ASTRI™

HONG KONG APPLIED SCIENCE AND TECHNOLOGY RESEARCH INSTITUTE COMPANY LIMITED
香港應用科技研究院有限公司

Annual Report

2018 - 19

Table of Contents

The ASTRI story

The Hong Kong Applied Science and Technology Research Institute (ASTRI) was established by the Hong Kong SAR Government in 2000 with a mission to enhance the city's global competitiveness. To remain globally prominent, Hong Kong strives to find new ways for its traditional sectors to thrive, and for the potential of emerging sectors to be unleashed. Harnessing the power of technology is key to achieving this. ASTRI lives up to its mission by pursuing applied Research and Development (R&D) that is delivering technological solutions to strengthen institutions, improve businesses, and benefit communities.

Since 2000, ASTRI has:

Completed nearly 500 research projects

Been granted over 800 patents for its innovations

Transferred over 700 technologies to different industries

Won numerous awards for its technological contributions

Our R&D strategy

ASTRI was chosen as the designated ICT research and development centre by the Hong Kong SAR Government in 2006. Its R&D endeavours focus on five key areas of applications:

- Smart City
- Financial Technologies
- Intelligent Manufacturing
- Health Technologies
- Application Specific Integrated Circuits

ASTRI's success has been driven by its vision for a better, smarter, safer Hong Kong powered by technology. To enhance Hong Kong's competitiveness in technology-based industries, we leverage the opportunities available across four key strategic domains: **Technology**, **Talent**, **Investment** and the **Market**.

Technology is our core focus. Our mission has always been to improve the overall technological competence of Hong Kong and the wider region – and the combination of **Talent**, **Investment**, and our mastery of the **Market** are vital catalysts.

Our technology roadmap

In 2018-19, ASTRI's R&D organisation operated through seven Technology Divisions: Advanced Digital Systems, Communications Technologies, Electronics Components, Mixed Signal Systems IC, Intelligent Sensing Technology System, Intelligent Software and Systems, and Security and Data Sciences.

These teams deliver market-relevant applications in five areas of applications: Smart City, Financial Technologies, Intelligent Manufacturing, Health Technologies, and Application Specific Integrated Circuits through our mandate as the Hong Kong branch of the Chinese National Engineering Research Centre (CNERC).

Smart City

The Hong Kong SAR Government has unveiled a detailed blueprint for Smart City development – the idea of a city that is fully intelligent, connected and trusted. When fully realised, the blueprint will enable Hong Kong to position itself as Asia's most global and most advanced 21st century city. To help achieve that goal, ASTRI is combining its ICT talents in sensors, intelligence, and new network and security technologies to improve the way the city operates and shares information, ultimately improving the quality of life for its residents.

The Smart City revolution will impact every aspect of our lives, businesses and communities. It will create enormous opportunities for sustainable economic growth. We are developing tools and platforms that will enable Smart City technologies to seamlessly communicate with one another – making full play of the upcoming 5G revolution, and ensuring increased functionality from smart technologies.

Financial Technologies

Financial Technologies (FinTech) is a cornerstone of the financial sector's continued growth. Advanced FinTech solutions are making financial services faster, more reliable, and more secure. They are also making it easier for banks, insurers and other financial service providers to cater to the needs of their customers, while enabling customers to access their accounts and information in a more secure and personalised way.

To help Hong Kong maintain its leadership as a world-class financial hub, our FinTech teams are developing solutions that leverage Blockchain technology, strengthen cybersecurity, make sense of big data, and provide valuable proofs-of-concept. As one of Hong Kong's strongest FinTech R&D groups, we are committed to benefiting the entire financial industry and helping drive the sector's growth into a new era.

Intelligent Manufacturing

Our Intelligent Manufacturing R&D helps to make production processes faster, easier and more efficient. As an emerging Smart City, Hong Kong has the ability to leverage Artificial Intelligence (AI), robotics and data-centric solutions to unlock the Industry 4.0 vision. The application of AI and robotics makes manufacturing more reliable and effective, while making maintenance significantly easier.

