in traditional sectors, while unleashing unbounded potential in new ones. To that end, harnessing the power of technology will drive Hong Kong's innovation-led economic growth. Hong Kong has clear advantages in pursing Innovation and Technology (I&T) development. The Hong Kong Applied Science and Technology Research Institute Company Limited (ASTRI) is fully aligned with the Government's strategic I&T blueprint for the city, and delivers solutions that are relevant for the economy and the communities.



Over the past 20 years, Hong Kong has been on a journey of growth and prosperity. Not only has Asia's World City flourished in international prominence in the financial, trade and shipping sectors since reuniting with the motherland, but it has been named the world's freest economy for 23 years running. In 2000, the HKSAR Government established ASTRI with a simple mission: to enhance the city's competitiveness in technology-based industries through applied research.

For ASTRI, success comes from:

Training technology talents and generating innovation-centric jobs

Enabling and attracting investments into technological innovation

Boosting contribution of the technology sector in Hong Kong's economy and development

Creating long-term sustainable value for the I&T ecosystem by actively collaborating with the industry as well as other I&T ecosystem players

Since 2000, ASTRI has:

400

Completed nearly 400 research projects

700

Been granted over 700 patents for its innovations

720

Transferred over 720 technologies to the industries

Awards

Won numerous awards for its technological contributions

Using local, national and regional resources and a diverse talent pool, ASTRI develops technologies that can be transferred, commercialised and leveraged across existing and emerging industries. It develops resources that support the Government's Innovation and Technology (I&T) strategy, and help to drive Hong Kong's innovation-led growth.

Connecting information and communication

Much as Hong Kong connects China to the world, ASTRI operates by connecting two ends of the Information and Communication Technologies (ICT) spectrum. It acts as a bridge between the academia pursuing basic ICT research and the industry applying those technologies, ensuring everyone benefits commercially and economically.

Designated as the Hong Kong SAR Government's dedicated ICT research and development centre in 2006, ASTRI galvanised its focus on five key areas of research: Smart City, Intelligent Manufacturing, Financial Technologies, Next Generation Network and Health Technologies.

In 2012, ASTRI established the first-ever Hong Kong branch of the Chinese National Engineering Research Centre (CNERC) for Application Specific Integrated Circuit Systems in collaboration with Southeast University (SEU) in Nanjing. The branch focuses on microelectronics and integrated circuits, which together with those five core priority areas forms the core of ASTRI's technology strategy.

Helping Hong Kong thrive

The strategic focus of ASTRI's R&D initiatives is powered by effective collaboration and active commercialisation with partners of all shapes and sizes. From Government agencies and quangos, to academia, industry leaders and start-ups, ASTRI strives to create high-quality, affordable ICT solutions that put innovation at the heart of existing and emerging industries — ensuring that Hong Kong thrives as a dynamic, global smart city.

Our aspiration is to help transform Hong Kong from a super-connector to a super-conductor, making contributions to our city, the Greater Bay Area, Greater China, and the world.

Our Guiding Principles

ASTRI's journey to help transform Hong Kong's economy stemmed from a simple yet powerful mission: to enhance Hong Kong's competitiveness in technology-based industries through applied research. This mission statement is fuelled by an ambitious vision: to enable and develop world-class technologies that enrich lives.

Vision: To enable and develop world-class technologies that enrich lives

Mission: To enhance Hong Kong's competitiveness in technology-based industries through applied research

As the largest applied R&D institution in Hong Kong, ASTRI works alongside the entire I&T ecosystem to strengthen Hong Kong's already successful industries using technological innovations, as well as to help channel the city's economy into emerging, innovation-powered sectors.

By attracting and training a talented technology workforce and partnering with academia and the industry, ASTRI acts as a partnerships' architect across the ecosystem. That also includes cultivating the next generation of Hong Kong's technology talents, professionals and entrepreneurs.

Our Values

Not only does ASTRI have a clear mission and vision, it also lives by a set of values that defines its character and directs its activities:

Innovation
We innovate to make things better for Hong Kong, our nation and the world.

Service
We are committed to delivering timely and world-class services to our stakeholders.

Accountability
We work in the most ethical, honest, open and fair manner – taking responsibility for our actions.

Tenacity
We strive to the best of our ability to overcome all challenges and obstacles.

Respect
We are deeply respectful to our employees, partners, stakeholders, and all other parties, to establish and support an environment of teamwork and growth.

Our Strategy

ASTRI's strong, focused strategy for success is what guides us towards our vision of a better, smarter, safer Hong Kong powered by technology. To secure Hong Kong's competitiveness in technology-based industries, we focus on four key areas: **Technology**, **Talent**, **Investment** and the **Market**.

Technology is our core focus. Our mission is, and has always been, to improve the overall technological competence of Hong Kong and the greater region — and the combination of **Talent**, **Investment**, and our mastery of the **Market** serves as an important trio of catalysts necessary for our formula to succeed.

Like any good formula, our four key focus areas react with one another to produce something great — a vivid and tangible improvement to the economy, and a wealth of benefits to the taxpayers of Hong Kong.

Technology

In 2017-18, ASTRI focused on five areas of applications:

Financial Technologies (FinTech)

FinTech is one of the cornerstones of the sector's continued growth.

Advanced FinTech solutions make financial services faster, more reliable, and more secure. They make it easier for banks, insurers and other financial service providers to cater to the needs of their customers and let the customers in turn access their accounts and information in a far more intuitive way.

To maintain Hong Kong's status as a world-class financial hub, we work to deliver innovative technologies with applications in the financing sector — our FinTech teams develop technologies that leverage Blockchain technology, strengthen cybersecurity, make sense of big data, and provide valuable proofs-of-concept that benefit the entire financial industry. As one of Hong Kong's strongest FinTech R&D groups, we are committed to helping to drive the sector's growth into a new era.

Smart City

Last year, the HKSAR Government unveiled a detailed blueprint for Smart City development — the idea of a city that's fully intelligent, connected and trusted. The blueprint, when fully realised, will allow Hong Kong to firmly position itself as Asia's most global and most advanced 21st century city. To help meet that goal, ASTRI combines its ICT talents with sensors, intelligence, and new network and security technologies to improve the way the city operates, shares information and, ultimately, improves the quality of life for its residents.

The smart city revolution will impact every single aspect of our lives, businesses and communities. It will create an enormous opportunity for sustainable economic growth. ASTRI develops various tools and platforms by which Smart City technologies can seamlessly communicate with one another. This will lead to increased functionality in AI-assisted technologies and, with that, the possibility of an improved quality of life for Hong Kong residents — who could, in a few years' time, be living symbiotically in a city that not only houses them, but also helps them to thrive.

Next Generation Network

With our sights set firmly on the future, it's inevitable that next generation technologies are one of our main areas of focus. The advent of 5G is as exciting as it is practical. With applications in healthcare, manufacturing and infrastructure development — not to mention the untapped potential it offers towards the Smart City initiative — its development means that ASTRI can continue to play a fundamental role in establishing Hong Kong's reputation as a high-tech global city.

With Hong Kong set to become one of the first-movers in adopting 5G technology, people, devices, knowledge and data are all going to be more interconnected than they have ever been. The development of cutting-edge communications technologies and solutions for both pre-5G and 5G wireless systems promises to revolutionise the way people communicate with each other. That, after commercialising our products and letting them reach the market, could potentially unlock a whole new world of possibilities in the future.

Intelligent Manufacturing

Intelligent Manufacturing is all about making production faster, easier and more efficient. Hong Kong, as an emerging smart city in the modern age, relies on Intelligent Manufacturing, Artificial Intelligence (AI) and Robotics to make R&D possibilities feasible. Without these, production processes would be significantly less effective. The application of AI and Robotics into the production lines means that manufacturing will be more reliable, less demanding, and infinitely more accessible.

Southern China, together with Hong Kong and Macau, is a leading centre of advanced manufacturing and modern service industries. Hong Kong stands to gain much by actively leveraging the transformation of the manufacturing sector in the Mainland. One of the pillars in ASTRI's R&D strategy is intelligent manufacturing technologies. ASTRI develops a number of advanced platforms, tools and solutions that can help transform the industrial sector.

By continuing to develop and apply Artificial Intelligence to production processes, ASTRI's sophisticated and advanced technologies help to create inter-connected, fully digital smart factories, enabling businesses to streamline their operations, work more efficiently, and be kinder to the environment.

Health Technologies

Health is as important to ASTRI as it is to Hong Kong — that's why we pursue the development of Health Technology solutions with firm commitment. With support from the HKSAR Government, we have been able to make breakthroughs in fields like biomedical imaging that have opened up new possibilities in medical sciences to better treat patients, and even save lives.

ASTRI's Health Technologies strategy aims to increase the efficiency of healthcare services, enhance and personalise medical services, and ultimately improve the quality of people's lives. Through new applications in areas like preventative health monitoring, medical diagnosis and medical computing, ASTRI aims to support the growth and improvement in Hong Kong's healthcare industry and positively influence the city's technological competence — for the benefit of its people.

The socially-conscious role of ASTRI's Health Technology solutions benefits various segments of the society. Many of our innovations — such as Telehealth Technology Platform, tracking and monitoring for the elderly, Intelligent Preventive Healthcare System, and non-invasive health screening devices — have been adopted by hospitals, care centres and other healthcare service providers.

Talent

At the heart of ASTRI's technology ecosystem are its people.

Over 500 talented engineers, scientists and researchers work together in our organisation, making it one of the strongest technology talent pools in the region. While our workforce is primarily formed from within Hong Kong's local talent pool, we are also blessed to have a large number of bright minds from across Greater China and other parts of the world. Through their hard work and dedication, these talented individuals have helped advance innovation and technology for Hong Kong and beyond.

ASTRI seeks to be a 'cradle of learning' for people who aspire to master their skills and sharpen their knowledge. Many of our former colleagues currently work as technology leaders in prominent local, regional and international enterprises. Other brave, enterprising souls have chased their dreams and started their own ventures. We are proud to say that these ASTRIANS have gone on to shape the technological future of our society.

At ASTRI, we focus on promoting the learning of Science, Technology, Engineering and Mathematics (STEM) to the next generation. Over the years, we have helped to inspire and enrich tens of thousands of tech talents from Hong Kong, Mainland and overseas, through student exchanges, training schemes, workshops and other initiatives. With the right guidance and determination, the minds of tomorrow could help build the future of today – and transcend our wildest ambitions for a more advanced society.

Investment

ASTRI's initiatives stem from the HKSAR Government's I&T agenda, focusing on Hong Kong's areas of strength including innovation in HealthTech, Artificial Intelligence, Smart City and FinTech. In its most recent budget, the HKSAR Government pledged HK$ 50 billion to I&T development over the next year. ASTRI too will drive investment into various R&D projects, supported by the Chinese National Engineering Research Centre (CNERC), to further Hong Kong's I&T development.

Market

Our goal to enhance Hong Kong's global technological competitiveness begins with commercialisation. It's a way for us to make sure that our technologies organically reach where they need to go — and propagate in the market. We partner with Government agencies, quangos, academia and the industry in Hong Kong, the Greater Bay Area, and the wider region to boost regional I&T momentum and enhance national development. Indeed, a thriving and innovative Hong Kong is great news for the nation, particularly when the Mainland is looking increasingly to Hong Kong for advanced R&D, as well as for world-class services and solutions. We have to focus on the Greater Bay Area development plan, take full advantage of the 'Made in China 2025' goal, and explore international opportunities coming through the 'Belt and Road' initiative.

By tapping into all these, Hong Kong can attain stronger prosperity for itself, improve lives and livelihoods of its people, and also help the country to lead in innovation on the world stage. Ultimately, effective commercialisation enables our technology to be used in the most effective way — by benefitting people, communities and industries that ASTRI strives to serve.

Chairman's Foreword

It is my great pleasure to present ASTRI's Annual Report – a privilege I am having for the fifth time since being appointed Chairman of ASTRI's Board of Directors in 2013.

I have formally been a part of ASTRI for a fraction of its lifetime – nearly six years to be precise. But I can confidently tell you that ASTRI, since its establishment 18 years ago, has remained focused on one clear mission: to enhance the competitiveness of Hong Kong and its enterprises through innovative technologies and applications.

Since 2000, ASTRI has filed over 1,000 patents, completed over 400 research projects and had 720 of its in-house-developed technologies transferred to and used in industries. In 2017-18 alone, 64 patents were filed and 53 were granted.

This is an incredible set of achievements and they are fuelling a new and exciting Hong Kong. We, as part of the wider Innovation and Technology (I&T) ecosystem, envision a Hong Kong that will thrive in an increasingly competitive global climate, produce rapid technological advancements through local, national and international collaborations, and ultimately harness technology in a way that will not only strengthen Hong Kong's economy, but also enrich the quality of people's lives in this region.

A new era with new possibilities

Time and time again, Hong Kong has proven its prowess in advancing communications, businesses and industries. We have grown from an 'Asian Dragon' that enjoyed a golden era of manufacturing, to a 'Super Connector' which acts as China's gateway to the rest of the world. But the next chapter in Hong Kong's history stems from the HKSAR Government's steadfast ambition to position the city as a global I&T hub. The Government's relentless focus on I&T development is not just necessary, it's also the most timely recognition of what the future holds for us. Hong Kong's world-class infrastructure and institutions, and a strong framework of governance and regulations, together with its legacy of innovation and enterprising spirit, present the perfect foundations for future success.

Already, Hong Kong's technology researchers and entrepreneurs have made major breakthroughs in many areas as smart manufacturing, next generation communication networks, Financial Technology (FinTech), Health Technologies and advanced robotics. ASTRI is at the forefront of those endeavours, focusing its R&D efforts on advancing these areas that the Government has rightly identified as Hong Kong's core I&T priorities.

The HKSAR Government's HK$ 50 billion pledge to I&T development will add an upsurge in the R&D and commercialisation momentum of various innovative technologies, allowing us to create even more cutting-edge solutions. More resources are being invested in nurturing technology talents through academic institutions and in smaller businesses, start-ups and individuals from whom innovation often flows the strongest. On the other hand, there is an active effort to attract the best technology talents, firms and investors into Hong Kong. Indeed, Hong Kong is well poised to become a powerful player in the highly competitive, global innovation landscape.

The Central Government has also extended an unprecedented level of support to Hong Kong's I&T ambitions. Under a recently announced policy initiative, Hong Kong-based researchers and institutions will have bigger, easier and more flexible access to state-level R&D funding. It also means, national-level R&D centres like Hong Kong branches of the Chinese National Engineering Research Centre – the first of these was set up in ASTRI in 2012 – will have greater support from the State. A thriving Hong Kong powered by innovation is great news for the country, particularly when the nation is looking increasingly to Hong Kong for advanced R&D, as well as for world-class services and solutions.

Success from collaboration

Although increased I&T funding is a fundamental factor in securing Hong Kong's status as a technological powerhouse, so too is collaboration with the Mainland. China's status as a powerful and reliable global superpower and its regional and global stewardship to push sustainable development – the kind that will come from I&T – is undisputable.

Historically, Hong Kong has played a significant part in helping China become a leading economy by boosting Southern China's manufacturing capabilities, and providing invaluable international financial and professional services to the nation. Our legacy as an innovation hub and financial hotspot, in combination with its strategic geographic position on the Pearl River Delta, has essentially positioned Hong Kong as a 'Super Connector' for the Mainland, helping to attract technology, talents, business and investment from the rest of the world.

We can expect Hong Kong to use its seamless connection with the Mainland, and fully utilise the recent policy support from the Central Government, to boost its I&T sector. By identifying and leveraging opportunities emanating from the Greater Bay Area development plan and the international Belt and Road programme, more technology talents and institutions from Hong Kong will partner with Mainland counterparts – benefitting both Hong Kong and the nation. Hong Kong's world-class institutions, regulatory and financial regime, highly skilled professional workforce, and its rule of law make the city a key facilitator in the Belt and Road programme, and forge a strong connection between Asia and the rest of the world. It will help us create an economy fit for the future. And for ASTRI, collaboration with the Mainland means contributing to technological endeavours at a national as well as a regional level to drive Hong Kong's re-industrialisation momentum and at the same time upgrade the country's massive industrial sector.

ASTRI is also relentless in its efforts to partner with the other players in Hong Kong's I&T ecosystem – from Government agencies to enterprises and researchers to start-ups. Pursuing practical and market-relevant solutions that benefit our economy and communities, we seek collaboration opportunities to not only commercialise our innovations, but also amplify their overall impact. We remain committed to playing a strong part in Hong Kong's I&T development, drawing strength and inspiration from within and beyond our city.

Strengthening businesses, benefitting communities

'Made in China 2025' or Industry 4.0 — the original philosophy it's based on — will see China rebrand itself, going from a manufacturer of large quantities to extremely high-quality, sophisticated goods and services. There is no doubt Hong Kong stands to gain much from this transformation. In that journey, the city's own industrial and business sectors will also be reshaped, and will harness smart technologies across multiple areas such as Smart City, Financial and Health Technologies, Artificial Intelligence (AI) and Robotics. The cornerstones of ASTRI's R&D strategy leverage developments in our city, in the Greater Bay Area, across Greater China and the wider world. ASTRI dedicates significant R&D efforts in these strategic core to support the overall I&T development in Hong Kong. I&T will not only improve the way Hong Kong functions as a city, but will also strengthen our 'traditional strength' sectors while providing a fantastic source of economic diversification. Dominating the I&T scene globally, AI in particular has made huge strides in a range of industries, from finance and banking, manufacturing and retail, to smart mobility and medical diagnostics. Smart technologies such as AI have started to enrich the lives of Hong Kong's residents, and we are only at the beginning of our five-year plan to build a Smart City. ASTRI is working in full swing to realise the great potential in this direction.

A collective pursuit for success

The future is bright but the challenges facing us are equally intriguing. I have the full confidence that ASTRI will continue to foster its innovative R&D efforts for the people of Hong Kong, our nation and beyond. We will continue to make significant investments in R&D infrastructure and conduct cutting-edge research, transfer our technologies for commercialisation, collaborate with universities and R&D centres to nurture technology talents, and support Hong Kong's ambition to be a model Smart City in this region. We will seek to contribute through our expertise to the technological advancement of Hong Kong in a way that positions our city as a global innovation hub, and supports our country's strategic technological aspirations.

I would like to extend my sincere gratitude to the HKSAR Government's Innovation and Technology Bureau and the Innovation and Technology Commission for their continued support and guidance. Also, I want to thank ASTRI's Board of Directors for their collective leadership, wisdom and guidance that have inspired us to remain strategically focused. My heartfelt appreciations extend to ASTRI's Senior Management team, R&D teams and all staff members for their hard work, dedication and commitment. Beyond that, I am very grateful for the support and encouragement of all our partners and well-wishers in Hong Kong, Greater China and beyond, who have helped us achieve great things throughout this year.

Finally, on behalf of the Board of Directors, it gives me great pleasure to introduce Mr Hugh Chow, ASTRI's Chief Executive Officer, who joined us in January. Please join me in wishing Hugh all the very best in leading ASTRI to continued success and a brighter future.

Wong Ming-yam
Chairman of the Board

Chief Executive Officer's Report

We live in an exciting time. Innovation is revolutionising the way we live and work, and Hong Kong plays a crucial role in leveraging as well as developing technologies that will shape our future. Using the power of Information and Communication Technology (ICT), ASTRI plays a key part in enhancing Hong Kong's competitiveness – not only in the Greater Bay Area or even in Asia, but also in the global market.

For us, ICT stands for a lot more than just Information and Communication Technologies. It also means Intelligent, Connected and Trusted. They are the three goals that inspire ASTRI's R&D strategy and endeavours. These are the three key objectives we bring to collaborations as we work with other players in the I&T ecosystem – Government agencies, quangos, businesses, trade and commerce bodies, R&D centres and the academia — to build and create technologies that will power our future.

The cornerstones of our technology strategy

Aligning our efforts to the Government's I&T priorities, we focus our R&D efforts on five strategic areas:

Financial Technologies | **Smart City and Next Generation Network** | **Application Specific Integrated Circuits** | **Intelligent Manufacturing** | **Health Technologies**

ASTRI operates the first-ever Hong Kong branch of the Chinese National Engineering Research Centre (CNERC) – focusing on Application Specific Integrated Circuits. In the 2017-18 financial year, ASTRI undertook 45 new projects across these five areas – seven more than the year before – and 72 technology transfers were completed to the industries, compared with 60 in 2016-17.

In the Financial Technologies (FinTech) space, we develop technologies that will strengthen cybersecurity, untap the power of data, and provide game-changing solutions based on Distributed Ledger Technology – popularly known as Blockchain. We have delivered some revolutionary white-label proofs-of-concept for Hong Kong's financial services sector – in close partnership with the industry's regulator and major players.

Our Smart City focus parallels the HKSAR Government's Smart City Blueprint. In line with our 'Intelligent, Connected, Trusted' philosophy, we develop technologies and solutions that will see Hong Kong thrive with the power of innovation. As a pioneer in Next Generation Networks research, and one of the largest R&D facilities in Hong Kong dedicated to 5G testing and development, our work in this field is part of that technological transformation. ASTRI has been working with industry partners to create Vehicle-to-Everything (V2X) technologies that will enable intelligent transportation and traffic management solutions, improve road safety, and truly corroborate Hong Kong's Smart City status.

Artificial Intelligence and Robotics hold the key to intelligent manufacturing. We continue to develop AI-enabled or robot-assisted manufacturing systems and tools that streamline production processes in smart factories. As we all know, fully digitalised factories mean more efficient operations. With the rapid growth of the Internet of Things (IoT) in manufacturing, ASTRI has also been creating end-to-end, real-time data analytics platforms that allow technology professionals to monitor machines and identify issues that can't be spotted by the naked eye.

And finally, Health Technologies will see the medical sector become more efficient, as personalised services increase and the quality of life for Hong Kongers improve. One of the projects ASTRI has been working on this year is a medical image analytics platform, which combines advanced computation with big data analytics to enable powerful medical image data mining and computer-aided diagnosis.

Leveraging the mandate of the CNERC Hong Kong Branch, ASTRI has developed a number of advanced and innovative solutions in various areas including Narrowband Internet of Things (NB-IoT), Bluetooth Low Energy (BLE), FinFET design, Hall-sensor IC solutions, ultra-high-definition and 3D conversion video technologies, power electronics modules, high-density electronic packaging and Gallium Nitride (GaN)-based high density power modules.

But of course, ASTRI isn't alone in this journey

To truly succeed in creating a better, more connected Hong Kong, we actively forge strong relationships with organisations across the ecosystem. These partnerships don't just show their value when it comes to research projects – they inspire the creation of future technologies too. Not only have we established joint innovation laboratories with different industry players, with support from the HKSAR Government's Innovation and Technology Commission, we parterned with Hong Kong Science Park. Together, we have developed the city's first Smart City Innovation Centre – a state-of-the-art infrastructure that facilitates many Smart City projects to shape our future.

And it's not just partnership projects or the creation of innovation centres that spread the I&T message far and wide. We acknowledge the crucial role we play within the ecosystem – seeking a collective and synchronised effort from our sister organisations like other Government-funded enablers and R&D centres, the academia, technology developers from Hong Kong and beyond, as well as various business and industrial sectors.

Sharing ideas, exchanging insights, forging collaborations

This year, we have hosted events, showcased our work in many industry expos, exchanged experience and insights at conferences, and run workshops that sought to inspire a new generation of talented tech professionals and advocates. The Industry University Collaboration Forum organised by ASTRI was one of the richest and most impactful platforms in the year that inspired compelling conversations on 'Connecting the Dots for Reindustrialisation: The Greater Bay Area Landscape'. In 2017-18, we also organised the inter-tertiary institute Capture the Flag contest, a 'Hackathon' which put the skills of next generation technology professionals to the test. Throughout the year, we took part in some of the largest and most important industry exhibitions and forums including two editions of the Mobile World Congress, Asia-Pacific Smart Mobility Forum, and the largest technology and electronics shows in the Mainland.

We also hosted a number of visitors, giving them the opportunity to discover more about our technology strategy and initiatives, and to witness first-hand how ASTRI is playing its part to shape Hong Kong's future. Visitors ranged from senior Hong Kong and Central Government officials to scholars from the Academy of Sciences Hong Kong, business leaders from Hong Kong and Greater China to the most senior academics, and university students to foreign diplomats. In addition, we had representatives from HSBC, INL, Infineon China, Alibaba Cloud, CLP, ICBC Asia and AXA, as well as some of our Smart City development partners including the Airport Authority of Hong Kong, the Water Supplies Department of Hong Kong and the Urban Renewal Authority of Hong Kong.

Awards and recognitions that speak for the value we add

On the local level, our Palm Fusion Biometric Access Control System project picked up a Gold award for information security at the Hong Kong ICT Awards 2018, while the 3D Vision System for quality inspection and robotic guidance won the Equipment and Machinery Design Award at the Hong Kong Award for Industries 2017. Internationally, at the Asia Pacific ICT Alliance Awards 2017, we won the Top Award in the Communication category for the TD-LTE-based Communication-based Train Control (CBTC) system. In addition, our Smart Water IoT project won an award of merit at the WITSA Global ICT Excellence Awards 2018.