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 leveraging the transformation taking place in the Guangdong-Hong Kong-Macau Greater Bay Area. Through its focus on Intelligent Manufacturing technologies, ASTRI is developing a number of advanced platforms, tools and solutions that will help reshape the industrial sector.

ASTRI's sophisticated and advanced technologies are helping to create interconnected, fully digital smart factories, and enabling businesses to streamline their operations, work more efficiently, and become more environment-friendly.

Health Technologies

ASTRI is fully committed to developing Health Technology solutions that support the medical sector and benefit the community. With support from the Hong Kong SAR Government, we have made several breakthroughs in fields such as biomedical imaging and medical data analytics that are enabling medical professionals to better treat patients and even save lives.

ASTRI's Health Technology strategy aims to increase the efficiency of healthcare, enhance and personalise medical services, and ultimately improve the quality of people's lives. It is achieving this by developing new applications in areas such as eldercare solutions, preventative health monitoring, medical diagnosis and medical computing.

Application Specific Integrated Circuits

Integrated Circuits (IC) are key to innovation-led growth and development for many high-tech industrial sectors. As these sectors strive to significantly upgrade their capabilities – especially in telecommunications, Smart City technology and electronics – reliable and robust IC research is paramount.

Our R&D initiatives in Application Specific Integrated Circuits leverage the mandate given to us in 2012 with the establishment of the first-ever Hong Kong branch of the Chinese Engineering Research Centre (CNERC) for Application Specific Integrated Circuit Systems at ASTRI, in collaboration with Southeast University (SEU) in Nanjing. The branch focuses on microelectronics and integrated circuits applied across various industries.

Chairman's Message

It is my great privilege to present ASTRI's Annual Report for 2018-19. As Chairman of the Board of Directors, I have had the opportunity to witness ASTRI's development from up close. ASTRI was established by the Hong Kong SAR Government over 19 years ago, with a simple but powerful mission – to make Hong Kong and its enterprises more competitive through the application of innovative technologies. Since then, the sheer number of innovations developed by ASTRI and the scale of its contributions to various sectors speak volumes for its success. At the core of all of ASTRI's accomplishments is its highly capable team of over 600 professionals, so I would like to begin by expressing my heartfelt appreciation to the entire workforce at ASTRI for their dedication, hard work, and the significant contributions they have made.

Focusing on what we do best, generating a meaningful impact

ASTRI develops innovative platforms and solutions designed to transform Hong Kong into a centre of technological excellence. Our R&D efforts are focused on five core areas: Smart City, FinTech, Intelligent Manufacturing, Health Technologies, and Application Specific Integrated Circuits. In line with the Government's vision to transform Hong Kong into a world-class Smart City, we are pursuing innovative R&D in key areas that include Connected Cars and Smart Mobility, Industrial and Consumer IoT, Device-to-Device (D2D) communications, Data Analytics, and Network Security.

Seizing today's opportunities, laying tomorrow's foundations

The world is witnessing a 'digital imperative' that is impacting national, regional and international markets, and touching all spheres of our daily lives. In 2018-19, ASTRI's industry collaborations led to many successful solutions and commercialisation projects, benefiting both businesses and consumers. From Blockchain research to cybersecurity, AI to Cellular V2X communications, HealthTech to sophisticated power electronics, we have been actively making a mark across many industries.

Over the years, we have also groomed tens of thousands of technology talents – many within ASTRI as R&D team members, others through student exchanges, training, workshops and other programmes. The talented engineers, scientists and researchers who have come on board with ASTRI have made a significant difference to the success of our endeavours. While our workforce is primarily drawn from Hong Kong's local talent pool, we have also attracted many bright minds from other parts of Greater China, as well as quite a few from elsewhere in the world. Through hard work and dedication, these talented individuals have advanced I&T development in Hong Kong and beyond. Many of our former colleagues currently work as entrepreneurs or executives in prominent local, regional and international enterprises. The ASTRI Alumni Network (ASTRIAN) continues to shape Hong Kong's technology-powered future, and bear witness to ASTRI's success in nurturing tech talents.