A remarkable year that leads us to an even more exciting future

The route to our success comes from living our values: to innovate, take responsibility for our actions, respect our peers, deliver services to the community, and overcome each and every challenge that stands in our way.

While there's no doubt we have had great success in innovating technologies that will revolutionise our future, none of it would be possible without the real power that's helping to write the next chapter of Hong Kong's story: our people. Our ASTRIANS are the reason for our success. Not only have they helped ASTRI achieve its goals, but some of them have also formed their own technology businesses, creating cutting-edge solutions and promoting a culture of innovation for the entire ecosystem.

This year, we have made great strides on our mission to enhance Hong Kong's competitiveness in technology-based industries through applied research. In this report, we have highlighted some of the achievements and events we are most proud of, and the projects and community engagements that see us making a tangible impact in our region. Do explore this report to learn more about the 'ASTRI Story' that powers us and the strategy that guides us. And don't forget to share your thoughts, ideas and suggestions with us.

Looking into the future

In the coming years, we will focus heavily on the market's needs. We will also take into account the inherent strengths and opportunities around us that we can actively leverage. To that end, we will be in full alignment with what the HKSAR Government and the people of Hong Kong expect from us – developing ground-breaking solutions in FinTech, AI and Robotics tools that aid Smart Manufacturing and other sectors, Smart City solutions including 5G development, smart diagnostic and bioinformatic solutions for the Healthcare sector, and semiconductor R&D using our CNERC mandate.

I look forward to working together with all my colleagues in ASTRI, our regulators and other stakeholders, and other relevant players in the ecosystem to devise a clear roadmap for ASTRI's technology endeavours for the future. We will work out the talents and technologies we will source and deliver, the sectors and markets we will focus on, and the eventual value we will add to the Hong Kong economy through the power of innovation.

Most importantly, we will work alongside our partners and peers in Hong Kong's I&T ecosystem closer than ever before. All that, with support and encouragement from all of you, will enable ASTRI to play its part in Hong Kong's I&T pursuit and Smart City development journey.

Here's to the next year!

Hugh Chow Hin-poon
Chief Executive Officer

Our People

As the largest Government-funded R&D institution operating in Hong Kong, ASTRI has a highly organised and professional structure that enables its endeavours. Functioning under the auspices of the HKSAR Government's Innovation and Technology Commission, ASTRI leverages the investments made by the HKSAR Government to develop innovative technologies that make lives easier and better for Hong Kong's people.

The chain of command

ASTRI's operations are led and steered by the Chief Executive Officer, who is accountable to the Board of Directors. The CEO is fully entrusted with all matters related to the overall management of the organisation and is assisted by a group of 'C-Officers' – the Senior Management team members responsible for R&D, administration, finance, commercial and other supporting functions.

In addition to the CEO and C-Officers, the Senior Management team also includes seven Technology Division Heads. Overseen by the Chief Technology Officer, they lead the R&D endeavours of teams delivering tools, technologies and solutions for various sectors, industries and markets.

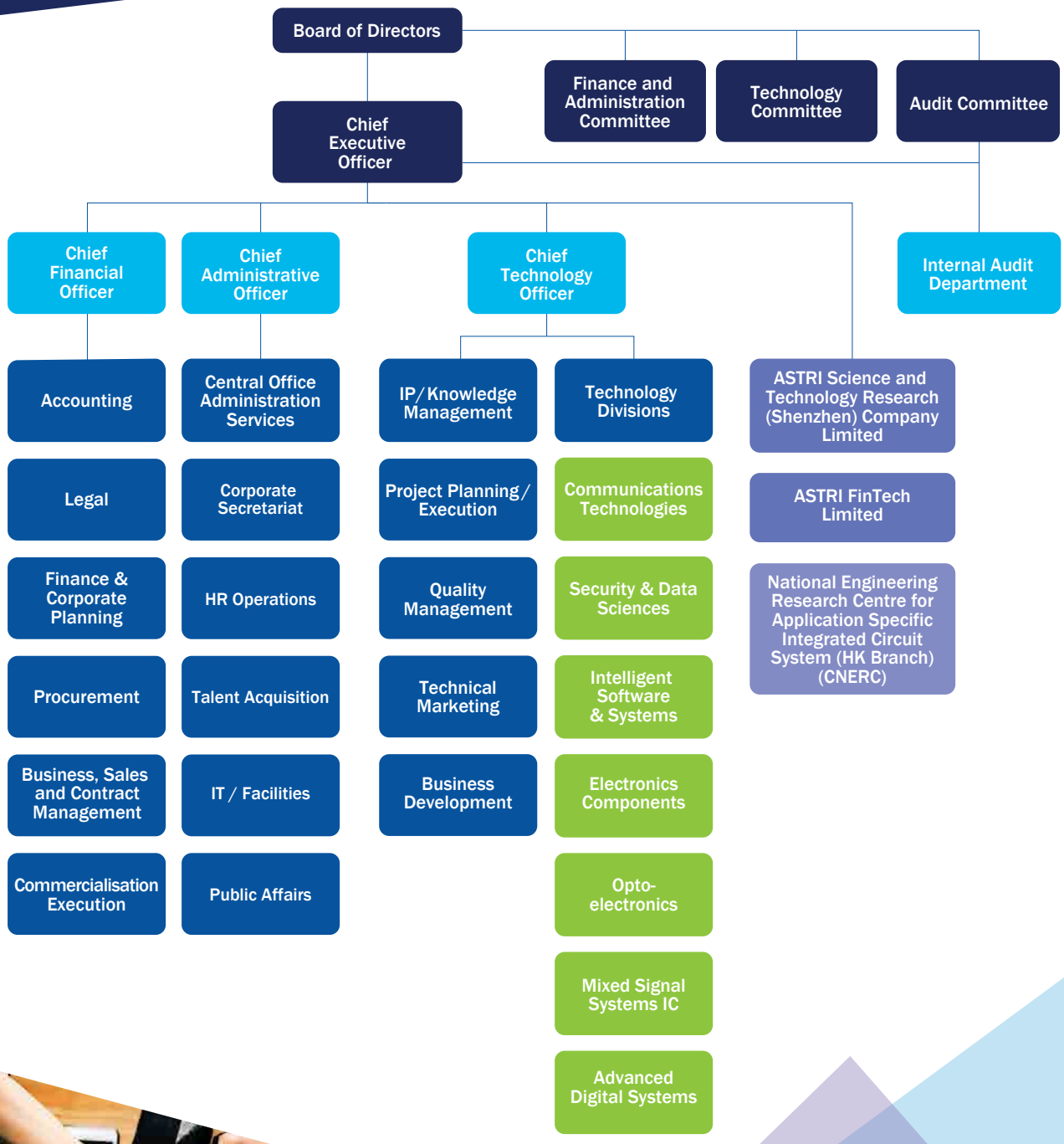
We are committed to a mission of growth as an R&D institution, and as a partner to the industries. ASTRI strives to scale up the R&D competence and capabilities of its people, and always seeks to provide ample room for professional growth and development that are conducive to innovative technology development.

How we work

We operate through a dynamic 'matrix' model. It is an effective method of organising our workforce that allows us to adapt quickly to meet new challenges as they arise, and rapidly synthesise a solution.

On one hand, our professional R&D teams are able to fully utilise a range of diverse talents to develop tools and technologies using their respective specialised skills. On the other hand, we can cater to the specific practical and market-oriented needs of the industries or all sector-specific applications – drawing skills and expertise from across our Technology Divisions.

The following chart represents ASTRI's organisation structure as of 31 March 2018:



Board of Directors

The Board of Directors is the governing force behind ASTRI's innovation endeavours. It provides strategic oversight and guidance to ASTRI's mission. Members of the Board are selected from among the most respected, experienced and capable members of the community.

What does the Board do?

The Board members represent the academic, industrial and commercial sectors of Hong Kong, and by extension, the wider community. As well as being the strategic decision-makers for the Institute, the Board of Directors is also responsible for shaping ASTRI's leadership direction, strategic impetus and technology roadmap.

1. Ms Hera Siu Kit-wan
2. Professor Roland Chin Tai-hong, BBS, JP
3. Mr Cheuk Wing-hing, JP
4. Mr Wong Ming-yam, SBS, JP
5. Mr Hugh Chow
6. Ms Annie Choi Suk-han, JP
7. Ms Cally Chan Shan-shan
8. Mr Kwong Chi-keung, JP
9. Ir Dr Alan Lam Hiu-fung
10. Mr Ha Yung-kuen, BBS
11. Professor Liew Soung-chang
12. Ms Cammy Yung
13. Mr Chuck Cheng Cheuk-wing
14. Dr MeiKei Ieong
15. Mr Duncan Chiu
16. Dr Davy Lo Kwok-wai
17. Mr Stephen Ho Wai-chung
18. Mr Sunny Lee Wai-kwong, JP
19. Mr Pindar Wong
20. Mr Humphrey Choi Chor-ching, JP
21. Mr Denis Tse Tik-yang
22. Mr Andy Liu An-ting
23. Ms Grace Hui
24. Dr Archie Yeh Tsuei-chi
25. Mr Tony Choi Siu-chow, JP

How does it work?

Good governance is one of our main priorities. With support from ASTRI's Senior Management team, the Board helps navigate the Institute through the ever-changing world of business and make sure that ASTRI demonstrates only the very best corporate practices and behaviours.

Ensuring that ASTRI delivers the most value-adding and productive R&D innovations, the Board of Directors maintains an institute-wide focus on what's important: meeting the wants and needs of the industrial and commercial sectors.

Who are the people on the Board?

Board Composition

As of 31 March 2018, the Board is headed by its Chairman, and includes 19 other members, two of whom are official members.

Name of Board Member	Title and Company of Board Member
Chairman	
Mr Wong Ming-yam, SBS*, JP	Director, eSPOT Lighting Limited
Official Members	
Mr Cheuk Wing-hing, JP	Permanent Secretary for Innovation and Technology, Innovation and Technology Bureau
Ms Annie Choi Suk-han, JP	Commissioner for Innovation and Technology, Innovation and Technology Commission
Members (in alphabetical order according to surname)	
Ms Cally Chan Shan-shan	General Manager, Hong Kong and Macau, Microsoft Hong Kong Limited
Professor Roland Chin Tai-hong, BBS, JP	President and Vice-Chancellor, Hong Kong Baptist University
Mr Duncan Chiu	Chairman, Lai Yuen Company Limited
Mr Humphrey Choi Chor-ching, JP	China and Hong Kong Assurance Leader, Asia Pacific Assurance Leader, PricewaterhouseCoopers
Mr Tony Choi Siu-chow, JP	Executive Director, Hong Kong Garment Manufacturing Co. Ltd.
Mr Ha Yung-kuen, BBS	
Mr Stephen Ho Wai-chung	Chief Executive Officer, CITIC Telecom International CPC Limited
Mr Kwong Chi-keung, JP	Senior Partner, Sit, Fung, Kwong and Shum Solicitors and Notaries
Ir Dr Alan Lam Hiu-fung	Chief Executive Officer, Sengital Limited
Mr Sunny Lee Wai-kwong, JP	Vice-President (Administration), City University of Hong Kong
Professor Liew Soung-chang	Professor and Division Head, Department of Information Engineering, The Chinese University of Hong Kong
Mr Andy Liu An-ting	CEO, ILUMI Limited, and Vice Chairman, HKBIO
Dr Davy Lo Kwok-wai	Consultant
Ms Hera Siu Kit-wan	Chief Executive Officer, Greater China, Vice President, Cisco Technologies (Beijing) Co., Ltd.
Mr Denis Tse Tik-yang	Managing Principal, Asia-IO Advisors Limited
Mr Pindar Wong	Chairman, VeriFi (Hong Kong) Limited
Dr Archie Yeh Tsuei-chi	Chief Executive Officer, Solomon Systech Limited

Note* Awarded the Silver Bauhinia Star (SBS) in July 2018

Board Functional Committees

Three functional committees – Finance and Administration Committee (FAC), Technology Committee (TC) and Audit Committee (AC) – assist the Board in overseeing ASTRI. The FAC oversees ASTRI's financial and administrative matters; the TC oversees R&D initiatives; and the AC ensures that internal and external audit processes are properly carried out.

The members of the committees as of 31 March 2018 are set out below.

Finance and Administration Committee
Name of Member
Mr Humphrey Choi Chor-ching, JP (Chairman)
Ms Cally Chan Shan-shan
Mr Duncan Chiu
Ms Annie Choi Suk-han, JP
Professor Liew Soung-chang*
Mr Andy Liu An-ting
Dr Davy Lo Kwok-wai
Ms Hera Siu Kit-wan
Mr Denis Tse Tik-yang

*Withdrew on 23 May 2018

Technology Committee
Name of Member
Mr Sunny Lee Wai-kwong, JP (Chairman)
Ms Cally Chan Shan-shan
Professor Roland Chin Tai-hong, BBS, JP
Mr Duncan Chiu
Ms Annie Choi Suk-han, JP
Mr Tony Choi Siu-chow, JP
Mr Ha Yung-kuen, BBS
Mr Stephen Ho Wai-chung
Ir Dr Alan Lam Hiu-fung
Professor Liew Soung-chang
Dr Davy Lo Kwok-wai
Mr Wong Ming-yam, SBS, JP
Dr Archie Yeh Tsuei-chi

Audit Committee
Name of Member
Dr Davy Lo Kwok-wai (Chairman)
Ms Annie Choi Suk-han, JP
Mr Kwong Chi-keung, JP
Mr Ha Yung-kuen, BBS
Ir Dr Alan Lam Hiu-fung
Mr Pindar Wong#

#Joined on 26 June 2018

Changes in Board Directors

	Date of Appointment
Mr Stephen Ho Wai-chung	1 March 2018
Professor Liew Soung-chang	1 March 2018
Dr Archie Yeh Tsuei-chi	1 March 2018

Retired Directors	Date of Retirement
Dr Tiger Lin Zhen-hui	9 May 2017
Mr Chuck Cheng Cheuk-wing	1 March 2018
Professor Ching Pak-chung, SBS	1 March 2018

Meeting Attendance

A total of five Board meetings took place during the year 2017-18. The attendance records of members in Board Meetings as well as Board Functional Committee meetings held between 1 April 2017 and 31 March 2018 are as follows:

Board Meetings	7 Jun 2017	13 Jun 2017	27 Jun 2017	27 Sep 2017	19 Dec 2017
Total number of directors during the period	19	19	19	19	19
Total number of directors present at meeting	16	13	16	17	14
Total number of apologies	3	6	3	2	5
Group attendance in percentage	84%	68%	84%	89%	74%

Finance and Administration Committee	23 May 2017	4 Sep 2017	22 Nov 2017	5 Mar 2018
Total number of directors during the period	9	9	9	9
Total number of directors present at meeting	7	6	7	7
Total number of apologies	2	3	2	2
Group attendance in percentage	78%	67%	78%	78%

Technology Committee	6 Jun 2017	13 Sep 2017	29 Nov 2017	21 Mar 2018
Total number of directors during the period	12	12	12	13
Total number of directors present at meeting	10	7	10	10
Total number of apologies	2	5	2	3
Group attendance in percentage	83%	58%	83%	77%

Audit Committee	7 Jun 2017	8 Sep 2017	28 Nov 2017	14 Mar 2018
Total number of directors during the period	6	6	6	4
Total number of directors present at meeting	5	6	6	3
Total number of apologies	1	0	0	1
Group attendance in percentage	83%	100%	100%	75%

Senior Management

ASTRI's dynamic R&D endeavours are steered by a strong Senior Management team. The Senior Management team helps to keep us on track to deliver against our mission. It also ensures our R&D projects are carried out with the highest level of strategic alignment and efficiency.

What does the Senior Management team do?

The Senior Management team collectively manages ASTRI's overall operations and leads it through its organisational endeavours.

From organising the R&D divisions to managing ASTRI's administrative, financial and commercial functions, the Management Team is responsible for keeping ASTRI moving forward.

1. **Dr Tsai Chen-jung**
   Acting Director, Opto-electronics
2. **Mr Bill Zhang**
   Senior Director, Mixed Signal Systems IC
3. **Dr Lucas Hui**
   Senior Director, Security and Data Sciences
4. **Ms Cammy Yung**
   Chief Financial Officer
5. **Dr Justin Chuang**
   Vice President, Next Generation Network
6. **Mr Hugh Chow**
   Chief Executive Officer
7. **Dr MeiKei Ieong**
   Chief Technology Officer
8. **Mr Li Yiu-kei**
   Senior Director, Advanced Digital Systems
9. **Ms Grace Hui**
   Chief Administrative Officer
10. **Dr Daniel Shi**
    Senior Director, Electronics Components
11. **Dr James Lei**
    Acting Director, Intelligent Software and Systems

How do they work?

The Senior Management team is led by our CEO, Mr Hugh Chow, alongside three C-Officers: the Chief Technology Officer Dr MeiKei leong, Chief Financial Officer Ms Cammy Yung, and Chief Administrative Officer Ms Grace Hui.

Supervised by the Chief Technology Officer, seven senior executives are responsible for the Technology Divisions.

Headquarter Executives

In 2017-18, the following Headquarter Executives were members of the Senior Management team:

Mr Hugh Chow
Chief Executive Officer

Dr Meikei leong
Chief Technology Officer

Ms Cammy Yung
Chief Financial Officer

Ms Grace Hui
Chief Administrative Officer

Technology Division Heads

Seven Technology Divisions are responsible for overseeing the development of respective technologies, each guided by an experienced leader.

ASTRI's Technology Divisions were led by the following heads in 2017-18:

Dr Justin Chuang
Vice President, Next Generation Network

Mr Li Yiu-kei
Senior Director, Advanced Digital Systems

Dr Lucas Hui
Senior Director, Security and Data Sciences

Mr Bill Zhang
Senior Director, Mixed Signal Systems IC

Dr Daniel Shi
Senior Director, Electronics Components

Dr Tsai Chen-jung
Acting Director, Opto-electronics

Dr James Lei
Acting Director, Intelligent Software and Systems

Each of these Divisions drives research and development opportunities that are relevant for ASTRI. Their leadership allows us to coordinate our efforts towards developing innovative tools, new technologies and smart solutions to distribute to the industries, various sectors, and relevant markets throughout Hong Kong and China.

Annual remuneration of senior executives

Post	Annual Remuneration* 1 Apr 2017 – 31 Mar 2018 (HK$)
Chief Executive Officer	844,240
2 level one executives	6,228,700
18 level two executives	26,681,650

Annual Remuneration* (HK$)	Number of Senior Executives
1,000,000 or below	3
1,000,001 to 1,500,000	6
1,500,001 to 2,000,000	7
2,000,001 to 2,500,000	2
2,500,001 to 3,000,000	2
3,000,001 to 3,500,000	1
3,500,001 to 4,000,000	0

*The information covers actual remuneration (including Base Salary, Salary Adjustment, Acting Allowance, Variable Payment, and Cash Award i.e. Inventor Award) for 2017-18 received by senior executives who were in service as of 31 March 2018. The figures have been rounded to the nearest HK$10. It also covers the remuneration of three senior executives who were appointed during the year i.e. the CEO on 15 Jan 2018, the CAO on 1 Nov 2017, and the Senior Director, Security and Data Sciences on 1 Feb 2018.

A Professional Team

At the heart of any great enterprise is a team who can collectively deliver the scale more than the sum of their parts. Its highly committed, competent and diligent team is the driving force behind ASTRI's success.

Teamwork turns our dreams into reality

At ASTRI, we deliver technologies that work for the people of Hong Kong. But without one key component, none of this would be possible. At the core of our vision lies the most important part of our organisation: our people.

We are proud of our workforce. With over 600 dedicated and highly competent individuals all working towards a common goal, we can help create a better, brighter future for Hong Kong and our nation.

We believe our success stems from combining a highly skilled workforce, the right leadership and guidance with a dynamic organisational structure.

What makes ASTRI's team great?

Applied R&D that caters to the needs of industries and communities is the integral mandate of our organisational mission. Under seven Technology Divisions, our R&D teams account for nearly 79% of the total workforce. That, aided by ASTRI's various support services and functions, enables ASTRI to operate at the high standards we pride ourselves on.

The support services and functions include Finance and Accounts, Public Affairs, Procurement, Legal, IT and Facilities Management, Human Resources, Business Development, Technical Marketing and Project Management.

Technology Divisions

- Mixed Signal Systems IC
- Advanced Digital Systems
- Electronics Components
- Opto-electronics
- Intelligent Software & Systems
- Security & Data Sciences
- Communications Technologies

Core Competence Groups

RF Systems	Visual Computing	Packaging	Manufacturing Technologies	Multimedia Systems & Analytics	Cyber Security and Analytics	Baseband Solutions
Low Power Design	Machine Learning Platforms	Intelligent Devices Energy	Modules & Integration	Intelligent Cognitive Systems	Data Analytics	Networking Software
Technology Co-Design	Secured System Platforms	Power Devices	Opto-electronic Devices	Cloud Computing	Blockchain / UIUX	Emerging Systems
	SoC Systems				ASL	Mobile and IoT Platforms
	Cyber-Physical Systems					

We are constantly growing

ASTRI offers career paths that suit the dreams and aspirations of scientists, researchers, engineers and professionals with diverse skills, backgrounds and aspirations from around the world. Developing new ideas keeps ASTRI at the forefront of applied technological research domains. That's why we strive to provide opportunities for career development across our technology divisions and corporate functions, and nurture talented individuals who have the drive and confidence to learn on the job.

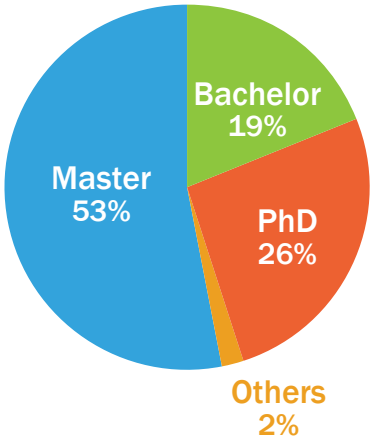
As of 31 March 2018, a total of 617 employees were part of the ASTRI team.

Employee number by function

Headquarters	80
Advanced Digital Systems	71
Communications Technologies	112
Electronics Components	48
Intelligent Software and Systems	119
Mixed Signal Systems	59
Opto-Electronics	45
Security and Data Sciences	31
Others	21
Interns	31
Total	617

Academic qualifications of our R&D staff members

At ASTRI, people are at the heart of every innovation we create. We are more than just research – we are a community, with a shared goal of creating strategic advantages for Hong Kong's institutions, industries and communities.



As of 31 March 2018

Corporate Governance

As an R&D centre funded by the HKSAR Government, ASTRI is committed to the highest standards of corporate governance – both in the interests of its stakeholders and the people of Hong Kong.

To ensure good corporate governance, ASTRI adheres to its Corporate Governance Manual that clearly articulates our policies and principles. The Manual supports the Board and Senior Management's efforts to oversee and operate ASTRI's business in a transparent and accountable way.

The manual provides a comprehensive overview on:

We update, modify and strengthen sections of the Manual in line with the developments needed to improve ASTRI's operations and to reflect the changing terms and conditions of the business environment that ASTRI operates in. During the year 2017-18, we revised the Corporate Governance Manual to strengthen our governance practice and enhance its efficiency.

Internal audit

ASTRI set up an Internal Audit Department (IAD) under the Audit Committee in 2003 as part of its drive to practise effective corporate governance and to provide the Board with information and assurance on internal controls.

The IAD provides objective review and assurance that adds value to ASTRI's endeavours and improves its operations. It helps the organisation to accomplish its objectives by bringing a systematic, disciplined approach to evaluating and improving governance, control and risk management processes.

Over the past year, the IAD has conducted internal audit reviews on various operations, including payments and receivables, procurement, and project management, in line with the risk-based Internal Audit Annual Plan approved by the Audit Committee. While these reviews identified some opportunities to improve, they ascertained that significant controls were in place and that regulations and procedures were observed in all material aspects. The IAD submitted reports and recommendations of these reviews regularly to the Audit Committee for consideration.

Compliance

As the Compliance Officer, the Head of Internal Audit helps the Board ensure good governance by reporting significant non-compliance issues identified by a team of Departmental Compliance Officers. The Compliance Officer submits quarterly reports to the Audit Committee on important compliance matters.

Safeguards against conflicts of interest

As a public organisation, it's important for ASTRI to have effective safeguards against conflicts of interest. To ensure it detects potential conflicts and manages declared ones, ASTRI regularly reviews and updates the Code of Conduct when necessary. Most recently, the Code of Conduct for Employees was reviewed and an updated version was communicated extensively to everyone in ASTRI.

In January 2018, the Independent Commission Against Corruption (ICAC) of HKSAR delivered a seminar for employees on the legal requirements around preventing corruption and managing conflicts of interest.

Workplace policy

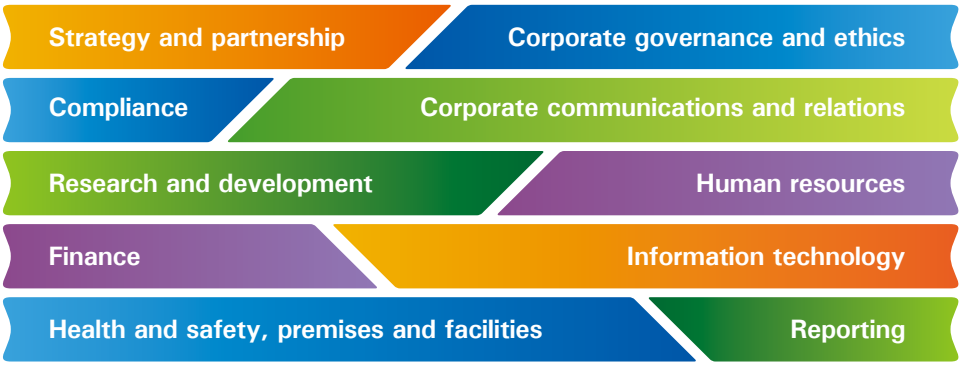
At ASTRI, we have zero tolerance for discrimination and harassment. We organise regular seminars on relevant policies and regulations to promote equal opportunities and prevent discrimination and harassment in the workplace.

Risk management

During the year, a review of the Risk Management (RM) process was carried out. As a result of this review, ASTRI introduced an RM policy that sets out the roles and responsibilities of various individuals and departments in the organisation around risk management. The policy also provides an overview of the evolving risk management process that identifies, evaluates and mitigates risk.

Updated on a regular basis, the Risk Register is reported periodically to the Board and the Audit Committee.

In line with the RM policy, our Risk Register tracks and monitors the various risks that ASTRI encounters, broadly categorised into the following themes:



ISO-based Quality and Information Security Management systems

As well as developing world-class intellectual properties (IPs) and introducing them to market, ASTRI puts strong emphasis on ensuring the quality of its research initiatives and management processes.

To ensure the quality of its R&D programmes, ASTRI implemented a four-step process for the annual planning and vetting of individual projects, and continuously monitors all ongoing projects.

ASTRI is one of the very few R&D institutions in the world with management processes that adhere to the ISO 9001:2015 standards.

The four objectives for ASTRI's ISO-based management system are:

Transparency **User-friendliness** **Responsiveness** **Governance**

In June 2017, ASTRI passed the conversion audit on the ISO 9001:2015 certification. This demonstrates that ASTRI's business operation was fully compliant with international quality management system standards.

In October 2017, ASTRI passed the surveillance audit on the ISO 27001:2013 certification. The audit confirmed that ASTRI's FinTech business operation fully complied with the international information security management system standards.

Achievements

At ASTRI, we are proud of our innovations. Our pride comes from the fact that we are making a difference to the future of Hong Kong by delivering innovative technologies that offer practical solutions. Our mission is to enhance Hong Kong's competitiveness in technology–based industries through applied research. This mission is reflected when our work is recognised by prestigious industry awards.

ASTRI's vision is to be a world-class technology developer and an enabler to enrich lives. In 2017-18 our projects that received awards and recognitions involved 3D video and display technologies, 4G/5G solutions, Internet of Things (IoT) applications, and authentication systems – all designed to enrich lives and boost the city's competitiveness. The projects and solutions we develop go on to benefit the people of Hong Kong and the wider region.

From prestigious local platforms to wider Asia Pacific awards, the recognition of our innovative projects stand testament to our passionate teams and the hard work of everyone in the organisation.

Hong Kong Award for Industries 2017

Category: Equipment and Machinery Design Award
Project: 3D Vision System for quality inspection and robotic guidance

Hong Kong Award for Industries 2017

Category: Technological Achievement Certificate of Merit
Project: End-to-end LTE system for value-added and mission-critical communications

Asia Pacific ICT Alliance Awards 2017

Category: Top Award – Communication
Project: TD-LTE-based Communication-based Train Control (CBTC) for subways

Asia Pacific ICT Alliance Awards 2017

Category: Merit Award – Industry Application
Project: Smart Water IoT System

WITSA Global ICT Excellence Awards 2018

Category: Merit Award – Public Sector Excellence
Project: Smart Water IoT System

Hong Kong ICT Awards 2018

Category: Gold Award for Information Security – Smart Business
Project: Palm Fusion Biometric Access Control System

Key R&D Projects

ASTRI's mission is simple: to enhance Hong Kong's competitiveness in technology-based industries through applied research. During 2017-18, we undertook 45 new R&D projects and successfully transferred 72 technologies to the industries. These R&D projects have been aligned with the following cornerstones of ASTRI's overarching technology strategy:

- **Smart City and Next Generation Network**
- **Intelligent Manufacturing**
- **FinTech**
- **Health Technologies**
- **CNERC Hong Kong Branch for Application Specific Integrated Circuit Systems**

You will find more details about the R&D endeavours of our seven Technology Divisions in their respective chapters. Below is a selection of the innovative projects that represent ASTRI's significant accomplishments during the year. Together, they unleash huge development potential for Hong Kong, the Greater Bay Area and the wider region.

Smart City and Next Generation Network

The HKSAR Government unveiled its Smart City Blueprint last year with a vision to become Asia's most global smart city by 2022. 5G technologies will be a key enabler of smart city development which is rapidly gaining traction in Hong Kong, promising to drive economic development and improve the quality of residents' lives.

Combined with Artificial Intelligence, deep learning and other new technologies, 5G can indeed unleash a whole new world of possibilities – facilitating the development of world-class smart cities. In future, sectors like healthcare, manufacturing or construction will benefit tremendously from 5G. For instance, connected robots can assist humans to deliver higher productivity and better performance. ASTRI plays a key role in developing 5G applications and solutions. ASTRI actively leverages the latest 3GPP standards for 5G and continues to strengthen its R&D pursuits leading to successful rollout of 5G and the overall Smart City development in Hong Kong. Furthermore, ASTRI has partnered with the local telecommunications regulator to help devise a framework to ensure optimal handling of Hong Kong's communication spectrum. This issue is critically vital for the successful launch of 5G in the city.

The wide adoption of 5G, along with the extensive usage of IoT and open data, will allow people to be more connected than ever. At ASTRI, we are developing a broad range of Smart City applications, leveraging Information and Communications Technologies (ICT) for Hong Kong's overall Smart City development. Here are some of our Smart City and Next Generation Network projects from the past 12 months.

5G access technologies for next-generation heterogeneous networks

The project team, working with Rohde & Schwarz, completed a study for the HKSAR Government's Office of the Communications Authority (OFCA) that will facilitate a seamless, smooth launch of 5G services in Hong Kong.

At present, the C-band 3.4 - 4.2 GHz spectrum are used by various services such as satellite-based television broadcasting as well as Hong Kong's two Telemetry, Tracking and Control Stations for the SAR's 12 satellites orbiting the Earth. The consultancy study carried out by ASTRI and Rohde & Schwarz provided OFCA with recommended mitigating measures to enable satellite-based television and 5G services to co-exist on the 3.5 GHz band spectrum.

Utilising the 3.5 GHz band spectrum is crucial for the successful introduction of 5G services. ASTRI has played a key enabling role to that end, by proposing practical solutions that will enable satellite-based television and other services to co-exist with 5G consumer voice and data services on the 3.5 GHz band spectrum. It helps potential industry partners to capture the huge 5G market in Hong Kong, Mainland China and other parts of the world – paving the way for new and innovative services to be introduced.

ASTRI's interference mitigation solution for satellite TV systems to co-exist with 5G

Smart Mobility using Vehicle-to-Everything (V2X) technologies

ASTRI is working alongside key players in the ICT industry to build a Smart Mobility system for Hong Kong using Cellular Vehicle - to - Everything (C - V2X) technologies. ASTRI was one of the founding members of Hong Kong's first Smart Mobility Consortium formed in 2017. ASTRI subsequently conducted a feasibility assessment of V2X use cases under the recently unveiled 3GPP 15 standards for 5G. ASTRI also completed the architecture design for V2X networking system and developed V2X 'needs analysis' and 'deployment scenarios' for real-life road safety management.

ASTRI conducted the first C-V2X live trial in Hong Kong

Through its V2X - based Smart Mobility solutions, ASTRI will help to revolutionise Hong Kong's transportation sector – covering both network-based and direct communications for vehicles. A V2X-powered Smart Mobility system will enable vehicles to connect to both the cloud and with each other, as well as to pedestrians and traffic infrastructures. Connected cars will not only improve road, vehicular and pedestrian safety, but will also help law enforcement agencies, traffic administrators and urban planners to design and monitor the efficiency of traffic movements.

ASTRI plans to work with the Government, telecom operators and hardware manufacturers, the automobile industry, and other stakeholders to realise this vision. The project is also expected to generate opportunities for many other sectors including logistics and shipment, insurance, infotainment and mobile healthcare.

Handwritten Chinese recognition semantics

ASTRI's handwritten Chinese character recognition system uses sophisticated machine vision and deep learning techniques to process handwritten text in traditional and simplified Chinese.

It can 'read' and process Chinese characters including Hong Kong's colloquial expressions, English block letters, and numbers. With efficient text extraction, character segmentation and deep learning-based recognition technologies, this application makes it simpler, easier and more efficient for banks and other businesses to deal with customer information and process application forms.

In 2017-18, ASTRI developed a set of semantic algorithms for this solution that reduces difficulties and delays in recognising handwritten Chinese characters as experienced in conventional offline systems. To completely automate the processing of handwritten forms et al, a near-100% recognition accuracy is essential. ASTRI's solution applies newly developed semantic algorithms at pre and post-processing stages, and refines the recognition of handwritten Chinese characters with greatly improved results.

Using the tool developed by ASTRI, the recognition rate per character has now peaked at around 97%. The semantic algorithms have been applied on both pre and post-processing stages, confining the domain of recognised characters to significantly improve recognition accuracy. Furthermore, ASTRI developed an algorithm that extracts handwritten strokes and segments characters from images, in accordance with the tool's built-in integrated recognition and segmentation algorithm.

A 'Hong Kong Address Database' has been built to correct wrongly-recognised characters. The project deals with Hong Kong addresses in handwritten Chinese and demonstrates the semantic algorithms to return promising recognition results. The project also leveraged a database of addresses in Hong Kong – enabling the system to correct wrongly-recognised characters quickly and accurately.

ASTRI's algorithms specially designed for Chinese characters deliver high recognition rate.

Financial Technologies

As one of the busiest and most important banking hubs in the world, Hong Kong has an advanced financial services sector. To maintain its leadership in the rapidly evolving global economy, it is extremely important for this sector to adopt innovative technologies. FinTech is a key driver of the sector's future growth. The emerging ecosystem of Financial Technologies will become more stable and 'mainstream' in the coming years. But that stabilisation will come after some significant and radical changes. The impact of FinTech is far-reaching and diverse. On one hand, we will see more and more areas of financial services adopting digitalisation and automation. On the other hand, we will see financial services professionals paying increasing attention to how FinTech will impact their careers and professional development.

ASTRI is a leading and pioneering R&D centre pursuing industry-relevant FinTech solutions. It has one of the strongest FinTech R&D teams in this region. ASTRI's FinTech solutions – ranging from cybersecurity, Blockchain, data analytics, identity management, authentication systems to machine learning – cater to the wider financial services industry in Hong Kong. It plays a key role in Hong Kong's FinTech development, grooming talents and working alongside regulators and industry players.

The following FinTech projects are great examples of the advances we made in 2017-18.

Palm Fusion biometric sensing device

The Palm Fusion Biometric Access Control System developed by ASTRI and its partner SSID from Sweden enables fully secure user identity verification. Passwords and PINs can be stolen; digital signatures can be hacked; but there are certain unique features in the human body which are extremely difficult to forge – such as biometric attributes like people's palmprint.

This award-winning solution includes a contactless biometric sensing device that can capture an individual's palm veins and palmprint pattern by radiating infrared and visible light when a user places his or her palm on it. As veins are beneath the skin, forging an identity in this method is extremely difficult. Furthermore, one's palmprint contains many exclusive and differentiating features – even identical twins don't have exactly the same palmprint.

Identity management is a key issue across many different sectors, as organisations as well as individuals strive to safeguard their information and digital assets. This innovative solution from ASTRI brings vast practical benefits through its robust access control mechanism. By using a fusion technology that combines both palmprint and palm vein features, ASTRI's solution yields a higher level of security.

With the contactless feature, ASTRI's sensing technology can turn into an authentication solution with better hygiene.

Cybersecurity Assessment System for financial services sector

Hong Kong's critical infrastructure and the safety of our financial system face constantly evolving cybersecurity threats. To address this challenge, ASTRI Security Lab (ASL) in collaboration with the Hong Kong Association of Banks (HKAB) has built a robust cyber-threat intelligence platform named 'Cyber Intelligence Sharing Platform' (CISP) to serve the local banking industry. CISP, one of the three pillars under the Cybersecurity Fortification Initiative of the Hong Kong Monetary Authority (HKMA), enables an industry-wide exchange of cybersecurity intelligence. It is currently used by over 150 banks operating in the city.

ASL regularly scans and monitors the cybersecurity landscape for red flags and publishes the findings on CISP. This facilitates the exchange of cybersecurity intelligence and helps strengthen the mechanism for industry-wide sharing of news and insights. By having a central depositary of information, banks can readily access an extensive body of intelligence, enabling them to protect their systems and act swiftly against cyber-threats.

CISP facilitates collaboration among public and private sector organisations and enables timely information sharing to combat cyber-attacks.

Distributed Identity Management System powered by Blockchain

Using Distributed Ledger Technology (DLT) or Blockchain, ASTRI is developing a robust solution that will allow Government agencies, financial institutions and other businesses to store and share their users' identity information in a way that protects privacy and data security. The solution allows various organisations to cooperatively contribute, share, manage and protect user identity information by storing data in distributed locations in a secure, inimitable and accessible fashion.

Leveraging the power of Blockchain technology, ASTRI has successfully applied its FinTech R&D expertise into action through this project. The project will address the evolving identity management needs of the industry and strengthen financial crimes prevention. The digital solutions developed by ASTRI will also help the industry to meet increasingly stringent regulatory expectations while improving overall banking experience for the customers.

Meanwhile, working as part of a Digital Identity Management working group that includes HKMA and leading banks, ASTRI performed a proof-of-concept-based feasibility study on using DLT-based Know Your Customers (KYC) processes in the sector.

When completed, the project will greatly simplify and expedite customer onboarding and service performance of organisations by offering a fully secure and state-of-the-art digital rights management system.

ASTRI is working with regulators and leading market players to develop DLT solutions.

Intelligent Manufacturing

Across the world, technological advancements lead to significant improvements throughout the industrial value chain. The application of advanced technologies in the industrial sector redefines business, manufacturing, and the relationship between humans and machines. For Hong Kong, this transformation means a world of opportunities.

As factories and businesses become digitalised, the demand for high-tech solutions will be on the rise. Applications, solutions, talents, as well as related of complementary products and services – all these will feed into smart factories. Southern China has long been a leading manufacturing base in the world. Guangdong province generates the largest exports value among all Chinese provinces and municipalities, accounting for 28.3% of the national total. Greater Bay Area, comprising cities in Guangdong as well as Hong Kong and Macau, will be a mega-economic zone. Hong Kong can leverage on the manufacturing industry across the GBA, as the industrial base in Guangdong goes through a quantum leap of technological upgradation.

Focusing on Artificial Intelligence and Robotics, Intelligent Manufacturing is one of the five pillars in ASTRI's R&D strategy. Since being founded by the Hong Kong SAR Government in 2000, we have actively pursued applied R&D, helping to enhance the competitiveness of businesses and improve the lives of people. Our intelligent manufacturing initiatives thrive on application of Artificial Intelligence and Robotics in the production process. Combining our expertise in machine vision, cyber-physical systems, sensing, power electronics and communications technologies, we develop solutions for our partners in the industrial sector. With strong partnerships across industries in the Mainland and elsewhere, ASTRI plays its part to elevate the competitiveness of the manufacturing sector. Here is a collection of our projects from 2017-18 that could help Hong Kong advance its reindustrialisation agenda and also take advantage of the Greater Bay Area development opportunities.

3D random bin-picking technology for industrial robots

ASTRI has successfully developed 3D robotic cognition technologies that enable random bin picking and flexible assembly in manufacturing. The 3D vision system provides a robot with information about its environment, enabling it to automatically locate and sort random and completely unstructured parts in generic bins.

ASTRI has developed a 'whole-field 3D scanning' technology with high speed and accuracy for robotic eyes. To enhance 3D robotic visual perception, ASTRI has also developed IP-protected platform technologies such as coded phase-shift 3D measurement and learning-based object recognition algorithms. The technologies developed in this project can be deployed across a wide range of applications, including 3D randomised bin-picking, pick-and-place, assembly, navigation, body scanning for garment manufacturing and 3D printing.

The solution not only enhances efficiency in smart factories, but also frees up human workers to focus on other value-adding tasks. This system can be easily integrated in industrial processes, especially when moving heavy parts in robot-assisted production factories.

Functioning as an eye of the robot, the 3D vision system projects light to locate objects.

3D conversion technologies for next generation 3D displays

ASTRI has developed a 3D conversion technology that can generate 3D contents for different types and scales of spectacles-free 3D displays. The technology incorporates image processing algorithms, FPGA/ASIC implementation and hardware system boards. The solution instantly converts conventional 2D contents into excellent 3D contents with hardware accelerator engines.

The stunning visual experience delivered by ASTRI's solution is of great value to the industry – benefitting a wide range of applications and devices from smartphones and television sets to large-scale digital signage.

The 3D conversion technology can be applied for different purposes, for example, digital photo frames.

Safe, efficient, environment-friendly power cells for Electric Vehicles and other smart city applications

ASTRI has been pursuing next generation energy storage systems which are safe, efficient, and eco-friendly. The project orchestrated ASTRI's scientific and technological expertise with the market-proven capabilities of ZKLF (HK) in the field of storage power products. The robust storage power unit comes with enhanced safety protection against risks like fire, explosion or temperature fluctuations in Lithium-ion battery cells. It has a smart thermal management function, an electric conductive enhancer and a self-shutdown layer to provide additional safety features.

This innovation is highly relevant for electric vehicles, data centres, and many other emerging applications required for Smart City development.

ASTRI is working with the project partner to further innovate the technology for broader applications.

Health Technologies

Health Technologies are important for Hong Kong. To improve medical services for residents and to take better care of the ageing population, the HKSAR Government is increasingly leveraging advanced technological solutions. Health Technologies have also been identified as one of the thrust sectors that the Government wants to heavily invest in, as part of its overall I&T agenda.

When advanced technologies like data analytics, machine learning, sensors, Artificial Intelligence and Robotics are applied in the healthcare industry, they not only make it easier and faster to diagnose ailments, but also bring down the amount of time and resources required to start effective treatments. With one of the longest per-capita life expectancies in the world, Hong Kong truly needs healthcare services that are fast, agile, secure, reliable and - most importantly - serve the ageing population who deserve the best quality of care having contributed to the city's growth and development throughout their lifetime.

ASTRI pursues innovative R&D in the field of Health Technologies with specific aims of making healthcare services more affordable and efficient, enhancing and personalising healthcare services, and ultimately improving the quality of people's lives. Through new applications in areas like preventative health monitoring, diagnostic tools and medical computing, ASTRI aims to assist Hong Kong's healthcare industry and positively influence the city's technological progress – for the benefit of its people.

Medical Image Data Analytics platform

ASTRI's Medical Image Data Analytics platform uses advanced computation technologies to leverage the power of big data in medical imaging. In particular, it utilises next generation medical image data mining and enables Computer-Aided Diagnosis (CAD). This platform is equipped with scalable medical image database, distributed parallel computing engine, and a powerful application development environment. It ensures efficient management of medical image big data and supports agile development of CAD applications.

The platform is supported by well-documented medical image repositories, which contain high-quality and large volumes of data – essential for CAD development and validation. Using big data analytics, it can process a large number of medical images very quickly, with appropriate diagnosis tags forming content descriptors for further data mining operations. In addition to generating results through machine learning, the platform also facilitates the evaluation and referencing of clinically-related patients' diagnosis.

With the implementation of Remote Diagnosis Server (RDS) and Remote Diagnosis Viewer (RDV), the platform ensures effective management of high volume of medical images. RDS and RDV allow users to review the corresponding slide information in an extremely convenient approach. In addition, the platform uses Cytological Analysis Server (CAS) for fast processing in a robust application environment. The powerful Cytological Analysis Algorithm (CAA) enables users to see slide images and proposed diagnosis directly from the Cytological Analysis Viewer (CAV). ASTRI has focused on the diagnosis of cervical cancer within the scope of this particular project. The overall arrangement helps medical experts to make diagnosis more accurately and much faster than before.

The machine learning feature of the Medical Image Analytics Platform feature greatly reduces time used for patients' diagnosis.

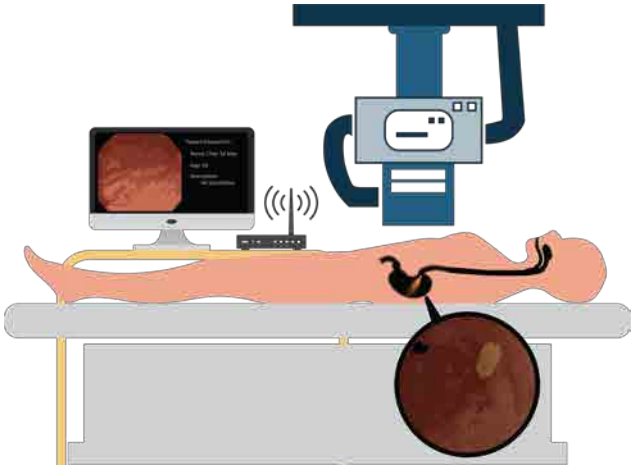
The Medical Image Analytics Platform is one of ASTRI's latest innovations in Health Technologies.

The Next Generation Capsule Endoscopy system

Capsule Endoscopy is a medical procedure uniquely designed to visualise the gastrointestinal tract, particularly the small bowel, in its entirety. Since 2000, capsule endoscopy has mostly been used for diagnosing the small bowel disease. However, the application of capsule endoscopy in other parts of the digestive tract has increased. The idea of using capsule endoscopy systems involves detecting small and difficult-to-trace ailments in the gastrointestinal tract.

ASTRI is working on a reliable and sophisticated capsule video endoscopy system that makes it easier to examine and inspect the digestive tract – a difficult organ to explore and examine with conventional technologies. The Next Generation Capsule Endoscopy system will provide a reliable, non-invasive, and well-accepted and well-tolerated procedure, which can revolutionise the diagnostic techniques in medical procedure.

This ongoing project focuses on stomach endoscopy and aims to develop a compact capsule localisation and navigation system that can guide the capsule to take photos within different areas of the stomach. The proposed capsule solution developed by ASTRI will add a position tag to each captured image, allowing for real-time frame-rate adjustment while the image is captured, using more stable external magnetic sources to control its movement and improving the accuracy and quality of the images.



ASTRI's capsule video endoscopy system focuses on stomach endoscopy.

CNERC Hong Kong Branch for Application Specific Integrated Circuit Systems

Integrated Circuits (IC) hold the key to innovation-led growth and development of a lot of high-tech industrial sectors. As China strives to significantly upgrade its industrial and manufacturing sectors – especially in telecommunications, smart city and electronics – the significance of reliable and robust IC research has become paramount. To that end, the Central Government has a clear vision to uplift technological capabilities and build a skilled talent-pool for the sector. Hong Kong SAR, with its strategic position as a globally-connected modern economy within China, could play a crucial role in that endeavour. Particularly in the context of global techno-economic dynamics, international developments like the Belt and Road initiative, and national-level plans such as the Greater Bay Area, Hong Kong can potentially harness a large pool of opportunities to excel and contribute.

In 2012, ASTRI established the first-ever Hong Kong branch of the Chinese National Engineering Research Centre (CNERC) for Application Specific Integrated Circuit Systems in collaboration with Southeast University (SEU) in Nanjing. The branch focuses on microelectronics and integrated circuits, which together with those five core priority areas, form the blueprint for ASTRI's technology strategy.

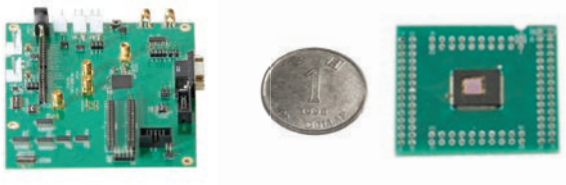
As the first CNERC branch in Hong Kong, ASTRI is responsible for many technological innovations, tools and solutions across multiple industry sectors. Using its mandate to focus on Application Specific Integrated Circuits, ASTRI has developed a number of solutions that serve various sectors such as smart manufacturing, smart city development, financial technologies as well as next generation network solutions.

IP platform for cellular Internet of Things

Using cellular networks, Internet of Things (IoT) will wirelessly connect around 2.7 billion devices by 2022, according to industry experts' forecast. Narrowband cellular IoT is a very promising low power wide area communication technology to meet the requirements of IoT. Its standardisation is in full swing following the release of the latest 3rd Generation Partnership Project (3GPP) standards. In this project, ASTRI developed an IP platform based on narrowband cellular IoT technology, which includes an RF transceiver and digital baseband. These IPs have been licensed to multiple IC companies globally to take full advantage of the enormous IoT market.

Several key technologies are in development, including integrated CMOS Power Amplifier (PA), high performance Digitally Controlled Crystal Oscillator (DCXO), multiplier-less digital mixer, digital low pass filter with model reduction, and a highly configurable protocol stack package.

This project will help Hong Kong to attain a technologically leading role in the field of IoT. It also seeks to create strong competitive edge for local IC design houses, IoT solution vendors, OEM and ODM manufacturers.



ASTRI's NB-IoT solution integrates multiple components into an IC that is smaller than a coin.

Medium range and high-power Wireless Power Technology platform

Wireless power transfer (WPT) is a promising technology with a wide application prospect. It offers exceptional flexibility and portability over conventional wired power transfer methods. The fundamental WPT technology is based on induction-coupling that transmits power from a charging station over very short distances. While wireless charging plays an increasingly important role in people's everyday lives, the industry constantly looks for further improvements to bring better user experience. This project works on the design of a medium-range power transfer solution using magnetic resonant coupling to wirelessly transmit electrical energy, enabling a whole new set of applications.

ASTRI is a pioneer in employing the latest third-generation semiconductor GAN FET devices in the application of medium range wireless charging systems for consumer electronics. Based on A4WP standards, ASTRI's wireless charging system adopts magnetic resonance technology with built-in dynamic impedance network compatible resonator module, high-frequency inverter circuit driver module and control algorithm measurement module. ASTRI's solution makes it possible to deliver medium to long-range charging, higher power transfer efficiency and simultaneous multi-device charging. It also allows flexibility in charging position, rapid charging and low-cost application among others. Meanwhile, ASTRI has the roadmap for a comprehensive patent strategy to manage wireless charging technology inventions.

This project targets to introduce ASTRI's own WPT technology to the market, offering great potential for the consumer electronics and smart home solutions markets of Hong Kong and Mainland China – enhancing the industry's competitiveness and bringing superior solutions to the consumers.

Flagship Events

Over the past year, ASTRI has been involved with many important events in Hong Kong, the Mainland and other locations. Whether it's demonstrating FinTech solutions, promoting a tech-savvy next generation, or discussing how to reinvigorate manufacturing in Hong Kong, ASTRI has played important roles in these pivotal discussions that are critical to I&T development in Hong Kong. The following examples are some of the most influential events we hosted in 2017.

Industry University Collaboration Forum

The theme of ASTRI's Industry University Collaboration Forum (IUCF) 2017 event was 'Connecting the Dots for Reindustrialisation: The Greater Bay Area Landscape'. With that in mind, ASTRI brought together experts and industry leaders from around the world on 14 November 2017. The attendees talked about their ideas on Industry 4.0 and smart manufacturing, with a focus on the Greater Bay Area Development programme.

The event featured inspirational speeches from more than 27 industry experts and leaders – including people from local and regional universities, research institutions and technology companies, as well as senior Government officials. The speeches covered topics including how innovation and technologies can boost and enable the next generation of industrial revolution in the Greater Bay Area. Other discussions covered key socio-economic priorities for Hong Kong: national programmes related to Industry 4.0, 'Made in China 2025', Greater Bay Area development, as well as international mega-plans like the 'Belt and Road' initiative.

Reindustrialisation is more than just an ambition for Hong Kong. The city has a strong legacy of successful manufacturing ventures, enjoys strong geographic location in the Pearl River Delta, and has historically been part of prominent international trade routes. Hong Kong can actively explore the development of smart manufacturing by making the most of its proven track record in industrial endeavours, paired with world-class institutions and rich expertise. It can also capitalise on the trusted 'Made in Hong Kong' brand, and lift the economy to new heights.

The Forum was hugely popular, and on the day it attracted over 400 participants. Hong Kong has a world of potential in innovation and technology, and participants explored how to unleash that potential and seize opportunities across the Guangdong-Hong Kong-Macau Greater Bay Area.

Inter-Tertiary-Institute Capture the Flag Contest 2017

The grand finale of the Inter-Tertiary-Institute Capture the Flag (CTF) Contest 2017 took place on 10 June 2017. ASTRI is committed to nurturing the next generation of technology-savvy professionals, and the teams taking part certainly had their digital skills put to the test. Organised by ASTRI and iChunQiu.com, the contest was the first of its kind in Hong Kong and Macau.

The CTF platform is globally recognised and is modelled as a series of simulated cyber-attacks. Participants competed in an 'ethical hackathon', focusing on topics like web-security, cryptography and reverse engineering. As well as applying their skills, the finalists had to demonstrate real-time teamwork and problem-solving abilities.

Ten teams took part in the finale representing five institutions: the Hong Kong University of Science and Technology, the Chinese University of Hong Kong, the Hong Kong Polytechnic University, the School of Professional and Continuing Education of the University of Hong Kong, and the Hong Kong Institute of Vocational Education.

In the first round of the CTF contest, participants competed in a 36-hour, non-stop online challenge. Over 300 students from 96 teams representing 14 institutions took part in the preliminary round. The initiative was backed by 'GovCERT.HK' of the Office of the Government Chief Information Officer (OGCIO), HKSAR Government.

Ir Allen Yeung, JP – erstwhile Government Chief Information Officer of the HKSAR Government, speaking at the event

Other events

ASTRI organised, co-organised and was a major partner in many other events and forums, including:

Sessions on Distributed Ledger Technology and Cybersecurity during Hong Kong FinTech Week – organised by InvestHK

FinTech Career Accelerator Scheme co-organised with the Hong Kong Monetary Authority, Hong Kong Science Park and Hong Kong Cyberport

Hong Kong's first-ever live demonstration of C-V2X technology at the Intelligent Transportation System (ITS) Asia-Pacific Forum 2017

'Smart City and the IoT Era' Industry Summit co-organised with GSMA

Computer Science Challenge for secondary students organised by the City University of Hong Kong

HSBC Safeguard Mobile App Contest as the Technology Enabler

IC Technologies and Application Seminar in Nanjing, China

ASTRI in major external events

Throughout the year, ASTRI took part in over 30 industry exhibitions, expos and similar events in Asia Pacific and around the world. These events showcased new solutions, gave people an insight into ASTRI and demonstrated exciting new technologies. Here are a few of the biggest ones of the year.

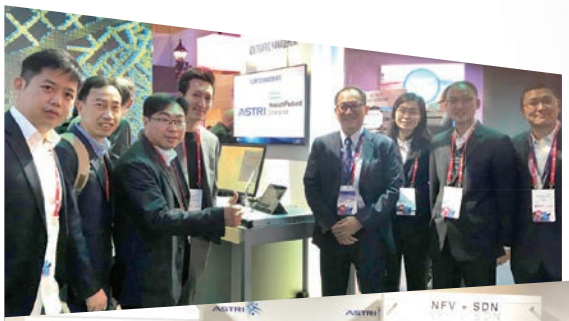
Mobile World Congress – where the telecom industry writes its future

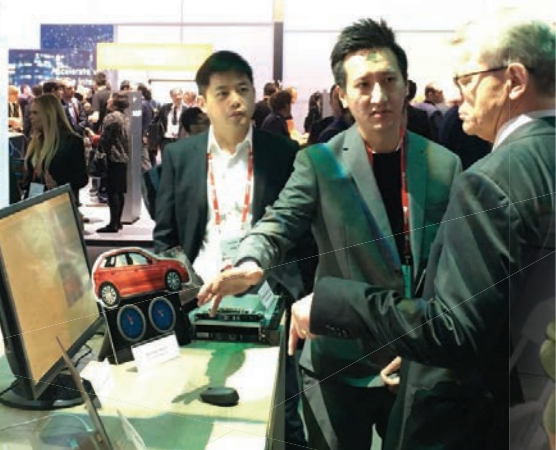
ASTRI took part in two editions of the Mobile World Congress (MWC) – one in Shanghai in June-July 2017, and one in Barcelona in February 2018. At both events, ASTRI showcased several advanced communications technologies including 5G solutions, in partnership with leading telecom equipment manufacturers.

At MWC in Shanghai, ASTRI showcased its technological breakthroughs in 4.5G and 5G, which will significantly improve the coverage, capacity, efficiency and reliability of telecommunications infrastructure. ASTRI explained how these technologies enable the use of innovative ideas and solutions towards smart city development.

And in Barcelona, ASTRI showcased a series of latest LTE and 5G communications technologies. We held joint technology demonstrations of 5G technologies, including Cloud Radio Access Network (C-RAN) virtualisation with live migration for 4G and 5G networks, 5G Ultra-Reliable and Low-Latency Communication (URLLC) and Cloud Radio Access Network (C-RAN) base-station.

The other technologies we demonstrated included Software Defined Wide Area Network (SD-WAN) Throughput Optimisation and Orchestration Prototype, and Control and User Plane Separation in EPC Nodes (CUPS) towards 5G core network. Finally, ASTRI also demonstrated Mobile Core/Edge Network on Next Generation Central Office (NGCO), V2X Networking System for enabling Edge Applications and Autonomous Driving, mini Evolved Packet Core (EPC) and Portable LTE Base Station innovation.





Gerontech and Innovation Expo and Summit 2017

In June 2017, ASTRI took part in the Gerontech and Innovation Expo and Summit 2017 (GIES). The summit was the first of its kind – a large-scale expo and summit designed to showcase the latest Gerontechnology, that is, products and solutions suitable for the elderly.

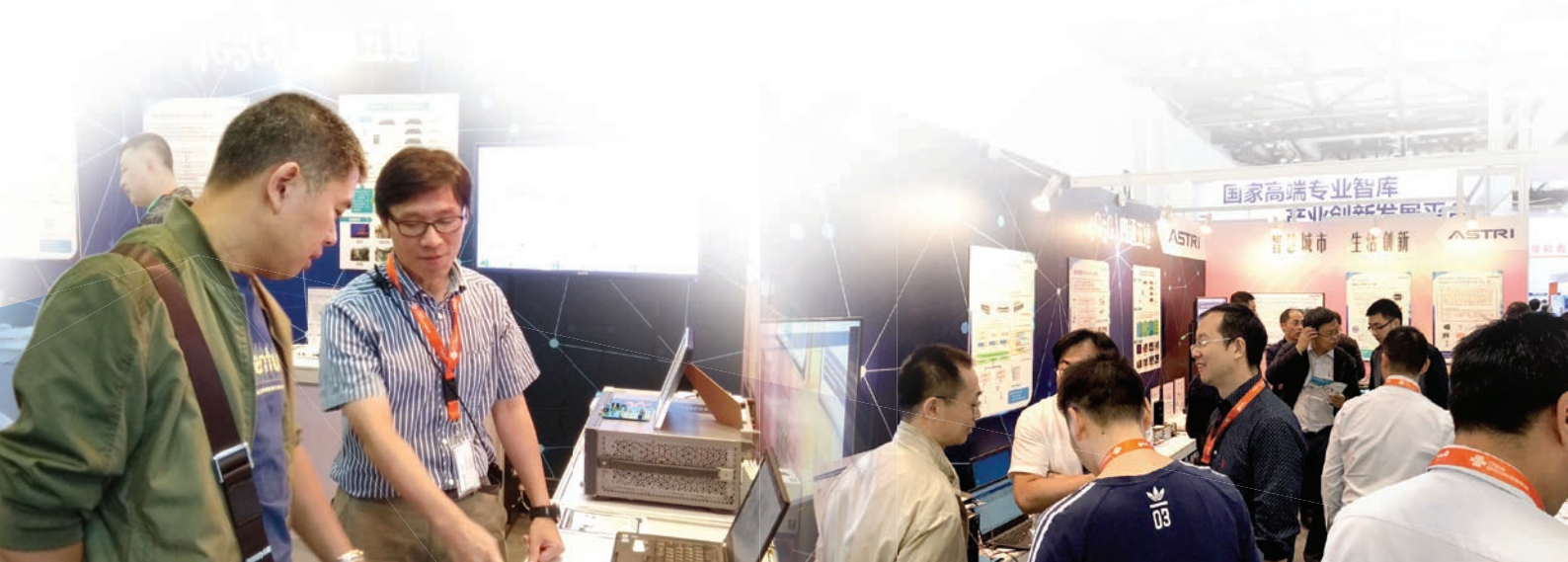
Drawing the latest innovations and advanced exhibits from around the world, the event showcased the best in health technologies for the audience. ASTRI demonstrated the outcomes of four projects: Elderly e-Education and Infotainment Platform for senior citizens, Preventive Healthcare System, Bluetooth Low-Energy Heart Health Monitoring System, and Cardiovascular Monitoring System.

PT Expo China 2017

In September 2017, ASTRI showcased its latest 4G/5G and smart city technologies at the PT Expo China 2017. The Expo is known as one of the ICT ecosystem's most influential events, so it was an ideal location for ASTRI to demonstrate our advanced solutions that drive technological breakthroughs in 4.5G and 5G, as well as a wide range of smart city applications.

The technologies and solutions showcased by ASTRI included:

- 3-in-1 SDN/NFV Core Network Turnkey Solution
- Centralised Radio Access Network (C-RAN) Reference Design for 4G and 5G Radio Access
- LTE Broadband Trunking Communication (B-TrunC) System for Mission Critical Communications
- Narrowband IoT (NB-IoT) Standardisation and Development
- Bluetooth Low Energy (BLE) solutions
- Automatic Meter Reading System (AMRS)
- Wireless Charging Platform
- Integrated Power Module Products
- Visually Enhanced Ultra-HD Platform (HD-4K Conversion) for 4K TV



InnoCarnival 2017

ASTRI's pavilion at the InnoCarnival 2017 was so popular that youngsters, senior citizens and science enthusiasts lined up every day to come and see what we had to offer. The pavilion – set up from 21 to 29 October – covered core technologies in smart city development, including FinTech, Smart City, Industry 4.0 and Next Generation Network.

Visitors were drawn to ASTRI for a simulation game called 'Drive Safe' that showcased ASTRI's Cellular Vehicle-to-Everything (C-V2X) technology for connected cars. There was also a matching game on Internet-of-Things, as well as demonstrations on smart navigation, smart parking applications and FinTech solutions. Visitors could also check out an innovative 'Smart Water Meter'.

Over the nine days of the Carnival, over 8,000 people visited ASTRI's pavilion. There, they learned about the latest developments in ASTRI's smart city R&D and had the chance to speak to the Institute's technology experts.

Three R&D experts from ASTRI also presented in the InnoTalk event on 26 October 2017 on 'Smart Technologies for Smart City'. Over 80 participants, mostly young people, attended the presentations and listened to the ASTRI experts.

Other events

Other major events and exhibitions where ASTRI participated include:

- China Innovation and Entrepreneurship Fair 2017, Guangzhou
- First China (Hengqin) International Quantitative Finance Contest
- Critical Communications World 2017
- Hong Kong International Medical Devices and Supplies Fair 2017
- Hunan (Hong Kong) Investment and Trade Conference Week
- Dragon 100 Programme 2017 Commissioning Ceremony
- 13th Mainland, Taiwan, Hong Kong and Macau Trade and Economic Forum
- 2017 Deloitte Technology Fast 20 and Rising Star programmes
- Symposium on Innovation and Technology organised by Hong Kong Trade Development Council
- International Science and Research Institution Innovation Achievements Fair, Dongguan
- Thailand National Credit Bureau Members Conference 2017, Bangkok
- IEEE International Conference on Image Processing, Beijing
- Technovation & Exhibition 2017 organised by Hong Kong International Airport
- China Innovation and Entrepreneurship Fair 2017
- China International Opto-electronic Exposition 2017, Shenzhen
- Consumer Electronic Show (CES) 2017, Shanghai
- Computex 2017, Taipei
- Laser World in Photonics China 2018
- China Content Broadcasting Network (CCBN) 2018
- Health Awareness Day 2018, organised by Hong Kong Science Park
- Singtel Cybersecurity Forum 2018, Hong Kong
- Vision China (Shanghai) Exhibition 2018

Thriving in partnerships

At ASTRI, we thrive in collaboration. We can make a difference to both the economy and the community through effective partnerships. ASTRI works with numerous industrial and business organisations, as well as other institutions both in Hong Kong and around the world.

It's our partnerships with companies in the I&T ecosystem that enable ASTRI to deliver practical, market-ready solutions to enhance Hong Kong's competitiveness on the global platform.

As a leading force in promoting both innovation and technology in the HKSAR, ASTRI puts emphasis on creating innovative R&D for industries, and on nurturing the technology talents of the next generation of tech leaders.

Our R&D strategy is deeply intertwined with our collaborative efforts with academic and R&D institutions, as well as with public and private sector enterprises.

Smart City Innovation Centre

ASTRI's biggest collaborative effort to strengthen Hong Kong's I&T ecosystem in 2017-18 came arguably through the opening of the Smart City Innovation Centre (SCIC). Operated at ASTRI's premises, the Centre is a joint effort by ASTRI and Hong Kong Science Park. The Centre was developed with support from the HKSAR Government's Innovation and Technology Commission. Equipped with state-of-the-art technologies, including a 5G Application Test Bed and an M2M Communications Lab, SCIC provides a purpose-designed environment and sought-after resources to facilitate 5G development by various stakeholders in Hong Kong. The Centre (SCIC) is also one of the most important first 5G innovation labs in Hong Kong, dedicated to promoting Hong Kong's smart city development.

It serves as an open innovative platform for users to researchers, start-ups and various other technology companies – both large and small – to incubate their ideas, share knowledge and develop collaborations on viable Smart City solutions. Laboratory training programmes, industry collaboration workshops and university brainstorming workshops also take place at SCIC, facilitating sharing of knowledge, insights and experiences.

SCIC is more than just an R&D lab. It symbolises ASTRI's commitment collaborating with other Government agencies, quangos, industry players, and the R&D community to inspire innovation towards a smarter future for Hong Kong.

Mr Albert Wong (L) — CEO of Hong Kong Science Park and Mr Wong Ming-yam — Chairman of ASTRI, speaking at the opening ceremony of SCIC

Other major collaborations

In our R&D partnerships, which include both project-specific and wider-scope initiatives, we focus on building platforms to promote advances in R&D, exchanging information, and sharing technological developments. Our joint laboratories and Memorandums of Understanding are good examples of the kind of collaborative platforms we build.

Some notable partnerships forged during 2017-18 include:

Notable R&D partnerships in 2017-18

Partner	Technology Division
Shenzhen Magic Eye Technology Company Limited	ISNS
Dongguan Southern Semiconductor Technology Company Limited	EC
Nanjing Jiangbei IC Research Institute Company Limited	MSS
The Hong Kong University of Science and Technology	HQ
Hong Kong Telecommunications (HKT) Limited, Huawei Technologies Company Limited, and Qualcomm Technologies Inc.	CT
TransUnion Limited	SNDS
Shenzhen ZHT Communication & Technology Company Limited	CT
SMC Multi-Media Trading Company Limited	EC
Meridian Innovation Pte Limited, and Meridian Innovation Limited	EC
Koios FinTech Limited	ISNS
Industrial and Commercial Bank of China (ASIA) Limited	ISNS
Marvel Digital Limited	ADS
Fundacio Privada i2CAT, Internet i Innovacio Digital a Catalunya	CT
Hunan Provincial Research Institute of Collaborative Innovation for Industrial Technology	ISNS
The University of Macau	HQ
Hangzhou C-SKY Microsystems Company Limited	MSS
Thomson Reuters Hong Kong Limited	SNDS
East Group Company Limited	EC
Changhong (Hongkong)Trading Limited	EC
Huawei Technologies Company Limited	CT
Red Hat Limited	SNDS
The International Iberian Nanotechnology Laboratory	OE

Advanced Digital Systems

The Advanced Digital Systems (ADS) Division delivers state-of-the-art 'System-on-Chip' design – from advanced algorithm research and system specification to IC implementation and production IC testing. It is an integral part of ASTRI's overall R&D endeavours, and plays a significant role in the operations of the Hong Kong branch of the Chinese National Engineering Research Centre (CNERC) for Application Specific Integrated Circuit Systems.

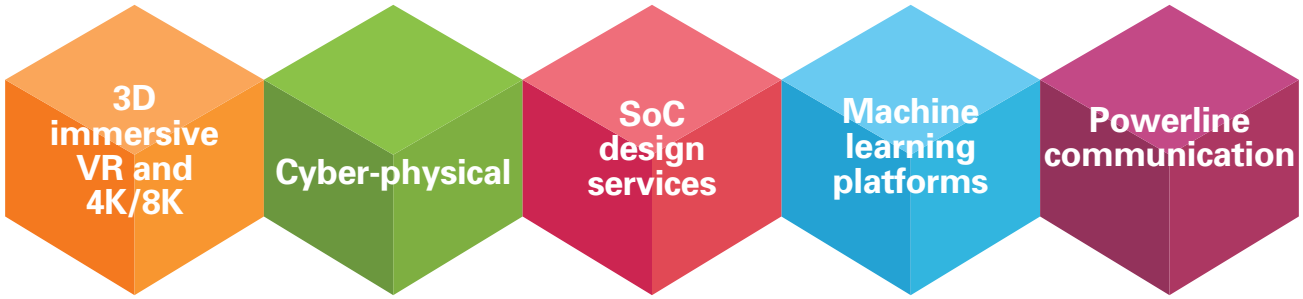
The Division also focuses on Blockchain technology research. It has assisted the Hong Kong Monetary Authority to publish two whitepapers on Distributed Ledger Technologies, and develops Blockchain solutions in partnership with various industry partners.

What does the team do?

Engineers in the ADS Division strive to create valuable silicon IPs through in-house innovation, targeting emerging Integrated Circuits (IC) applications.

They actively engage with partners across relevant industries by channelling in-house research results and those from local universities, and commercialising them through circuit actualisation and customisation.

To enhance the competitive edge of its industry partners, the ADS team offers market-competitive IPs and total turn-key IC solutions on the following key technology initiatives:



What are the Core Competence Groups?

The ADS Division has five Core Competence Groups (CCGs), each specialising in a particular type of technological applications.

Visual Computing

The Visual Computing CCG focuses on developing software and hardware-accelerated solutions for immersive video applications, including 3D displays and 360° panoramic video capture devices.

ASTRI's hardware-accelerated solution captures 360° panoramic videos.

Machine Learning Platforms

The Machine Learning Platforms CCG focuses on developing hardware-accelerated solutions for deep learning enabled applications. They have strong specialisation in neural network optimisation, dataflow neural network processor design, as well as hardware-enabled solutions for intelligent video production, object recognition, and various computer vision applications.

Intelligent video platform is developed on the basic of machine learning.

ASTRI's blockchain solutions optimise Blockchain security, performance and scalability.

Secured System Platforms

The Secured System Platforms CCG develops Blockchain system protocols and applications to evaluate and optimise Blockchain security, performance and scalability.

This CCG has hardware expertise to develop high-performance secured communication processors. It implements silicon IPs to improve communication integrity over powerline networks.

SoC Design

The SoC Design CCG realises IC product ideas for innovative designs. It works closely with customers as well as other R&D teams in ASTRI to implement production-ready silicon system platforms. The team adopts an agile and resilient support model that is flexible enough to balance the various trade-offs based on diversified design scenarios and maximised design value.

ASTRI's SoC design is one of the cornerstones of commericalised naked-eye 3D display technology.

Collaborative Mobile Manipulator is one of ASTRI's advanced robotic systems designed for smart factories in future.

Cyber-Physical Systems

The Cyber-Physical Systems CCG is dedicated to the development of digital-physical twins based on the model-based systems engineering principle. This CCG takes care of system-level design, synthesis and validation of AI-enabled robotic systems of smart factories in Industry 4.0.

Major areas of applications

The technologies developed by ADS are adopted across many commercial and professional sectors in Hong Kong and in the Guangdong-Hong Kong-Macao Greater Bay Area region.

These technologies target the following application markets:

- Digital signage, media and entertainment
- Video surveillance and monitoring
- Smart retail and logistics, video content production
- Powerline communication and smart meters
- Robotics and automation in smart manufacturing
- Blockchain technologies for financial services and many other applications

The year in focus

Throughout the year, ADS worked with a large number of industry partners delivering projects related to powerline communications, Systems-on-Chip solutions, immersive display units, Blockchain solutions for transaction optimisation, and virtual prototypes.

Highlights of ground-breaking innovations developed by ADS in 2017-18 include: (i) a Panoramic Video Processor that combines multiple HD video sources into a high quality 360° video with 4k resolutions, wide dynamic range and uniform screen resolution, (ii) a re-configurable neural network accelerator for video enhancement and object recognition applications, and (iii) a real-time 3D conversion solution which has attracted interest of a leading commercial organisation due to its strong market potential.

Moreover, in partnership with a world-leading magnetic tape-head manufacturer, the Division developed a Collaborative Automator System that provides strong mobility, sensing and manipulation capabilities to production lines, making the manufacturing process more flexible and efficient.

Looking back

ADS projects completed during the 2017-18 year include:

ADS projects completed during the 2017-18 year

Project	What is it?	Application Focus
Advanced Powerline Communications	The project implemented advanced broadband powerline communication Integrated Circuits IP, and developed total solutions for home appliances, entertainment streaming and smart meters.	Application Specific Integrated Circuits
BeiDou/GPS Dual-mode baseband SoC	It's the next generation baseband SoC, with significant improvement in positioning accuracy, power consumption and initial start time. It can be used in new application areas such as wearable devices, smart grids, and many more.	Application Specific Integrated Circuits
3D Processing for Immersive Analytics	We have investigated 3D processing algorithms and system architectures for immersive analytics, and built a simulation prototype system with immersive displays, natural user interface modules, and data visualisation modules. The project enabled us to identify the critical components of the immersive analytics systems, and also provided solid foundation for utilising Virtual Reality technology for big data visualisation.	Smart City
Blockchain network performance optimisation	As Blockchain gains wider acceptance and Blockchain systems process an increasing volume of transactions, the performance of Blockchain-based solutions becomes an important issue. Because Blockchain platforms are deployed across networks of wide coverage, we worked on the vital issue of network performance. This project aimed to investigate and design mechanisms to enhance Blockchain's P2P network performance to reduce transmission delay in communications between nodes in the network, with an ultimate goal to support business operations that require faster transaction processing.	Financial Technologies

ADS projects completed during the 2017-18 year		
Project	**What is it?**	**Application Focus**
Design Space Exploration based on Virtual Prototypes	This project investigated and delivered design-space exploration based on virtual prototypes by focusing on: • System-level performance specifications and constraints • Design-space exploration algorithms on virtual prototypes • Performance evaluation of prototypes to enable innovative co-simulation technologies for performance-critical embedded systems. Through new research in this area, ASTRI can enrich the foundations for the design of cyber-physical systems, enabling smart factories in the Industry 4.0 era.	Intelligent Manufacturing

…and looking forward

ASTRI is constantly looking to push the boundaries of technology, so here is a list of ADS projects that started or continued in 2017-18 and beyond the year:

ADS projects continued during the 2017-18 year		
Project	**What is it?**	**Application Focus**
Intelligent Video Accelerator (IVA)	This project aims to develop a dedicated hardware accelerator for intense computations of deep neural networks, and handle massive data in various video applications. A topology-mapping micro-architecture is proposed to obtain high performance. A reconfigurable processing pipeline will support various Deep Neural Network (DNN) structures. Training and optimisation tools will be developed to train DNN models with the optimised structure for intelligent video processing applications. All these technologies will be realised and verified on an FPGA platform.	Application Specific Integrated Circuits
Wideband Smart Meter SoC	This is a collaboration project with an industry partner to develop a complete Wideband Smart Meter SoC solution. Key research areas in hardware development will involve design and implementation of Mixed Signal SoC/IP conforming to China wideband PLC standard and smart meter evaluation hardware. The software development will also involve collaboration with the industry partner to develop SoC firmware for control and monitoring.	Smart City
Immersive 3D Video Accelerator	The project aims to develop an Immersive 3D Video Accelerator for stereoscopic 3D generation in virtual reality (VR). This includes novel algorithms, and a world-first ASIC for real-time stereoscopic, panoramic content generation in VR.	Application Specific Integrated Circuits

ADS projects continued during the 2017-18 year

Project	What is it?	Application Focus
Distributed ID Management System	This project aims to develop a distributed identity management system for financial, business, and government applications. Organisations can cooperatively contribute, share, and manage user identity information in an easy and secure manner. Using distributed ledger technology, this project can provide a record sharing system where identity information is permanently stored in distributed locations for greater reliability and accessibility.	Financial Technologies
Dedicated Visual Intelligence Platform	This project will build a dedicated SoC FPGA platform, including hardware accelerator, firmware, and software tools, designed to realise deep learning neural network based visual intelligence devices for video surveillance and monitoring applications.	Application Specific Integrated Circuits
Model-Based Deep Reinforcement Learning Robotic System	The project aims to collaborate with industrial partners to deliver model-based deep reinforcement learning robotic systems with close coordination of sensing and manipulation capabilities. The solution will pave the way for significant upgradation of the next generations of smart factories.	Intelligent Manufacturing

Communications Technologies

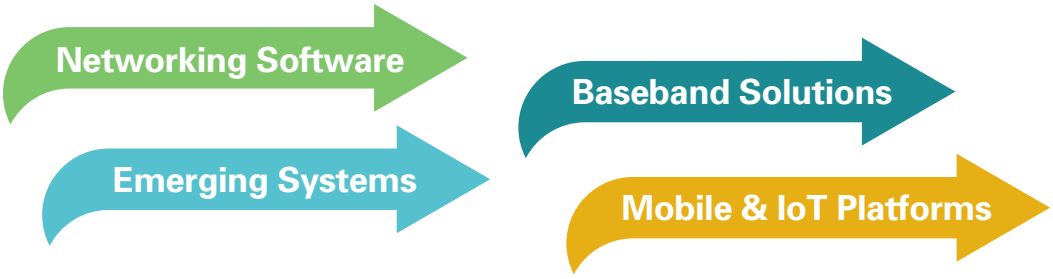
The Communications Technologies (CT) Division strives to research, develop and commercialise leading-edge Information and Communications Technology (ICT) applications, services and solutions for the industry and the community.

The Division works closely with HKSAR Government agencies, industries, universities, and R&D institutions to deliver market-driven and commercial-quality solutions. Its Next Generation Network solutions play a crucial role in the overall Smart City development of Hong Kong.

What does the team do?

The Division's R&D efforts are structured through its Core Competence Groups (CCGs) that focus on developing open broadband wireless network and applications, pre-5G and 5G small-cell infrastructure and solutions and, in the longer term, Next Generation Network (NGN) solutions with new technology infrastructure and platform for wider applications.

The CT Division offers end-to-end system solutions to various players in the ICT industry ecosystem at different levels of the value chain. The Division's four CCGs encompass various areas of specialisation:



What are the Core Competence Groups (CCGs)?

The CT Division is structured into four CCGs to effectively contribute to ASTRI's overall mission. Each CCG specialises in a particular area of technological innovation.

V2X management system is essential for mobility in a smart city.

Networking Software

The Networking Software CCG provides commercial-quality and high-performance networking software that enables customers to build products and solutions for mobile and other communications networks. The CCG has successfully enabled customers in building private 4G networks for vertical applications, such as mass transit railway signalling.

With strong expertise in networking software technologies and in 4G/5G architecture, the CCG spearheads the network evolution and development towards 5G, particularly focusing on Mobile Packet Core, Network Functions Virtualisation (NFV) and cellular Vehicle-to-Everything (V2X) networking system software.

Baseband Solutions

The Baseband Solutions CCG's reference designs are industry-proven and have passed various infrastructure vendors' and operators' inter-operability tests. With strong professional support from this CCG, one of CT's industrial partners has passed a leading operator's tender tests on small cells and terminals – the design ranked first in China Mobile's small cell tendering.

Working with industry partners, the CCG delivered the world's first commercial-grade FDD/TDD dual-mode LTE small cell and TD-LTE terminal baseband core reference designs. It has also enabled the reference design for Broadband Trunking Communications (B-TrunC). Together, these technologies address the demand for high-speed mobile data and higher quality services in both public and private telecommunication networks.

ASTRI leveraged on 5G technology to develop a B-TrunC base-station for mission critical communication.

ASTRI is working on a smart pole solution for connected car applications.

Emerging Systems

The Emerging System CCG develops Software Defined Radio (SDR) platforms and core technologies for 5G cellular systems, increasing spectrum efficiency and reducing both hardware cost and energy consumption. The Group has worked closely with Government bodies and mobile service operators to conduct a feasibility study on the 3.5GHz band as the potential candidate for 5G communications.

The CCG also enhances the existing Device-to-Device (D2D) technologies to develop pre-5G and 5G Vehicle-to-Everything (V2X) solution for connected car applications, enhancing road safety and paving the way for a wider range of Smart City applications.

Mobile and IoT Platforms

The Mobile and IoT Platforms CCG focuses on technologies that tackle the scalability issue of IoT systems in large-scale deployment. These systems need to accommodate vast amounts of network traffic triggered by millions of devices and mobile users, while working cohesively with cloud resources that can scale horizontally instead of vertically. The Group also works on proximity, geographic information and real-time telemetry technologies including positioning, navigation, map rendering, sensors data processing, and smart distributed gateways.

GIS solutions developed by ASTRI facilitate smart navigation service and sharing of real-time parking information.

Major areas of applications

The Communication Technologies division focuses on Networking software, Baseband solutions, 5G and other emerging systems, as well as Mobile and IoT platforms. The solutions are used and adopted across various segments of the telecommunication market, the CT Division's solutions facilitate telecommunication equipment manufacturers, network service providers, SoC developers, and mobile device vendors to deliver state-of-the-art products and services.

The year in focus

The CT Division has made great strides in communications technologies over the past year – delivering market-driven and commercial-grade solutions for businesses and the community. In 2017-18, the division succeeded in conducting Hong Kong's first-ever real case demonstration of Cellular V2X technology i.e. connected cars that can alert drivers and improve city-wide traffic management. The Division is helping Hong Kong to prepare for the next important transition towards 5G by conducting R&D projects on Narrowband Internet-of-Things (NB-IoT), Mobile Network Functions Virtualisation, 5G New Radio MIMO technologies, private network solutions, and next generation small cells.

In line with the latest industry standards and benchmarks such as the 3GPP version 15 standards and Mission Critical Communications, the CT Division has actively partnered with the industry to develop solutions and proposed technological benchmarks. These will facilitate a smooth transition towards 5G. The Division continues to partner with public sector entities such as the Airport Authority Hong Kong and Energising Kowloon East Office, as well as with leading industry players, e.g. Huawei, Foxconn, HPE and Intel, to develop solutions that fully leverage its technical expertise and core competence.

Looking back

The innovative CT projects completed during the 2017-18 year include:

The innovative CT projects completed during the 2017-18 year

Project	What is it?	Application Focus
Core network evolution research for NB-IoT	We researched the necessary interfaces and functional enhancements in the LTE Core Network to support NB-IoT applications and services.	Next Generation Network
Long-haul IoT and location service for Smart City applications	This project designed and realised a scalable architecture for a seamless integrated push notification service which is distance and location-aware. The service could send notifications (e.g. fire alarms) based on the locations of the sensors. The solution will greatly facilitate development of various Smart City applications particularly in the context of Hong Kong.	Smart City
LTE vehicle-to-vehicle (V2V) communications technologies	This project developed algorithms and a simulation platform of LTE V2V sidelink including: 1) synchronising between vehicles both in and out of cellular coverage 2) estimating channels for high-speed vehicles 3) channel sensing and semi-persistent resource selection for vehicles in the case of distributed transmission scheduling. The project has laid foundations for ASTRI's V2X terminal and base station development efforts and will bring significant benefits when the Government rolls out dedicated spectrum and operating standards for V2X service operators.	Next Generation Network
5G New Radio MIMO	This project investigated massive Multiple Input Multiple Output (MIMO) technologies for 5G New Radio (NR) cellular systems. When the Government carries out public sector trial for 5G applications, such as mmWave, this technology will be particularly relevant for the roll-out and implementation various 5G applications in Hong Kong.	Next Generation Network

The innovative CT projects completed during the 2017-18 year		Application Focus
Project	**What is it?**	
High-efficiency RF system	In partnership with a major Mainland-based telecommunication equipment manufacturer, this project developed a high-efficiency Radio Frequency (RF) system that caters to current 4G system as well emerging pre-5G and future 5G networks. The project focused on four major areas to increase the spectral and power efficiency of RF systems: (1) high efficiency power amplifier, (2) closed loop RF system, (3) panel antenna array and (4) Maximum Ratio Combining (MRC). When combined with small cell baseband core, Evolved Packet Core (EPC) and LTE/Legacy 3GPP network/WiFi gateways, this high-efficiency RF system can benefit telecom operators and equipment manufacturers in Hong Kong and the Mainland to a great extent.	Next Generation Network
Network Function Virtualisation for LTE, pre-5G and 5G networks	The project researched, developed and integrated LTE network subsystems (EPC, smallcell gateway, security gateway, WiFi/LTE convergence gateway) in the Virtualised Network Function (VNF) format. The coverage, reliability and performance of this carrier-grade solution has already been commercialised through the revolutionary LTE-powered Communication Based Train Control (CBTC) signalling system implemented at the Wuhan Metro service in Mainland China. This project attracted international industry players to collaborate on deploying the developed technologies in live networks. A joint whitepaper on this VNF solution was published by Intel and ASTRI.	Next Generation Network
Next generation small cells	We developed the next generation small cells reference design, implemented on a commercially available SoC device, including a C-RAN baseband pool with basic L2/L3 protocol stack functions. The design has been the outcome of joint collaboration between ASTRI, a leading global telecom equipment vendor, and two major Mainland-based equipment makers.	Next Generation Network
LTE private network for video delivery	This project included the feasibility trial of an LTE private network at Hong Kong International Airport's (HKIA) selected areas, and to test the performance of video streaming applications. HKIA is one of the largest and busiest aviation hubs in the world. The project aimed to facilitate the enhancement of HKIA's mission critical communication capabilities and promote the commercialisation of ASTRI's LTE small cell product. The solution has practical relevance for other public- sector applications especially in times of accidents, natural disasters, terror attacks, fire hazards etc.	Next Generation Network

…and looking forward

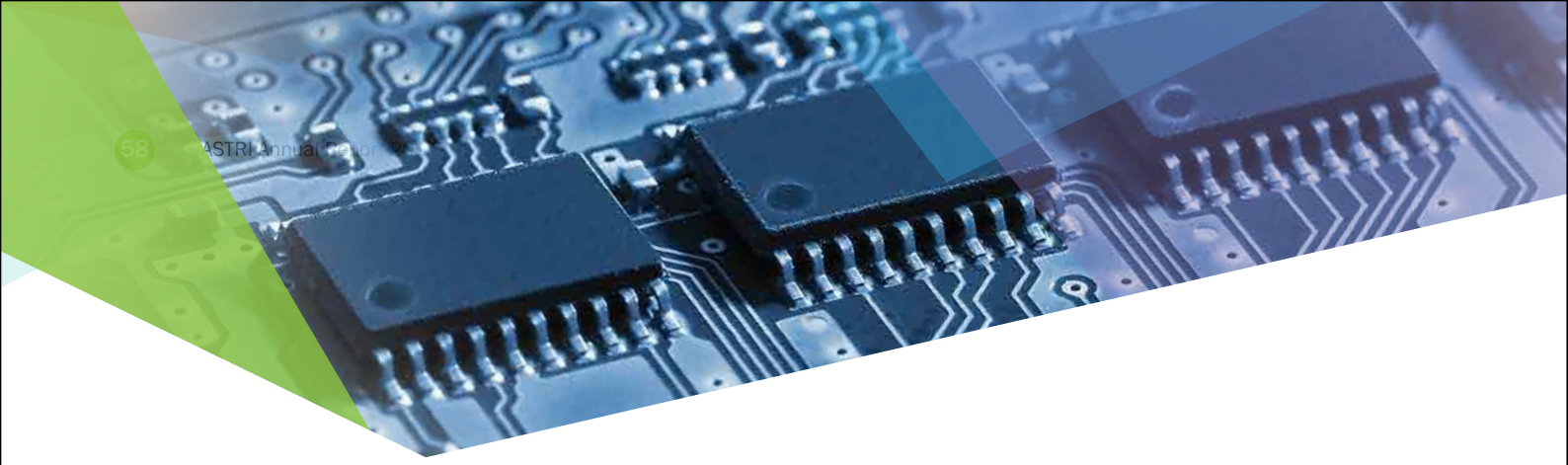
Constantly striving to accelerate the opportunities in the blooming ICT industry, the CT Division has been working on a number of projects going beyond 2017-18:

CT Division has been working on a number of projects going beyond 2017-18

Project	What is it?	Application Focus
Evolution of mission critical and reliable communications	In this seed project, we are addressing the industrial automation control needs by investigating key technologies on 5G NR for Ultra-Reliable Low-Latency Communication (URLLC). Specifically, we are designing key algorithm technologies, including: • Algorithms for the evolution of industrial automation control with URLLC • Algorithms for URLLC receiver optimisation • Algorithms for the integration of URLLC in existing wireless systems	Next Generation Network
Evolution of Connected Vehicle Wireless Technology - study and module design for connected vehicle communications engine	The aim of this project is to drive terminal-level technological innovation by studying the module design of the vehicle communication engine.	Next Generation Network
Smart indoor and outdoor geographic information system	In this project, we will design and realise the scalable architecture for a seamless integrated indoor and outdoor Geographic Information System (GIS). It will be capable of supporting real-time data capturing and monitoring, and also feature algorithms for smart navigation and efficient mesh networks for IoT telemetry data.	Smart City
Next-generation mission-critical communications	This project will develop new mobile cell and terminal technologies to address the new public safety market requirements. The CT team will develop four major features: 1) Mobile cell self-configuration to enable the system setup without network plan and guaranteeing high availability 2) LTE based B-TrunC (Broadband Trunking) base solution (BS) to support one-to-many group call 3) LTE D2D side-link physical layer to enable device-to-device, off-network direct communication 4) Self-contained base station for public safety to allow standalone mobile cell operation with reduced end-to-end delay. As a result, public safety features/requirements can be demonstrated from the reference design developed in this project.	Next Generation Network
Service aware virtualised mobile core network	In this project, we will develop mobile edge computing (a.k.a. multi-access edge computing) to support edge applications and services.	Next Generation Network

CT Division has been working on a number of projects going beyond 2017-18

Project	What is it?	Application Focus
Open 5G innovation platform (5GIP)	The aim of this project is to develop an open 5G platform by integrating ASTRI's and other 3rd parties' 5G LTE technologies. This will provide a configurable real network environment for system development, integration, and verification. 5GIP will also be an innovation platform for small-medium enterprises (SMEs), industry partners, research institutes and universities to take part in the 5G development in Hong Kong.	Next Generation Network
Smart IoT platform for activity tracking	This project will develop a unified cloud/mobile framework and a smart distributed Bluetooth Low Energy (BLE) gateway infrastructure for both individual and group-based activity management. Individual activity will be recorded using lightweight wearable devices, and the smart BLE gateways will scan and discover any devices in the proximity and seamlessly collect and aggregate the activity data to cloud-based scalable servers for further individual and group-based processing such as tracking, monitoring, analysis, recommendation, etc.	Smart City
Next generation ultra-dense networks - procedures and interworking	This project will develop new physical layer procedures for Hong Kong's first next-generation Ultra Dense Network (UDN) reference design based on the 5G architecture.	Next Generation Network
Vehicle-to-everything (V2X) communication systems	This project plans to develop the latest 3GPP standard-compliant V2X base station and user terminal reference design based on commercial SoC platforms, supporting: • V2X control signalling and multicasting • Base station sidelink control signalling • Sidelink physical layer • Sidelink autonomous scheduling	Next Generation Network and Smart City
Next generation ultra-dense networks - PHY core	In this project, we will use new 5G UDN Physical Layer (PHY) technologies to adopt large bandwidth, high modulation and large scale spatial multiplexing. We will implement 5G 3D beamforming technologies to reduce inter-cell interference and increase spectral efficiency.	Next Generation Network
Software defined wide area network (SD-WAN)	The project aims to develop and apply SD-WAN technologies onto 4G/5G network edge. The project aims to use SD-WAN technologies in application development and deployments that utilise 4G/5G networks, mobile edge, and cloud computing.	Next Generation Network



Electronics Components

The Electronics Components (EC) Division is committed to finding market driven solutions for advanced power electronics and smart energy storage technology development. The Division caters to various technology-centric business sectors, including data centres, telecommunications, electric vehicles, charging piles, new energy solutions, high speed trains etc. EC's technologies focus on the power electronics sector, and in particular, on power conversion, power transfer, energy saving and energy storage segments.

EC specialises in innovating and developing 3rd generation semiconductors, including power devices, advanced packaging, and power module related technologies and next generation energy storage systems. The Division seeks to develop leading-edge core competence in advanced value-added power electronics products with significant cost and performance improvement.

What does the team do?

Elevating Hong Kong's research capabilities in electric power and energy applications is EC's core mission. The Division delivers advanced solutions to improve environmental performance and facilitates wider adoption of smart power devices and energy sources for a secure and sustainable future of Hong Kong and beyond.

EC's R&D initiatives encompasses a diverse scope of domains addressing the field of power electronics and energy storage that include:

Power semiconductors

3D packaging and power modules

Wireless power transfer

Next generation energy storage

The Division is forging ahead towards more efficient power applications in smart city applications, such as electric vehicles, autonomous locomotives, data centres, wireless charging, as well as solar and wind energy. It facilitates industries and communities to adopt evolving environmental and regulatory frameworks in Smart City Development to build a greener, people-centric society.

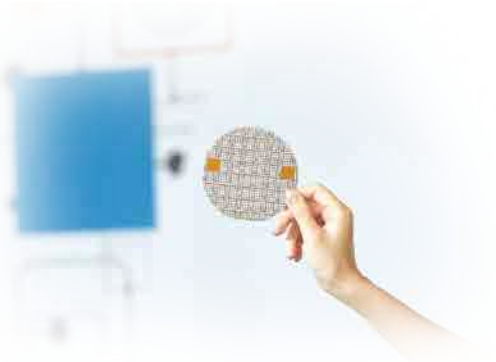
EC's Core Competence Groups (CCGs) develop solutions that significantly improve the performance and cost-efficiency of electronic products. These solutions are useful for many Smart City applications such as electric vehicles and hybrid electric vehicles, data centres, and new energy sources.

What are the core competence groups?

EC's CCGs allow the Division to get the most out of its talented people and teams. The EC Division has three key CCGs. They work together in innovative R&D projects on various technology solutions and industry applications, each specialising in a specific branch of technology.

Power Devices

The Power Devices CCG develops advanced semiconductor power devices and focuses on both wide-bandgap technologies and applications with SiC/GaN devices. The Group provides customised solutions from discrete level device design and fabrication to module testing.



ASTRI develops cost-efficient power devices based on Silicon Carbide (SiC).

3D packaging is one of the advanced techniques ASTRI employed in R&D of integrated power modules.

Packaging

The Packaging CCG provides advanced total solutions for power electronics products, particularly specialising in SiC and GaN based packages, modules and subsystems with significant cost and performance advantages for data centres, 5G applications, electric and hybrid-electric vehicles, charging piles, new energy solutions, and railway-related applications.

Intelligent Devices Energy

The Intelligent Devices Energy CCG develops robust energy storage technologies from materials to module solutions for green and clean environmental applications. The CCG has successfully demonstrated industry fabrication and field test of LIB cell prototypes.

ASTRI's energy storage systems aim to be environment-friendly.

Major areas of applications

The Electronics Components Division endeavours to take a leading position in the 3rd generation semiconductor industry.

Through ASTRI's role as Chair for the international collaboration committee of the China Advanced Semiconductor Industry Innovation Alliance (CASA), and Co-Chair for the China and Packaging & Module subcommittees of the International Technology Roadmap for Wide-bandgap Semiconductors (ITRW), the Division aims to enhance the competitiveness of local industries in Smart City and Industry 4.0 development and related applications within the Greater Bay Area and beyond. This includes:

- Automotive electronics
- Data centres
- New energy
- Railway and mass transit related applications

The year in focus

The Electronics Components Division has used its skills and expertise to help develop many projects during the 2017-18 year.

EC transferred its technologies and products to a number of Hong Kong and Mainland-based companies through collaborative projects and contracts. Through these partnerships, the Division supports partner companies to rapidly realise their commercial products with advanced and innovative technologies. Throughout the year, EC's innovative R&D endeavours involved power devices and system integration for Smart City solutions and various other applications. All these are expected to generate substantial economic returns and social benefits for both local and overseas markets.

Looking back

The Electronics Components Division's R&D pursuits are vital to ASTRI's overall technology strategy and add significant value to the city as well as the wider region, particularly in the areas of Intelligent Manufacturing and Smart City development.

The Electronics Components Division's work in 2017-18

Project	What is it?	Application Focus
GaN-based High Density Power Module for Next Generation Power Conversions (HDPM)	ASTRI successfully developed the Vertically-Driven-GaN (VDG) technology – the first ever 3D power packaging solution in this field to solve the gate driver and interconnect reliability of GaN devices for next generation power conversion applications. Compared to conventional silicon-based power switching technologies, test results showed that, ASTRI's VDG packages dramatically reduced the parasitic inductance by up to 60%, improved thermal performance by 100% and extended the fatigue life of solder joints by 300%. Furthermore, the power density was boosted by at least 200% with a power loss reduction of at least 30% when integrated with ASTRI's VDG packages. These test results clearly showed the effectiveness of the packaging approach innovated by the EC team.	Intelligent Manufacturing
Next-generation SiC Diodes for Power Electronics Applications (NSD)	In this project, ASTRI developed the Silicon Carbide (SiC) power device to replace traditional Silicon power device, delivering a 90% reduction in energy consumption for AC/DC conversion applications and 10 times higher breakdown voltage in high power applications. The SiC device was designed to improve switching loss, switching speed, power density as well as high temperature operation and covered application areas where Si devices cannot be used. ASTRI implemented a short-path technology laser process and an inverted island technology for the Schottky barrier diode fabrication process. The prototype diode samples, with standard and special processes, had a blocking voltage of over 600V, and a forward current from 1A to 15A.	Intelligent Manufacturing

…and looking forward

Pushing the boundaries of technological innovation is an intrinsic driver of ASTRI's endeavours. The Electronics Components Division helps to make it happen. Here are a few of the projects the EC team is currently working on.

The projects the EC team is currently working on

Project	What is it?	Application Focus
Medium-range Wireless Power Transfer Technology for the Smart Home (MWPT)	This project aims to develop a medium-range power transfer solution based on the magnetic resonant coupling theory. It aims to deliver improved efficacy over the existing induction-based WPT technology which has limitations not only in short charging distance, but also in high position alignment and single loading per device. ASTRI's new reference design for a Wireless Power Transfer (WPT) module has a target power transmission performance greater than 33W. It also allows a charging distance longer than 15cm and supports simultaneous charging of multiple devices. It will be built into a wireless power technology platform for a diverse range of electronic products and applications such as wearable electronics, portable devices, smart manufacturing facilities as well as electric vehicles.	Intelligent Manufacturing
Robust Battery Module for Light Electric-drive Vehicles (RBM-LEV)	The background of this project draws from concerns like potential fire hazards and explosion risks caused by self-overheating of Lithium-ion battery cells. In the worst-case scenario, such hazards may lead to serious accidents, damage to properties, or even casualties. A safer and more reliable robust battery module can greatly mitigate these risks – yielding a more consummate and effective solution to protect properties, environment, and human lives. This project aims to develop smart thermal management functions in robust battery modules, with electric conductive enhancers and self-shutdown layer features in respective cells providing an additional and direct safeguard. A custom battery module of 10-24V which contains an assembly of battery cells with the thermal management design will be developed to demonstrate field application results.	Intelligent Manufacturing
Advanced Ceramic Substrate for High Power & High Frequency Applications (ACS)	In this project, ASTRI will design a range of solutions to improve the fabrication process and materials of direct plated copper ceramic substrate for high power applications. It will conquer the challenges of void-free through-hole filling, while meeting the requirements of surface plated thickness, and surface flatness for circuitry formulation. A butterfly-mode plating process is employed for through-hole filling by optimising pulse plating waveform, organic additives, and agitation condition in the hole. A differential etching process is added to enhance the butterfly-mode plating and control the surface plated thickness.	Intelligent Manufacturing

Intelligent Software and Systems

The Intelligent Software & Systems (ISNS) Division has strong core R&D competence in technology areas such as multimedia processing, mobile computing, Internet of Things (IoT), and Artificial Intelligence (AI). Woking closely with industry partners, various public and private sector organisations, and technology developers, the ISNS Division strives to contribute to overall Smart City Development in Hong Kong and this region.

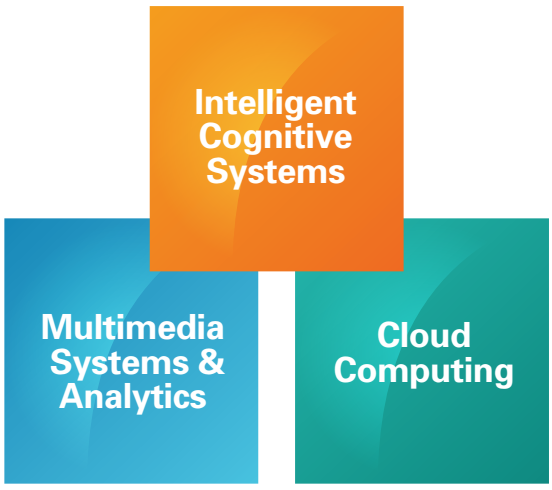
The Division leverages its fundamental R&D competence in actionable intelligence, cognitive reasoning and real-time AI core. It pursues excellence in innovation by focusing on core technologies including devices and sensors data, connectivity and digital ecosystems, cloud computing, machine learning and cognitive computing.

What does the team do?

Over the past decade, ISNS has developed innovative, end-to-end hardware and software solutions that meet the needs of the business sectors. The ISNS Division also responds to emerging technology trends across industries. The Division's sound domain knowledge facilitates the development of relevant systems and applications in areas like FinTech, Smart City, Healthcare, marketing, retailing, e-commerce, infotainment, surveillance, and many more. The Division closely follows industry technology trends and provides innovative end-to-end hardware and software solutions designed to meet the market's practical needs. The talented R&D specialists in ISNS have acquired sound domain knowledge and developed relevant systems and applications, that support innovation-led economic development in Hong Kong, the country, and the wider region.

The Division is also responsible for Cyber Range — Hong Kong's first-ever cybersecurity training and simulation facility, developed in collaboration with Hong Kong Police Force and the financial services industry. The Cyber Range facility provides cybersecurity training to law enforcement agencies as well as the financial services industry. This state-of-the-art facility is equipped with advanced computer systems as well as sophisticated cybersecurity hardware. Its software platform facilitates team-based cyber-attack and defence exercises. It also includes an advanced training management system that facilitates, among other programmes, regular preparatory courses for aspiring professionals in Hong Kong who take the internationally accredited cybersecurity certification test. Besides training, investigations and analysis of cyber-attacks as well as cyber-defence research can also be conducted in the Range.

The Division has three Core Competence Groups (CCGs) that specialise in respective technological domains and application fields.



ASTRI hosts Hong Kong's first Cyber Range facility.

What are the Core Competence Groups?

The three CCGs in ISNS allow the Division to ensure that its talents and teams pursue innovations and developments on particular subject matters that they are most skilled at. ISNS has three CCGs, each specialising in their own niche:

Cloud Computing

Through system development, contract services, and consulting services, the Cloud Computing CCG develops high-performance, large-scale distributed computational cloud platforms. Solutions developed by this CCG support a wide range of applications spanning from media broadcast and digital rights management to FinTech solutions like internet finance and financial trading.

Smart Wealth Management Platform providing algorithm-based portfolio management advice can be an effective tool for financial planning.

Multimedia Systems & Analytics

With focus on the Embedded System and Machine Learning technologies, applications are developed in Health Tech (Medical Image Analysis and Medical Imaging Device Development), Smart City (Virtual Reality/Augmented Reality, Intelligent Video Analysis), and FinTech (Biometric Authentication, Intelligent Character Recognition).

ASTRI developed a smartphone-based authentication technique that uses biometric features to replace passwords or PINs.

Intelligent Cognitive Systems

The Intelligent Cognitive Systems CCG specialises in developing user experience technologies and machine learning, while also providing scalable solutions for smart systems.

Intelligent cognitive systems can develop smart systems for the elderly.

Major areas of applications

The Cloud CCG focuses on smart metering and monitoring systems for utilities, various applications of Blockchain technology, AI-based FinTech solutions, smart wearables etc.

The Multimedia Systems & Analytics CCG has strong competence in Machine Learning and AI-based solutions. The team focuses on intelligent systems and tools in the area of FinTech, Healthcare Technology applications, and other Smart City solutions.

The Intelligent Cognitive Systems CCG focuses on developing machine learning and user experience technologies. The team specialises in handwriting image recognition, 3D motion data analysis, and integration of existing equipments with IoT technology.

The year in focus

The ISNS Division had an extremely prolific year in 2017-18. From a Robo-Advisor that helps make investment decisions to Smart Utility Meters powered by sensors and IoT, vehicles tracking and detection to smart indexing system for smartphones, the Division has developed a plethora of intelligent applications that will benefit the people, communities and industries across this region. Its Blockchain and AI-based applications support the development of FinTech on one hand, its solutions to improve elderly care and medical diagnostics benefit the community on the other.

Looking back

Some of the ISNS projects completed during the 2017-18 year include:

ISNS projects completed during the 2017-18 year

Project	What is it?	Application Focus
Complex Event Computation System and Platform for uncertain data	This data and event processing platform uses dedicated modelling tools to address data related uncertainties. It's an open platform, so academics and the industry can build modules and tools to enhance its functions, conduct quantitative research, collect feedback, and produce innovative products and solutions. The platform has been successfully leveraged to build a smart investment platform. The solution, in addition to analysing data trends, provides features like information security, access control and biometric user authentication, risk management and controls, as well as complex quantitative modelling.	Smart City, Financial Technologies
Smart Portfolio Management System for Robo-Advisor	The Robo-Advisor solution is an online wealth management service that can replace or augment human financial planners by providing automated, algorithm-based portfolio management advice. Its advisory output is based on the client's age, income, family status, financial needs, risk tolerance, risk preference etc. Applying modern portfolio theories, algorithm-generated data models, AI, and the internet platform, it is an efficient and effective tool for the financial services industry. The Robo-Advisor solution leverages behavioural finance, machine learning and optimisation technologies, which are useful for future development of investment and wealth management platforms.	Financial Technologies
Investment Strategies Analysis with Extensive Simulations	This financial strategy analytics platform, developed by ASTRI, supports quantitative algorithms and market modelling. It carries out extensive simulations to evaluate and select investment strategies based on real market data and market modelling. Developed on scalable cloud architecture, this platform can produce classified stock modelling methods and perform quantitative analysis for various trading strategies.	Financial Technologies
Computer Generated Trading Strategies for Smart Investment (CGTS)	This practical system provides highly sophisticated trading strategies and supports in-depth analysis of historical and real-time market data. The solution delivers financial market simulation, smart selection and execution advisory, and computer-generated trading strategies. The project unearthed new dimensions of AI and machine learning related R&D for FinTech development, and paved the way for further collaborations between academia and the business sector.	Financial Technologies

ISNS projects completed during the 2017-18 year

Project	What is it?	Application Focus
Mixed Language Cognition	This interactive platform is powered by Artificial Intelligence and machine learning. It has been designed to answer questions in specific domains of subject matters. This mixed language speech-to-text engine with sentence comprehension (Standard Chinese, Cantonese, Cantonese slangs, and English words) uses information and content from other sources to learn new answers for conversations. This highly intelligent solution, whether processing voice-based input or text-based input, can deliver interactive and intuitive solutions for various Smart City and FinTech applications.	Smart City, Financial Technologies
Cybersecurity Research & Practice Platform for Financial Services	ASTRI developed a cybersecurity training platform in collaboration with the Cyber Security Technology & Crime Bureau of the Hong Kong Police Force. In addition to training cybersecurity professionals in law enforcement agencies and financial institutions, this platform can also be adapted for the education sector. In light of the relatively weak cyber-risk awareness among primary and secondary schools in Hong Kong, the platform can provide useful cybersecurity service to the schools.	Financial Technologies
Medical Image Data Analytics Platform	This project is a co-operation between one of the largest diagnostic service provider chains in Greater China and ASTRI. It aimed to develop a digital pathology image management and analytics platform. The platform uses advanced computation and big data analytics to enable powerful medical image data mining and computer-aided diagnosis. Equipped with a scalable database management system, it's compatible with different slide image formats. Its powerful application development environment delivers simultaneous and fast processing of large volumes of digital pathology images. Using machine learning, evaluation and referencing can be done for patients' diagnosis. The platform carries out cytological analysis of patients' data, supported by a remote diagnostic server and viewer.	Health Technologies
Continuous Latent Multi-modal Authentication for mobile application	This project developed a smartphone-based authentication technique which verifies user identity in an implicit, latent, and continuous fashion. The project's objective was to address security issues for mobile banking. Using face and fingerprint recognition touch context can authenticate smartphone users in a seamless manner, without relying on passwords or PINs. Those factors are then used as user images to generate a trust score - if it falls below the pre-defined threshold, a challenge-response will be prompted to determine whether the user is legitimate or not. This user-friendly and easy-to-implement solution offers an added layer of security across various Smart City and FinTech applications.	Smart City and Financial Technologies

ISNS projects completed during the 2017-18 year

Project	What is it?	Application Focus
Handwritten Chinese Recognition Semantics	This project developed a set of semantic algorithms to improve offline Chinese character recognition systems. Existing recognition rate per character is peaked at around 97%. In order to completely automate form processing, the recognition accuracy must achieve a rate of 100%. Based on the several newly developed technologies for recognising handwritten Chinese characters and form analysis, we developed a new Automated Form Processing System for automating form data entry to suit exactly what the Hong Kong market needs. There are several interesting parties from FinTech and InsurTech sectors willing to discuss about applying the solutions in their companies.	Financial Technologies
Intelligent 3D Data Analysis System	This project focuses on the development of technologies for 3D data analysis, such as human motion data, pressure sensitive pen movement when writing and signing, or generic three-dimensional data. The main areas include machine learning and data analysis for three-dimensional data, classification algorithms for normal and abnormal data, and adaptive learning algorithms to enhance accuracy. In addition, the project includes developing a prototyping system with adaptive learning for demonstrating 3D data processing.	Financial Technologies, Intelligent Manufacturing

…and looking forward

Here are some of the projects they're currently working on, and plan to work on in the future.

The projects they're currently working on, and plan to work on in the future.

Project	What is it?	Application Focus
Smart Behaviour Analytics (SBA) platform	The Smart Behaviour Analytics platform can provide real-time processing, discovery, understanding and analytics to the continuous time-serial data from utility applications. The platform is cloud-based and easy to deploy.	Smart City, Financial Technologies
Smart Wealth Management Platform	The Smart Wealth Management Platform system contains software modules for asset allocation and portfolio optimisation, and to provide an efficient and real-time wealth management platform with excellent user experience and good balance between profit and risk, which has significant competitive advantage in the current market.	Financial Technologies
Cloud-Edge AI Engine for Name Entity Recognition	This Cloud-Edge AI Engine for Smart City applications delivers accurate and secure Name Entry Recognition (NER) solution.	Smart City

The projects they're currently working on, and plan to work on in the future.

Project	What is it?	Application Focus
Automated Dialogue Builder	The process involves collating information from company websites and creating automated decision flows. The built-in intelligence then allows the Chatbot to generate a list of dialogues which can be leveraged to develop virtual assistants like chatbots, or automated customer service systems.	Smart City, Financial Technologies
Data and video analytics on driving behaviour	In light of catastrophic traffic accidents that shocked Hong Kong in the recent past, this technology provides the means for public transportation to improve the service. Through integrated analysis of the operational data of a vehicle as well as the video recording of surrounding scenarios and circumstances, it helps the transportation operator identify high risk drivers for continued professional development. The technology is also meant to help a company with a fleet of vehicles and a team of drivers to manage.	Smart City
Intelligent platform for scheduling and operations for autonomous devices	Routing and scheduling algorithms are installed on Automated Guided Vehicles (AGV) to autonomously navigate them through warehouses or distribution centres. Deep learning is also applied so that the collective performance and safety of hundreds of AGVs can be improved as a whole.	Smart City
Mobile Visual Computing Platform	ASTRI's Head Mount Display (HMD) device works on VR and AR technologies. HMD is a popular device with innovative and advanced functions. The device uses core techniques like sensor fusion, embedded OS optimisation, gesture recognition, and positional tracking. Our multi-user VR environment enables interactive virtual reality experience tailored for various industry segments such as tourism, real state, education, etc. It allows a guide on a tablet to lead multiple users on HMD for an immersive experience of a virtual tour, 360° live streaming and exploring 3D models. The guide could see each HMD user's view on tablet and interact with them.	Smart City
Next Generation Capsule Endoscopy System	Since the early 2000's, capsule endoscopy has been mostly used for small bowel disease diagnosis, due to its unique advantage of passing through the whole small intestine while images are being taken. The demand for capsule endoscopy for other parts of the digestive tract has increased steadily by patients' demand, especially in replacing (at least partially) the unpleasant flexible endoscopy procedures. Among them, stomach capsule endoscopy poses the greatest technical challenge, as active locomotive control is required to manoeuvre the capsule so as to take images in different stomach cavity areas. Compared to the current commercial capsules, our proposed next generation capsule will provide a position tag to each captured image, which allows real-time frame rate adjustment during image capture.	Health Technologies

The projects they're currently working on, and plan to work on in the future.

Project	What is it?	Application Focus
Intelligent Companion for Elderly (ICE)	This project collaborates with different kinds of experts, such as geriatric doctors, social workers and engineers, to develop an intelligent companion for the elderly. This companion enhances their psychological and physiological health through different kinds of sensors and embedded interactive functions. Our goal is to reduce the elderly's medical expenditure and detect most types of old-age diseases at an early stage.	Health Technologies
Intelligent Data Management System (iDMS)	We have developed proof of concept systems by applying machine learning to a Chinese handwriting image. This allows companies to further improve the efficiency of processing a paper document, thanks to incremental Chinese handwriting image recognition. We can now apply human intelligence and human verification results as new training samples for machine learning to improve the accuracy of Chinese handwriting recognition. This platform is scalable and flexible for enterprises with open software development kits and sample source code, allowing them to develop specified applications with fewer resources. Our framework improves on machine learning with knowledge topology, enabling accurate results in different domains.	Smart City
eForm	With smart devices offering strong capabilities and features, the market these days needs a more effective way to collect different data for novices in different sectors. Privacy and security is an important issue in this information world. We will develop a Smart eForms system with end-to-end security support which can be deployed in any public cloud or intranet. New multimedia and sensor capabilities for the Smart eForms Server allow our engine to support multiple devices with an adaptive user interface. With a cross-platform eForms editor and source code generator, non-IT professionals can easily create data collection eForms via a native app to collect more data types, and with better security.	Smart City

Mixed Signal Systems

The Mixed Signal Systems (MSS) Division has a very capable team of talented researchers and designers. The MSS Division employs an effective infrastructure dedicated to realising leading-edge Integrated Circuits (ICs) and related solutions.

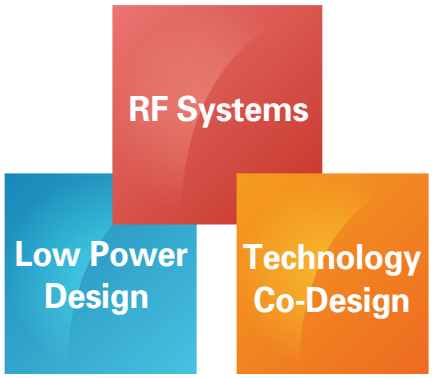
The Division is a major constituent of the first-ever Chinese National Engineering Research Centre (CNERC) branch established outside the Mainland of China. The Branch is operated by ASTRI and focuses on Application Specific Integrated Circuits. The targeted IC applications cover Internet of Things (IoT), wireless communications, and sensor signal processing, among others.

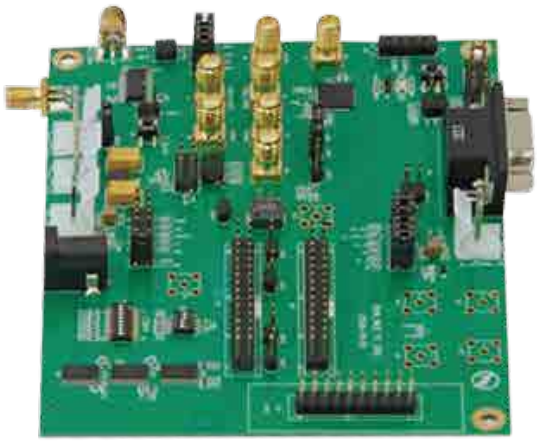
What does the team do?

The MSS Division offers competitive IC Intellectual Property (IP) and practical solutions across various technology areas including: Wireless IoT System-on-Chip (SoC) Design, Ultra Low Power IC Design, Electrostatic Discharge (ESD) and Input/Output (I/O) Design Technology.

What are the core competence groups?

MSS has the following three Core Competence Groups (CCGs). Together they offer end-to-end system solutions. The R&D efforts of the MSS Division focus on these key technology initiatives:





ASTRI's BLE 4.2 solution is delivered to customers for commericalisation.

RF Systems

The RF Systems CCG creates wireless connectivity solutions with state-of-the-art low power integrated circuit design, including Narrowband Internet of Things (NB-IoT) and the latest Bluetooth Low Energy (BLE) technologies. As well as enabling the development of Smart City applications, NB-IoT enables wide area connectivity for personal, industrial and IoT appliances. BLE covers local and personal area connectivity for consumer electronics and IoT applications.

Low Power Design

The Low Power Design Group has developed a full range of silicon-proven IPs for low-power sensor signal processing. These IPs have been widely adopted in various applications such as motion system, wireless electrocardiography, uncooled infrared micro-bolometer and G-sensor.

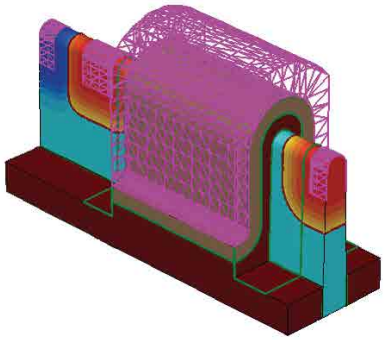
Many of the solutions developed by this CCG have already been licensed to customers for mass production.

ASTRI's Hall sensor ASIC has been delivered to a Hong Kong-based manufacturer for mass production.

Technology Co-Design

The Technology Co-Design CCG focuses on the development of advanced semiconductor devices and modelling. It provides solutions for ESD protection devices, semiconductor sensors and other novel semiconductor devices. Its core competence includes virtual fab technology as well as compact model extraction methodology. These technologies make it possible to virtually develop processes and devices in an optimised, efficient manner. The Group has developed comprehensive IP portfolios for device design and modelling, including area-efficient ESD structure IPs, process independent scalable I/O libraries and BSIM models.

The Technology Co-Design Group collaborates very closely with IC foundries and design houses to develop unique advanced devices and model IPs in Complementary Metal-Oxide-Semiconductor (CMOS) technologies. The group has successfully delivered device and model IPs from 0.5um to 16nm Fin Field Effect Transistor (FinFET) processes.



ASTRI's 16nm FinFET design is adopted by a Chinese IC developer to enhance its design capability and product reliability.

Major areas of applications

Our core competence groups work hard to deliver the solutions MSS offer. MSS provide competitive Intellectual Properties (IPs) and IC solutions in the following key technology areas:

- Wireless IoT System on Chip (SoC) Design
- Ultra-Low Power IC Design for sensor nodes
- Electrostatic Discharge (ESD) and Input/Output (I/O) Design Technology

The year in focus

The Mixed Signal Systems Division focuses on delivering cost-effective solutions for cutting-edge products and applications – enabling companies to offer the most sophisticated devices and interfaces to consumers. The Division, using the mandate of the CNERC Branch, plays its part in developing innovative technologies that benefit enterprises both in Hong Kong and the Mainland. In 2017-18, a number of breakthrough projects were delivered by this team.

Looking back

Some of the projects completed in 2017-18 include:

The projects completed in 2017-18 include

Project	What is it?	Application Focus
Investigation of FinFET ESD design	This project focused on Electrostatic Discharge (ESD) simulation-design methodology. By using Technology Computer Aided Design (TCAD) simulation, Transmission Line Pulse (TLP) curves and ESD capability of Fin Field Effect Transistor (FinFET) structures were explored, and the inside relationship of ESD capability and design parameters were established.	Next Generation Network
RF Transceiver investigation for Bluetooth Low Energy 5	This project investigated a cost-effective Bluetooth Low Energy 5 (BLE 5) RF transceiver with low power consumption and outstanding performance. We focused on the investigation and design of low power transceiver architecture, RF front-end for high output power and no TX/RX switch, Phase Locked Loop (PLL) with direct wideband frequency modulation and asynchronous Successive Approximation This will deliver greater efficiency and a much higher sampling rate.	Smart City, Health Technologies, Financial Technologies

…and looking forward

ASTRI's Mixed Signals Systems Division has some ongoing projects that promise to deliver significant benefits to Smart City development, as well as business and industrial sectors. Here are a few that the team is currently working on:

The team is currently working on

Project	What is it?	Application Focus
Low capacitance ESD structures for RF applications	Thanks to the progress in wireless connectivity and network technology, the working frequency and data transmission rate of various industrial and communication systems have increased to GHz and Gbit. At the same time, concerns around reliability has made ESD/surge protection become an important issue. The major challenges for RF circuit interfaces are ESD-to-Circuit interactions. This project focues on developing on-chip low-capacitance (low-c) ESD structures for RF circuit ESD protection, and developing on-board low-c structure for ESD/surge protection for high speed data lines. The virtual fab approach was presented as the basis of a complete ESD design methodology. The methodology employed Synopsys TCAD as simulation tool. By process design and device parameter optimisation, the low-c ESD structure could be conceived and optimised at the pre-silicon phase. ESD structure and related IO cells were verified in specified process nodes, and customised low capacitance IO Cells could be generated for on-chip ESD protection or on-board high speed ESD/surge protection.	Smart City, Next Generation Network
Advanced Bluetooth Low Energy SoC	This project helps to meet the target performance by developing critical and innovative technologies in RF transceiver, digital baseband, as well as other IPs. The team designed advanced RF transceiver architecture such as direct modulation transmitter and low-IF single conversion receiver with optimised digital baseband algorithms. These were designed to achieve optimal power, cost and performance. Going forward, the project team will develop new features, such as 2Mbps PHY and low energy (LE) long range to double the speed and quadruple the range. There are two tapeouts planned to produce Bluetooth 5 ready BLE SoC with reference design.	Smart City, Health Technologies, Financial Technologies

The team is currently working on

Project	What is it?	Application Focus
System-on-Chip for Narrowband Internet of Things	This project developed a system-on-chip (SoC) supporting Narrowband Internet of Things (NB-IoT) standard for terminal/sensor node applications. The SoC is comprised of an embedded DSP core, RF transceiver, digital baseband and integrated peripherals. The SoC can be licensed to the industry to capture the huge IoT market in future. Several key technologies have been developed including low intermediate frequency (IF) RF receiver, polar RF transmitter, integrated CMOS Power Amplifier (PA), on-chip buck/boost DC-DC converter, high performance synchroniser, and high-performance modulators and demodulators.	Smart City, Health Technologies, Next Generation Network, Intelligent Manufacturing
Dual-mode RF Transceiver for Enhanced eMTC and NB-IoT	This project developed a dual-mode RF transmitter that supports specifications defined in 3GPP Release 14. A novel architecture and design was adopted for on-chip high power high efficiency power amplifier (PA) for low power and low-cost dual-mode operations. The RF transceiver supports wide frequency band and various types of batteries. Several key technologies have been developed, including: low intermediate frequency (IF) receiver, polar transmitter, integrated CMOS PA, embedded power management unit, on-chip RF switch, and integrated digitally controlled crystal oscillator (DCXO). The RF transceiver could be licensed to the industry to help our customers to capture the huge IoT market in future.	Smart City, Health Technologies, Next Generation Network, Intelligent Manufacturing

Opto-electronics

ASTRI's Opto-electronics (OE) Technology Division aims to develop enabling technologies for intelligent manufacturing and smart city applications with its core competence in (i) intelligent industry robots, (ii) 2D / 3D industry visual inspection, (iii) emerging display and sensing, and (iv) environmental sensing.

What does the team do?

OE strives to make a difference to the manufacturing and business sectors in Hong Kong, Greater Bay Area and the wider region by powering smart enterprises with advanced automation and productivity solutions.

What are the Core Competence Groups?

The Division has two Core Competence Groups (CCGs):

Manufacturing Technology (MTECH) | **Modules & Integration (MI)**

Manufacturing Technology

Manufacturing Technologies CCG focuses on vision technology development. It has advanced and miniaturised optical engines, as well as image understanding and deep learning algorithms as the core competence. There are four major key technology platforms within this CCG, (i) Intelligent industry robot – vision & cognition, (ii) 2D/3D intelligent automatic optical inspection (AOI), (iii) Emerging display of AR HMD & HUD, and (iv) Human-machine interaction (HMI) & biometric sensing.

i. The Intelligent Industry Robot team focuses on developing intelligent 2D/3D vision sensing module and recognition & cognition methodology for industrial robots and intelligent manufacturing related applications for realising Industry 4.0 smart factory. In 2017-18, the team continued their R&D efforts in 3D Random Bin Picking technology (3D-RBP) for industrial robot application.

ii. The Machine Vision Inspection team currently focuses more on developing Machine Learning and deep learning based algorithms for defect inspection and classifications. Specifically, the team developed Deep Machine Vision Platform in FY17-18, for various defects inspection on cover glass, lens and wafers. Furthermore, the team has been working with tier-1 manufacturers to adopt ASTRI's novel 2D/3D automatic optical inspection (AOI) system for their production lines to reduce labour cost and enhance product quality as well.

iii. The Emerging Display team focuses on developing emerging display devices for various applications. Riding on the team's core competence established in developing head-mounted display (HMD) in the past, the team further focused in FY17-18 to develop augmented reality (AR) display technologies for automotive Head-Up Display (HUD), covering major technology development in LCoS phase modulation panel design and packaging, and laser holographic projection optics and related algorithms.

iv. The Human-machine interaction and biometric sensing team works out various types of sensing solutions involving gestures, eye movement and biometrics. In FY17-18, the team developed eye area sensing module with EEG sensing for AR/VR applications. In addition, the team has successfully stepped into a new area of the Palm Fusion Biometric Sensing for security applications, which has been adopted by client for commercialisation.

Intelligent 2D/3D vision sensing module and recognition & cognition methodology for industry robot are expected to be widely used in Industry 4.0 smart factories.

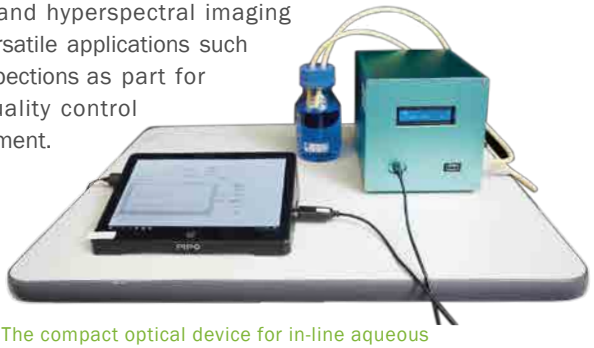
ASTRI's HMD solution is further enhanced by incorporating eye-sensing technology.

Modules & Integration

The Modules & Integration CCG develops integrated optical modules for environmental sensing and manufacturing processes. Riding on the team's expertise in built-in miniaturised spectroscopy-based technology for preventive healthcare applications in the past, the team stepped into new areas in 2017-18 for (i) food safety & quality sensing, (ii) chemical sensing for in-line electroplating process control, and (iii) mobile phone-based spectroscopy.

Obtaining single spectrum for colour and chemical information, the smartphone-based spectrometer can be used to check the quality of food, air, water, and even diamonds.

The team has developed technologies that are going through pilot tests for on-site food safety and quality screening. They are also being trialled for in-line process control for industry IoT sensing in the emerging market. In addition, the team has been exploring multi-sensing approaches for air quality monitoring, and hyperspectral imaging for more versatile applications such as colour inspections as part for industrial quality control and management.



The compact optical device for in-line aqueous monitoring is a pure optical system with no additional chemical agents.

Major areas of applications

The OE Division develops solutions that are relevant across many industries and sector. Its R&D efforts are primarily catering to:

- Defect inspection automation
- Industrial robot
- Wearable display
- Automotives
- AR/VR display
- Food safety & quality sensing
- Electroplating in-line process control

The year in focus

In 2017-18, The Division made meaningful contributions to the industries and markets in Hong Kong, Mainland and the wider region:

- Integration solutions with AI-equipped robot and deep learning-based vision technologies for improved automation: better speed and quality to advance the Hong Kong's as well as the nation's manufacturing industry in line with Industry 4.0
- Product-ready solutions in AR glasses and Biometric sensing areas: for emerging display applications and security applications
- Optical-based sensing technologies: to enable miniature spectrometer solution for in-line chemical sensing in improved food testing and environmentally friendly operations

Looking back

OE's projects completed during the 2017-18 year include:

Completed during the 2017-18 year include

Project	What is it?	Application Focus
Intelligent Visual Inspection Technology	The team developed a system level intelligent in-line surface defect visual inspection platform for variable characteristics surfaces. The project deliverables included: a mixed characteristic surface visual inspection solution, a multiple layers transparent surface visual inspection solution, a curve transparent surface visual inspection solution, and a 'One Glass Solution' (OGS) touch panel glass defect inspection machine. These technologies have been licensed including design services to various industrial partners. With the implementation of ASTRI's intelligent vision inspection technologies, automatic production lines can be widely applied in the future manufacturing industry.	Intelligent Manufacturing

Completed during the 2017-18 year include

Project	What is it?	Application Focus
Smartphone-based mini-spectrometer for healthy living	ASTRI has designed and developed the prototype of a mini-spectrometer integrated to protective smartphone casings. The solution works with interferometer-based spectrograph. The project team also developed a Smartphone-based spectrum acquisition and processing application. Smartphones enhanced with embedded miniature spectrometer module will create a new platform of personal spectroscopy – facilitating healthy living for residents.	Health Technologies, Smart City
Feasibility study on eye area sensing for AR/VR users	This project extracted more useful information from the AR/VR user's eye area. A feasibility study was carried out exploring how to accurately and effectively extract user's concentration and distraction points, emotions, and drowsiness levels through eye area vision based and bio-signal information. Accordingly, a compact portable user status monitoring system was developed which can determine the user's mental and physical status through a combination of vision based and bio-signal information in real time. In future, the project team will seek to integrate the current technology into VR/AR head mount display for better human-machine interactions.	Smart City

…and looking forward

OE continues push the boundaries of innovation, so here are a few of the OE projects that continued in 2017-18 and beyond the year:

The OE projects that continued in 2017-18 and beyond the year

Project	What is it?	Application Focus
Automotive Holographic Head-up-Display (AHHUD)	In this project, OE will develop highly efficient holographic HUD (HHUD) with large field-of-view (FOV) and compact volume for next generation automotive applications. We will use sub-pixelated liquid-crystal-on-silicon (LCoS) phase modulator, which will leverage stabilised multi-domain photo-alignment process, to increase the holographic HUD's FOV. The solution will use reflective total-internal-reflection (R-TIR) type projection engine and waveguide type optical system design to make the holographic HUD smaller and more compact.	Smart City

The OE projects that continued in 2017-18 and beyond the year

Project	What is it?	Application Focus
3D Random Bin Picking Technology for Industrial Robot	This project aims to develop 3D robot cognition technologies to enable random bin picking and flexible assembly. To achieve this goal, the project team will develop IP protected platform technologies, including: (1) robot visual sensing technology by designing 3D data acquisition device and (2) robot recognition technology by designing 3D object recognition algorithm.	Intelligent Manufacturing
Compact Optical Module for Food Safety & Quality Screening	The standards and market expectations on food safety and quality are getting increasingly stricter. While this forces manufacturers to deliver better quality and still maintain their profitability, there is also a lack of effective technologies to ensure fully reliable food quality and safety standards to the consumers. A compact food sensor is being developed by the OE Division for onsite screening and food processing control. It uses Raman spectroscopy to effectively determine chemical fingerprints of the sample with zero or minimal pre-treatment. The project aims to design and develop a portable Raman sensing system for food safety and quality that can match regulatory requirements and meet consumer expectations, making quality control for hazardous matters like pesticides and residue more reliable.	Intelligent Manufacturing, Health Technologies
On-chip spectrometer for chemical sensing	Compact and low-cost optical sensor for multi-chemicals detection by optical spectroscopy is desirable for many applications such as environmental and physiological IoT sensors. This smart health project will develop an on-chip spectrometer for chemical sensing with CMOS compatible technology. OE will develop a planar optical waveguide based micro-spectrometer in a range of 1150-1550 nm and study its feasibility for chemical sensing applications.	Intelligent Manufacturing

The OE projects that continued in 2017-18 and beyond the year

Project	What is it?	Application Focus
Deep Machine Vision Platform	This project leverages deep machine vision platform technologies to empower vision applications for defect inspection. The project team aims for the following IP protected platform technologies to tap the market requirement: (1) rapid vision application development technologies for vision measurement software; (2) deep learning defect detection technologies which discover the defect detection rules from a set of vision training data, rather than manually designed by the vision engineers; (3) deep learning based defect classification technologies for advanced defect analysis; (4) 2.5D/3D glass inspection illumination and capture technologies. The proposed technologies can be widely used in different manufacturing industries such as consumer electronics and semi-conductors.	Intelligent Manufacturing, Smart City
Diffractive & Holographic Optics for See Through AR Display	In the era of Internet of Thing (IoT), large FOV AR see-through display devices such as head-up-display (HUD) and head-mounted-display (HMD) make it possible for the human to communicate with the world in a way completely different from before. In addition to the connected devices, the new communication method highly depends on the information layer generated by display network and will create immerging demand on large FOV AR display. To achieve the project objectives, OE will develop patented platform technologies including real-time noise depressed CGH algorithm, multi-layer Diffractive Optical Element (DOE), and hybrid functions HOE w/notch filter and lens. These technologies can be widely applied in both AR and VR displays across various industries, such as automotive, aviation, education, household products, navigation, and media.	Intelligent Manufacturing

Security and Data Sciences

Security and Data Sciences (SNDS) Division drives its R&D and innovation through three Core Competence Groups (CCGs). Partnering with the financial services industry, the team excels in information security and data analytics, FinTech applications including Blockchain, advanced information systems, consultancy and assessment. It also nurtures future talents. It has a specific mandate to help cement Hong Kong's position as a premier, global FinTech hub.

What does the team do?

The SNDS Division acts as a prolific platform for talented practitioners committed to boosting Hong Kong's credentials in data analytics, cybersecurity and other FinTech solutions, including Blockchain. It is made up of some of the brightest FinTech and data sciences professionals in the region.

The three core teams under SNDS are:

ASTRI Security Lab (ASL)

Cybersecurity & Analytics (CSA)

Data Analytics (DATA)

What are the core competence groups?

The Division drives its R&D and innovation through three CCGs. In addition to partnering with the financial services industry, the SNDS team excels in information security and data analytics, and in FinTech applications such as Blockchain, advanced information systems, consultancy and assessment to various sectors, and nurturing future talents.

ASTRI Security Lab (ASL)

ASL provides in-depth assessments for cyber-threats as well as consultancy and review if a threat is detected. ASL is also developing a cybersecurity information sharing platform. The Lab is made up of professionals who build up cybersecurity research and training systems, and develop advanced cloud security, encryption and authentication technologies. The team has expertise in building Blockchain applications on major platforms like Bitcoin, Monax, Corda, Ethereum and Hyperledger. The Lab also seeks to enhance the Blockchain consensus algorithm and network security.

ASL facilitates training and certification of cybersecurity professionals.

Cybersecurity & Analytics (CSA)

Cyber-threat hunting and analysis are largely done manually by well-trained security professionals such as members of the ASL team. However, nowadays, security professionals are overwhelmed by the increasing volume and sophistication of cyber-attacks. In light of this, the CSA team focuses on helping the industry by applying big data analytics, machine learning and Artificial Intelligence in the field of cybersecurity. CSA and ASL strives to bring humans and machines together in combating cyber-threats.

ASTRI's partnership with different players through CISP ensures timely sharing of cybersecurity threat intelligence.

Data Analytics (DATA)

The team specialises in building innovative technologies and advanced solutions to help customers gain insights from big data for better decision making. We are developing technologies throughout the whole data lifecycle which includes: data acquisition, data storage and management, data analytics and data presentation. The team uses machine learning, deep learning and artificial intelligence technologies to deliver various big data analytics solutions especially in the areas of FinTech, InsurTech, RegTech and Intelligent manufacturing.

The Real Time IoT Data Analytics Platform facilitates machine status monitoring, root cause analysis and predictive maintenance.

Major areas of applications

The SNDS Division concentrates on developing data-driven and security-enabling applications, insights and solutions for various industries with particular focus on the financial services sector. Its cybersecurity and data analytics expertise are applied across a wide variety sectors and industries including retail, logistics, law enforcement, public services for residents and telecommunications, among others.

The year in focus

The SNDS Division have leveraged its collective skills and expertise to help develop many projects during the 2017-18 year. With more innovations currently in the pipeline, the future looks bright for ASTRI's R&D efforts. The Division took on a number of cybersecurity initiatives throughout the year by partnering with industry players and regulators. As a partner in the Hong Kong Monetary Authority's (HKMA) Cybersecurity Fortification Initiative (CFI), ASTRI enables industry-wide information and intelligence sharing through the Cyber Intelligence Sharing Platform (CISP), and facilitates training and certification of cybersecurity professionals.

The Division's Data Analytics CCG has built some big data analytics solutions and platforms for different industries and organisations. The team has developed solutions for automated risk identification from online news media using deep learning technology, partnering with one of the largest global banks. The team has also built an end-to-end real-time data analytics platform for a large manufacturer. Powered by Artificial Intelligence, the platform promotes next generation data-driven manufacturing to drive efficient and responsive production systems.

SNDS has pursued significant application development and insights in Blockchain-based solutions, and also delivered platform technologies where big data analytics and machine learning algorithms are combined for automated security threat analytics.

Looking back

Some of the projects completed during the 2017-18 year include:

The projects completed during the 2017-18 year include:		
Project	**What is it?**	**Application Focus**
Fine-grained access control technique for Distributed Ledger Technology (DLT)	This project provided an innovative access control solution to empower the emerging Distributed Ledger Technology (DLT) and paved the way to a production-grade DLT system.	Financial Technologies
ThreatRadar - Search engine, crawler for company profiling on related threat intelligence	This project provided the latest intelligence to alert companies that have already been hacked or have high potential to be hacked. This was designed to help prevent attacks from malicious hackers around the world.	Financial Technologies
Text-mining Tools - with Natural Language Process (NLP) for security-related topics	This project aimed to develop a text-mining tool with trained parameters specified on security domain. Text mining tools make it easy to collect daily security information around the world.	Financial Technologies
Apply graph analytics for fintech solutions	The project investigated data analytics technologies, especially the graph analytics to provide 'real-time intelligence service' for FinTech applications. It initially focused on bitcoin transaction analysis for centrality analysis of the network, fraud detection and risk assessment for transactions.	Financial Technologies
Secure computation for FinTech applications on the cloud	This project aimed to address the growing trends and needs of safeguarding sensitive corporate data deployed in hybrid cloud — one that is both private and open.	Financial Technologies
Distributed Ledger / Blockchain technologies empowered medical claims	This project aimed to develop a shared medical claim platform powered by Blockchain / Distributed Ledger Technologies (DLT) for the customer and its insurance company alliance. The underlying R&D works involved: a DLT-based platform design, architecture, and implementation; smart contract for storing and acquiring medical claim data.	Financial Technologies
Distributed Ledger Technology (DLT) empowered import invoice financing system	This project leveraged Blockchain technology to build a standalone Trade Finance system for Bank of China (Hong Kong). The solution will be applied to the Bank's Import Invoice Financing process.	Financial Technologies
Enhancement for the Bank of China (Hong Kong) property valuation Blockchain system	The project helped to enhance Bank of China (Hong Kong)'s property valuation Blockchain system in the areas of data encryption and peer authentication.	Financial Technologies
HSBC China mobile banking — multiple factor authentication	The project conducted an investigation on security, software modules, architecture and scope endpoints for the HSBC China mobile banking app.	Financial Technologies

The projects completed during the 2017-18 year include:		
Project	**What is it?**	**Application Focus**
Proof-of-concept (PoC) of Over-the-counter (OTC) derivative transaction analysis system	The project aimed to develop a system for OTC transactions data analysis, to help regulators easily grasp the hidden information inside large amount of data.	Financial Technologies
Corporate news analysis for risk management	Partnering with one of the largest global banks, the project explores using machine learning based predictive model to identify risk-related news for banks and other financial institutions. This helps them to have a standardised way for risk evaluation. And the predictive model can also automate the news monitoring process to save time and human effort, and enable large-scale news monitoring from many different sources.	Financial Technologies

…and looking forward

The Security and Data Sciences Division is working on some cutting-edge projects that will help secure ASTRI's reputation as one of Hong Kong's most pioneering FinTech innovators. These are a few of the most prominent projects that are currently underway:

The projects completed during the 2017-18 year include:		
Project	**What is it?**	**Application Focus**
Security analytics platform for the financial industry	This project aims to develop the Security Analytics Platform for the financial industry. The platform establishes a set of security metrics, covering both externally observable security evidences and internally collected logs and events, to formulate the corporate cybersecurity level.	Financial Technologies
Cyber-Security Assessment System for Financial and Securities Institutes	The sharing platform can help upgrade the cybersecurity information and intelligence sharing system of the entire industry. By centralising the information, the platform helps every participating organisation to get the latest information on cyber-threats so that the industry players can respond and protect their systems in a fast, agile and effective manner.	Financial Technologies
Real Time IoT Data Analytics Platform for Industry Manufacturing	The project aims to increase manufacturing productivity and efficiency through engineering automation and intelligence enablement by leveraging machine learning and data mining techniques. The platform allows users do real time monitoring of devices status and carry out different analytics such as anomaly detection and root cause analysis which would help engineers to find out issues more efficiently or cannot be identified manually or with limited rule definition.	Intelligent Manufacturing

Engaging with the community

ASTRI is a pioneer in promoting Innovation and Technology in Hong Kong and across the Greater Bay Region. In 2017-18, we continued investing time and resources to share our knowledge and insights with the community, and proudly supported the Hong Kong SAR Government's vision for a smart future.

Throughout the year, we worked with public and private sector organisations, students and teachers from academic institutions, social service organisations, community campaigns and many other I&T organisations.

ASTRI's R&D professionals and senior leaders regularly attended seminars, workshops, training programmes and other thought leadership forums to discuss the latest developments and technology trends in this region.

By participating in many of these forums in 2017-18 – over 60 events in Hong Kong, the Mainland and abroad – ASTRI played its part to realise the HKSAR Government's I&T development strategy.

ASTRIANs

ASTRIANs are the current and former members of ASTRI who contribute to the advancement of I&T either from within the organisation or outside it. The ASTRIAN initiative focuses particularly on bridging ASTRI and its current team with the alumni members – seeking to enhance the bond and the connections and reinforcing the shared ASTRIAN identity based on a deep sense of belonging.

In 2017-18, an active effort started to formalise the engagement within the ASTRIAN community through periodic interactions and regular exchanges, to maximise the support ASTRI can offer to its past and present team members. Similarly, the professional and technological prowess of ASTRIAN members will be leveraged by reaching out to the technology industry and the tech start-up community. In the coming months, the ASTRIAN platform will be used to pursue an active 'Tech-novation' initiative – a technology incubation and partnership hub that ASTRIANs can access and benefit from. The theme of our ASTRIAN initiative will be: "Technovate Hong Kong, Technovate the Future".

Visits

ASTRI welcomed over 160 visiting groups throughout the year, giving them the opportunity to discover more about our various projects and initiatives. The delegations mainly came from four different groups: government officials, academic institutions, businesses and technology developers. The visitors were not only from Hong Kong but also from the Mainland and other international territories. Among the visiting delegations, 55% of visitors came from organisations in Hong Kong, 32% from the Mainland, 6% from Asian countries and 7% from the rest of the world.

Senior Government officials included visitors from the HKSAR Government's Constitutional and Mainland Affairs Bureau, Registration and Electoral Office, Financial Services and Treasury Bureau, Information Services Department, Water Supplies Department of Hong Kong, and Urban Renewal Authority of Hong Kong.

Academics and scholars included Professor Tsui Lap-chee – Founding President from the Academy of Sciences Hong Kong, as well as Mr Tony Chan – President of the Hong Kong University of Science and Technology, and Professor Joseph Sung – former President of the Chinese University of Hong Kong.

Business delegations included HSBC, ICBC Asia, Manulife, Infineon China, AXA and Alibaba Cloud.

Smart City partners included delegations from the Airport Authority of Hong Kong, CLP, HKT Limited, and China Mobile who visited ASTRI during the year.

Visitors from the Mainland and Macau included:

- The Chinese Academy of Engineering
- APEC Policy Partnership on Science, Technology and Innovation (PPSTI) China, led by Vice Chairman Mr Chen Lin-hao
- Guangzhou Association for Science and Technology, led by Vice Chairperson Ms Chen Shuang
- Macau Pass SARL, led by Chairman Mr Liu Hei-wan
- Guangdong Provincial Department of Science and Technology, led by Deputy Director General Mr Yang Jun
- Science, Technology and Innovation Commission of Shenzhen Municipality
- Commission of Legislative Affairs, Standing Committee of Shenzhen Municipal People's Congress
- Zhuhai Municipal Hi-Tech Zone

Other visiting delegations including those representing international organisations included:

- Australian Government delegation, led by Mr Peter Runice – Business Leader of Data61/CSIRO and Ms Wendy Haydon – Australia's Trade and Investment Commissioner for Hong Kong
- A delegation from The Eisenhower School of the US National Defence University
- A team from Technopark Zurich, led by Mr Matthias Hölling – Team Leader of Foundation Affairs
- A team from the Government Housing Bank of Thailand
- A delegation from European 5G R&D institution I2Cat
- Members of Spanish-Portuguese R&D institution INL
- Dr Frédéric Bretar, Consul General of France in Hong Kong
- A team of senior scholars from the Royal Swedish Academy of Sciences

Other groups came from various government and statutory organisations, public sector and utility services companies, diplomatic missions, academic institutions, inter-governmental and industry associations and charities.

Investing in the next generation

ASTRI is committed to helping the younger generations to better appreciate the infinite potential of technology in improving economies and lives. One of our many initiatives to engage and inspire the youth during 2017-18 was the Inter-Tertiary Institution Capture the Flag Contest, organised in partnership with iChunQiu.com for students from 14 different academic institutions in Hong Kong and Macau. 317 students forming 96 teams took part in the contest.

ASTRI is co-organising the second edition of the FinTech Career Accelerator Scheme jointly with the Hong Kong Monetary Authority, Hong Kong Science Park and Cyberport. The programme aims to nurture the next generation of FinTech talent in Hong Kong, and is supported by all major banks and universities operating in the city.

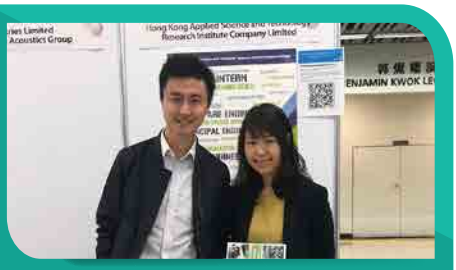
ASTRI welcomed various groups of students from primary schools to universities, predominantly from Hong Kong-based universities but also from the Mainland and other parts of the world. Our R&D and technological collaboration efforts were greatly supported by these exchanges with teachers, researchers and students from educational institutions, allowing us to bridge a connection between academia and the industry.

Engaging with Chinese University of Hong Kong students

ASTRI at the Chinese University of Hong Kong Career Fair

ASTRI at the University of Hong Kong Career Fair

Engaging with Hong Kong Polytechnic University students



ASTRI at the City University of Hong Kong Career Fair

Graduates of ATSRI's 2017 Summer Internship programme

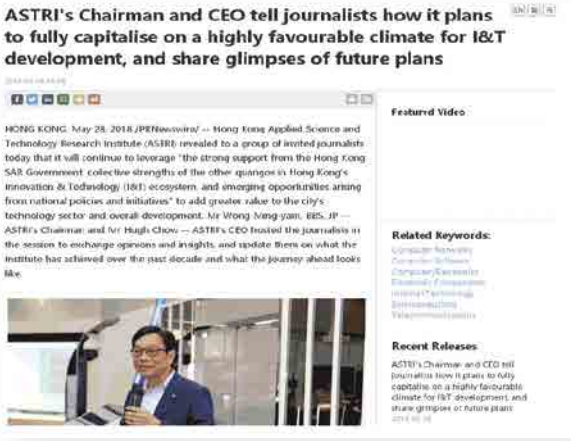
ASTRI at Hong Kong Science Park Career Expo

ASTRI in the media

ASTRI is committed to helping Hong Kong transform into a global Smart City as well as an international innovation hub. Our efforts to this end have been recognised by local, regional and international media throughout 2017-18.

Altogether, 19 ASTRI news releases were published during the year, with around half of them announcing major breakthroughs or innovative technologies. We have been featured in many major online, print and electronic news media stories, including South China Morning Post, China Daily, Ming Pao, Sing Tao, Metro Daily, Computerworld HK and Standard. Our R&D professionals were quoted in multiple media articles, and several of our senior leaders were interviewed for different publications.

The main highlight of our 2017-18's media presence was the extensive coverage of ASTRI's role in advancing I&T in Hong Kong. Media outlets also approached ASTRI for our opinion on the latest technological developments in and beyond the city.


ASTRI's Chairman and CEO tell journalists how it plans to fully capitalise on a highly favourable climate for I&T development, and share glimpses of future plans

HONG KONG, May 28, 2018 /PRNewswire/ -- Hong Kong Applied Science and Technology Research Institute (ASTRI) revealed to a group of invited journalists today that it will continue to leverage "the strong support from the Hong Kong SAR Government, collective strengths of the other quangos in Hong Kong's innovation & technology (I&T) ecosystem, and emerging opportunities arising from national policies and initiatives" to add greater value to the city's technology sector and overall development. Mr Wong Ming-yam, BBS, JP — ASTRI's Chairman and Mr Hugh Chow — ASTRI's CEO treated the journalists in the session to exchange opinions and insights, and update them on what the institute has achieved over the past decade and what the journey ahead looks like.

Featured Video

Related Keywords:

Recent Releases

ASTRI's Chairman and CEO tell journalists how it plans to fully capitalise on a highly favourable climate for I&T development, and share glimpses of future plans

ASTRI's **Industry-University Collaboration Forum 2017** event received extensive coverage in the news. At the event, more than 27 industry experts and leaders delivered inspiring speeches.

We have seen very strong media coverage of the grand finale of the **Inter-Tertiary-Institution Capture the Flag (CTF) Contest 2017**. Organised by ASTRI and iChunQiu.com, the contest was the first of its kind in Hong Kong and Macau.

ASTRI took part in many other talent and technology promotion campaigns, industry exhibitions, expos and similar events throughout the year. Among these, ASTRI took part in two editions of the Mobile World Congress (MWC). Other major exhibitions where ASTRI showcased its latest innovations included InnoCarnival 2017, FinTech Career Accelerator Scheme, Hong Kong FinTech Week, Intelligent Transportation System (ITS) Asia-Pacific Forum 2017, 'Smart City and the IoT Era' Industry Summit, HSBC Safeguard Mobile App Contest, and Symposium on Innovation and Technology organised by Hong Kong Trade Development Council.

Throughout the year, ASTRI was in the news for its collaboration and partnership efforts with various organisations. Most notable among these partnerships were those with Hong Kong Monetary Authority, Zhonke Laifang Energy Technology (HK) Limited, TransUnion, Beijing Institute of Collaborative Innovation (BICI), the Hong Kong University of Science and Technology, HKT, ICBC Asia, the University of Macau, Thompson Reuters, Changhong (HK) Limited, Redhat, Huawei, I2Cat, and INL. Many of these partnerships were covered by the media.

ASTRI in the social media

ASTRI maintains an active and lively presence in various social media channels. Through our presence in the digital space, we stay in touch with the people of Hong Kong, the Mainland and other parts of the world. As well as posting regular news stories on our corporate website, we remain active on our official Facebook, LinkedIn, WeChat and YouTube channels too.

As of 31 March 2018, ASTRI's Facebook channel has over 7,000 subscribers. With many representing students and the youth of Hong Kong, the channel is an important way to communicate and connect with the young generation of Hong Kong, other groups, and people from around the world. ASTRI posts bi-lingual content on its Facebook channel in Traditional Chinese and English.

ASTRI's presence on LinkedIn uses the English language while our WeChat channel presents content in Simplified Chinese. The content in our LinkedIn channel appeals to experts, professionals and graduates. WeChat helps ASTRI to communicate its updates to the audience in the Mainland and across Greater China.

Key statistics covering period 1 April 2017 – 31 March 2018

7,068 followers
106 Posts

3,806 followers
39 Posts

684 followers
136 Posts

Some of the most popular Facebook posts from the year included:

What does it mean to be ranked the world's most competitive economy? Especially, if that economy is also one of the most important global financial hubs? How can Hong Kong marry its global competitiveness and financial service leadership with the latest advancements in technology? In this recent article produced in partnership with ASTRI, SCMP tries to answer some of these questions.

Around 70 enthusiastic students took part in the 'First-Round Completion' ceremony of the first-ever Inter-Tertiary Institute Capture the Flag (CTF) contest in Hong Kong/Macau. The event took place at the ASTRI premises on 28 April. The students not only celebrated their successes and enjoyed the sunny afternoon's funny Photosession – they also expressed their interest in cybersecurity topics.

Groove with ASTRI @Innocarnival 2017: Visit us today! Innocarnival 2017 is taking place right now till 29 October in Hong Kong Science Park. Tens of hundreds of exciting events, activities and forums make the Carnival the coolest place to be in Hong Kong right now. Do visit ASTRI's pavilion [#B16] to learn about the latest developments in FinTech, Smart City, Industry 4.0 and Next Generation Network. You can also challenge yourself with exciting interactive games to win some nice gifts. We are very glad that some honourable guests came to ASTRI booth on the opening day: Mr Nicholas W Yang, GBS, JP, Secretary for Innovation and Technology of HKSAR Government; Ms Annie Choi, JP, Commissioner of Innovation and Technology, Mr Liu Zhi Ming, Associate Counsel of the Central Government's Liaison Office in HKSAR; as well as Ir Dr the Hon Lo Wai Kwok, SBS, JP and the Hon Charles Mok, JP.

When one of the leading newspapers in Hong Kong provides young students with an exposure to news-hunting and storytelling, and complements that with an opportunity to learn about latest technological developments in the city, the outcome can be quite captivating. That's exactly what happened when some 12 student-reporters from Ming Pao Daily visited ASTRI recently. The visitors spent a few hours visiting various R&D labs and facilities within ASTRI's premises and chatting with Dr Justin Chuang – ASTRI's Vice President for Next Generation Network.

Dr Chuang shared about ASTRI's technology vision, the potential of the tech-industry in Hong Kong, the city's ability to attract global talent and investors, and building the next generation of technology leaders for Hong Kong. He explained to the student reporters why "Hong Kong continues to be Asia's world city with lots to offer and lot more to achieve."

Showcasing technological innovation, inspiring Hong Kong's youth to embrace the power of STEM, and tech-ecosystem players coming together for a grand show – that's how the "MakeIT Hong Kong: 3-2-1 Go!" event in Science Park unfolded on 21 March 2018. ASTRI took part in the event with three ground-breaking innovations on display. One of them – a health technologies R&D project – is an intelligent tool that can 'read' medical images and help doctors make faster, more accurate diagnosis. The innovation – ASTRI's Medical Image Analytics Platform – combines the power of big data, image analytics and artificial intelligence to facilitate diagnosis of various ailments like cervical cancer. ASTRI's Smart Pole project was also showcased in the event – an amazing innovation that acts as a communication hotspot, facilitates 5G and IoT services, and helps with environmental tracking as well as smart traffic management. In addition, the event's visitors also witnessed ASTRI's R&D on smart mobility and Vehicle-to-Everything (V2X) communications.

ASTRI's Smart Water IoT System has received yet another global recognition – this time from World Information Technology and Services Alliances (WITSA). The innovative smart city solution, which has the potential to revolutionise the way water supply is monitored, measured and analysed, won a Merit Award at the WITSA Global ICT Excellence Awards 2018. The award presentation ceremony took place on 19 February 2018 in Hyderabad, the international ICT hub of India.

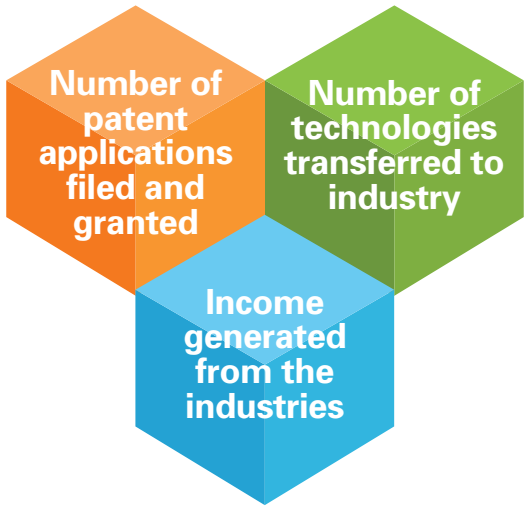
ASTRI's Smart Water IoT System won a series of local, regional and international accolades in the past. The impressive list includes: Best Business Solution (Application) Bronze Award in the Hong Kong ICT Awards 2017 and Merit Award in the Industrial Application category of the Asia Pacific ICT Alliance Awards 2017 (APICTA).

From diamonds and luxury retail to insurance and banking, Blockchain applications offer tremendous benefits across different industries. ASTRI hosted a panel discussion on 'Cutting Edge Blockchain Applications' on the opening day of the Hong Kong FinTech Week 2017. Dr MeiKei Ieong, ASTRI's Chief Technology Officer moderated the discussion. The panel included: Pritesh Patel – SVP and Chief Operating Officer of Gemological Institute of America; Jade Lee – Deputy General Manager or Chow Tai Fook; Harry Wong – Governing Committee Member and Chairman FinTech Taskforce of The Hong Kong Federation of Insurers; and Zhi Yong-wang – Head of Product Development and Management of ICBC Asia. Representing different segments of the ecosystem, the panellists discussed huge opportunities and dynamic challenges facing firms rolling out Blockchain applications.

Performance

As a publicly-funded applied research institution, ASTRI is committed to leveraging the power of science and technology to benefit communities and strengthen businesses. The success of ASTRI's efforts is measured by the scale of its innovation, the economic impact of its solutions and the tangible improvements brought to people's lives. To generate tangible and meaningful impact, ASTRI focuses on commercialising its technologies — addressing the specific needs of its customers and also the community.

Striving for success in its endeavour and aiming for excellence, ASTRI uses three major quantitative benchmarks to measure its performance on an annual basis:



Patents

Patents are important assets for ASTRI because they represent the originality and value of our innovation, and serve as a foundation for technology transfers to the industry. In 2017-18, 64 patents have been filed in the US, Mainland China, and other territories.

Number of patents filed			
Technology Division	2017-18	2016-17	2015-16
Advanced Digital Systems	4	8	0
Communications Technologies	16	10	15
Electronics Components	11	14	8
Intelligent Software and Systems	9	11	2
Mixed Signal Systems IC	8	6	15
Opto-electronics	16	11	12
Security and Data Sciences	0	0	4
Total	64	60	56

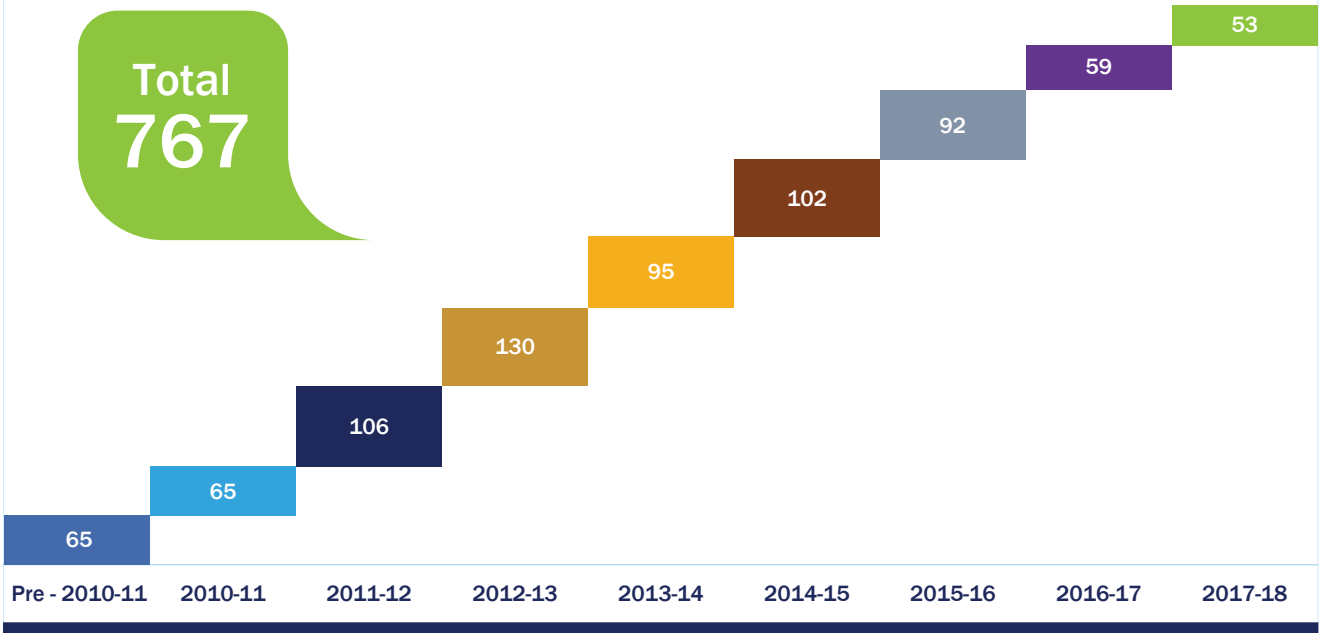
Number of patents granted

Technology Division	2017-18	2016-17	2015-16
Advanced Digital Systems	1	4	6
Communications Technologies	10	7	12
Electronics Components	8	7	15
Intelligent Software and Systems	4	4	14
Mixed Signal Systems IC	13	9	10
Opto-electronics	13	26	31
Security and Data Sciences	4	2	4
Total	53	59	92

Number of patents granted by territory

Territory	2017-18	2016-17	2015-16
US	26	33	41
Mainland China	27	25	46
Others	0	1	5
Total	53	59	92

Patents granted to ASTRI since its inception



Technology transfers

One of ASTRI's most important missions is to commercialise cost-effective, market-compatible and innovative technologies by transferring them to the industries. Technology transfers can be done through technology licensing, contract services, Industry Collaborative Project (ICP) and other legal arrangements.

Number of technology transfers by Technology Division

Technology Division	2017-18	2016-17	2015-16
Advanced Digital Systems	9	9	4
Communications Technologies	18	11	8
Electronics Components	7	7	6
Intelligent Software and Systems	20	9	7
Mixed Signal Systems IC	5	2	7
Opto-electronics	8	11	5
Security and Data Sciences	5	11	16
Total	72	60	53

Number of technology transfers by channel

Channel	2017-18	2016-17	2015-16
Industry Collaborative Projects	3	4	5
Contract Research	43	31	31
Licensing Agreements	26	25	17
Total	72	60	53

Certain licensing agreements consist of contract research services provided by ASTRI.

Number of projects undertaken by project type

Technology Division	2017-18	2016-17	2015-16
Platform Projects	52	44	49
Seed Projects	44	44	37
Industry Collaborative Projects	9	11	9
Public Sector Trial Scheme Projects	2	8	8
Total	107	107	103

Number of projects undertaken by Technology Division			
Technology Division	2017-18	2016-17	2015-16
Advanced Digital Systems	17	17	14
Communications Technologies	21	17	17
Electronics Components	9	10	9
Intelligent Software and Systems	25	26	14
Mixed Signal Systems IC	9	10	11
Opto-electronics	13	14	13
Security and Data Sciences	13	13	25
Total	107	107	103

Income from industry

Income received from the industry for all projects amounted to HK$ 111.36 million. The level of industry contribution is 21.8%. The level of industry income in the year 2017-18 has been 33.1%. The table below shows the income received from industry in the past three years.

Income from Industry (HK$M)	
2017-18	111.36
2016-17	78.00
2015-16	81.43

Including cash and in-kind contribution.

Income from Industry (HK$M) by Division			
Division	2017-18	2016-17	2015-16
Advanced Digital Systems	21.74	10.98	12.24
Communications Technologies	22.96	15.59	16.61
Electronics Components	9.39	8.4	8.14
Intelligent Software and Systems	16.23	10.41	8.3
Mixed Signal Systems IC	18.29	10.94	12.31
Opto-electronics	9.75	12.57	13.88
Security and Data Sciences	12.98	6.65	9.72
Headquarter	0.02	2.46	0.23
Total	111.36	78.00	81.43

Including cash and in-kind contribution.

Financial Report

Overview

For 2017-18 financial year, the consolidated income and expenditure of ASTRI amounted to HK$500,742,063 and HK$498,603,232 respectively, resulting in a surplus of HK$2,138,831.

The funds from the Government comprised HK$137,907,891 from recurrent subvention, HK$240,930,117 from ITF project funds ("ITF"), HK$1,555,064 from ITF General Support Programme ("GSP"), HK$4,552,506 from ITF Public Sector Trial Scheme ("PSTS"), HK$4,638,692 from ITF Internship and HK$5,019,784 from ITF for Chinese National Engineering Research Centre for Application Specific Integrated Circuit System (Hong Kong Branch). In 2017-18 financial year, the income from the industry amounted to HK$106,138,009. The total expenditure of recurrent subvention amounted to HK$143,018,901, which represented an increase of HK$1,030,463 (0.7%) compared with the previous year.

ASTRI's operation remained steady with prudent financial management throughout the year. The total expenditure of the ITF, GSP and PSTS projects amounted to HK$316,968,713, of which 76% of the expenditure was spent on manpower and 24% of the expenditure was spent on equipment and other direct costs.

The total expenditure mainly represented the actual cash outflow incurred during the year for 69 full projects, 52 seed projects, three GSP projects and three PSTS projects. Meanwhile, the internship expenditure amounted to HK$4,638,692, which represented the actual cash outflow of salary payment for interns engaged in 23 full projects and seven seed projects.

The consolidated financial statements of ASTRI for the year ended 31 March 2018 have been audited by independent auditors with unqualified audit opinion, an extract of the Consolidated Statement of Income and Expenditure, Consolidated Statement of Comprehensive Income and Consolidated Statement of Financial Position are set out on pages 95-96.

Consolidated Statement of Income and Expenditure and Comprehensive Income

Year ended 31 March 2018	2018 (HK$)	2017 (HK$)
SUBVENTION		
Income from Government subvention	137,907,891	142,706,472
Administrative expenses	(143,018,901)	(141,988,438)
Surplus / (deficit) on subvention	(5,111,010)	718,034
PROJECT FUNDING FROM INNOVATION AND TECHNOLOGY FUND AND INDUSTRY CONTRIBUTIONS		
Project fund income		
- Innovation and Technology Fund	240,930,117	212,894,473
- Industry contributions	69,861,026	50,573,437
Project expenditure	(310,791,143)	(263,467,910)
Balance on project funding	-	-
Project fund income - General Support Programme		
- Innovation and Technology Fund	1,555,064	788,639
- Industry contributions	70,000	451,180
Project expenditure	(1,625,064)	(1,239,819)
Balance on project funding	-	-
Project fund income - Public Sector Trial Scheme		
- Innovation and Technology Fund	4,552,506	4,532,070
Project expenditure	(4,552,506)	(4,532,070)
Balance on project funding	-	-
INTERNSHIP FUNDING FROM INNOVATION AND TECHNOLOGY FUND		
Internship fund income	4,638,692	3,915,777
Internship expenditure	(4,638,692)	(3,915,777)
Balance on internship funding	-	-
FUNDING SUPPORT FROM INNOVATION AND TECHNOLOGY FUND FOR CHINESE NATIONAL ENGINEERING RESEARCH CENTRE FOR APPLICATION SPECIFIC INTEGRATED CIRCUIT SYSTEM (HONG KONG BRANCH) ("CNERC-ASIC")		
Expenditure incurred in relation to Funding Support from Innovation and Technology Fund	(5,019,784)	(4,656,107)
Amount for reimbursement	5,019,784	4,656,107
OTHER INCOME, NET		
Other income	36,206,983	25,520,205
Other expenses	(20,244,339)	(18,281,132)
Other income, net	15,962,644	7,239,073
AMOUNT RETURN TO THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION	**(7,404,218)**	**(4,201,322)**
SURPLUS BEFORE TAX	3,447,416	3,755,785
INCOME TAX CREDIT/(EXPENSE)	(1,308,585)	114,855

Consolidated Statement of Income and Expenditure and Comprehensive Income

Year ended 31 March 2018	2018 (HK$)	2017 (HK$)
SURPLUS FOR THE YEAR	**2,138,831**	**3,870,640**
OTHER COMPREHENSIVE LOSS TO BE RECLASSIFIED TO SURPLUS OR DEFICIT IN SUBSEQUENT PERIODS		
Exchange differences arising on translation of foreign operations	(10,944)	(62,909)
TOTAL COMPREHENSIVE INCOME FOR THE YEAR	**2,127,887**	**3,807,731**

Consolidated Statement of Financial Position

31 March 2018	2018 (HK$)	2017 (HK$)
NON-CURRENT ASSETS		
Property, plant and equipment	14,752,664	19,761,787
CURRENT ASSETS		
Accounts receivable, prepayments and deposits	32,273,800	29,868,833
Amount due from the Government of the Hong Kong Special Administrative Region	4,677,665	4,473,375
Tax recoverable	-	687,237
Cash and cash equivalents	244,105,059	171,568,853
	281,056,524	**206,598,298**
CURRENT LIABILITIES		
Accounts and other payables and accruals	61,331,713	67,285,532
Receipts in advance	127,153,829	58,545,919
Amount due to the Government of the Hong Kong Special Administrative Region	7,701,044	4,345,661
Tax payable	1,311,742	-
Provision	1,500,000	-
	198,998,328	**130,177,112**
NET CURRENT ASSETS	**82,058,196**	**76,421,186**
TOTAL ASSETS LESS CURRENT LIABILITIES	**96,810,860**	**96,182,973**
NON-CURRENT LIABILITY		
Provision	-	1,500,000
Net assets	**96,810,860**	**94,682,973**
EQUITY		
Share capital	2	2
Reserves	96,810,858	94,682,971
Total equity	**96,810,860**	**94,682,973**

Note

These financial statements have been prepared in accordance with Hong Kong Financial Reporting Standards (which include all Hong Kong Financial Reporting Standards, Hong Kong Accounting Standards and Interpretations) issued by the Hong Kong Institute of Certified Public Accountants, accounting principles generally accepted in Hong Kong and the Hong Kong Companies Ordinance. They have been prepared under the historical cost convention and are presented in Hong Kong dollars ("HK$").

The financial information relating to the years ended 31 March 2018 and 31 March 2017, included in the Consolidated Statement of Income and Expenditure and Comprehensive Income, and the Consolidated Statement of Financial Position set out on pages 95-96, is not part of the Company's statutory consolidated financial statements for those years but is derived from them. Further information relating to those statutory financial statements required to be disclosed in accordance with section 436 of the Hong Kong Companies Ordinance is as follows:

As the Company is a private company, the Company is not required to deliver its financial statements to the Registrar of Companies and has not done so.

The Company's auditor has reported on the consolidated financial statements of the Group for both years. The auditor's reports were unqualified; did not include a reference to any matters to which the auditor drew attention by way of emphasis without qualifying its reports; and did not contain a statement under sections 406(2), 407(2) or (3) of the Hong Kong Companies Ordinance.

www.astri.org

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