Thriving in innovation, shining in impact

As the largest applied R&D facility in Hong Kong, ASTRI plays a crucial role in promoting technology and innovation, contributing not only to the city's advancement, but also to national development. Hong Kong currently stands at a historic crossroads. In the context of major initiatives such as the Greater Bay Area development plan and the Belt and Road initiative, Hong Kong must capitalise on what it does best – in areas such as financial services, creative design, technology research, flow of information, legal and IP frameworks, and so on. If Hong Kong's existing strengths can be complemented with innovative technologies, we can boldly write a new chapter of growth and prosperity. International rankings consistently place Hong Kong at the forefront of innovation, and ASTRI is indeed perfectly placed to facilitate further excellence in applied technologies.

Teamwork at the heart of everything

Once again, I would like to thank ASTRI's senior executives, technology leaders, and all staff members for their hard work, dedication and commitment over the year. At ASTRI, we will continue to invest in our people and our infrastructure, while engaging in cutting-edge research in line with local, national and regional priorities. I thank the Government's Innovation and Technology Bureau and the Innovation and Technology Commission for their continued patronage of and guidance to ASTRI. My sincere thanks also go to the members of ASTRI's Board of Directors for their collective leadership, wisdom and guidance.

In an era where technology is shaping every aspect of people's lives, the way that economies shape their development strategies in the digital age also needs to evolve. ASTRI plays a strong supporting role to Hong Kong in that evolution. With the continued support and patronage of all our valued stakeholders, ASTRI will continue to support Hong Kong on its journey towards technological excellence.

Wong Ming-yam, SBS, JP
Chairman, Board of Directors

Chef Executive Officer's Report

In the 19+ years since starting our journey, ASTRI has had great success innovating technologies that will revolutionise our future. Not only have they helped ASTRI succeed, but many ASTRIANs have also gone on to form their own technology businesses, create cutting-edge solutions, and promote a culture of innovation. I would like to dedicate all of ASTRI's successes in 2018-19 to our extremely talented and dedicated workforce, the bedrock underlying all our endeavours.

ASTRI's innovation efforts involve effective collaboration and active commercialisation with its partners – from Government agencies and quangos, to academia, industry leaders and start-ups. For instance, in partnership with Hong Kong's major telecommunications industry players, we collaborated on multifaceted applications of 5G technology, such as connected and autonomous vehicles, Artificial Intelligence, the Internet of Things, and different data-centric platforms.

ASTRI also collaborated with a leading property developer and a major bank to create Hong Kong's first property-purchase Blockchain platform. In addition, ASTRI has been one of the founding members of Hong Kong's first-ever 'Smart Open Data Advancement Consortium'. The consortium aims to revolutionise data-driven innovation endeavours and create a tangible impact through the development of a secure and user-friendly platform to effectively leverage open data.

One of our proudest moments in 2018-19 came at the World IoT Summit 2018 in the Mainland city of Wuxi. Following our successful trial of Cellular Vehicle-to-Everything technologies at the Hong Kong Science Park, we demonstrated the technology in Wuxi in September 2018. The demonstration was carried out in partnership with equipment maker Huawei, auto manufacturer Audi, and other ecosystem players. We conducted the world's first-ever citywide demonstration of a 5G-powered Smart Mobility system in the test site which spanned around 170 km², stretching over most areas of Wuxi city.

In our efforts to create meaningful impact for Hong Kong's economy and the community, ASTRI relies heavily on collaboration with various Government agencies and public sector organisations. From helping the Water Supplies Department optimise the way it manages data to developing Smart Parking solutions for the Urban Renewal Authority, from assisting the Office of the Communications Authority with 5G groundwork to continuing our partnership with the Hong Kong Monetary Authority, we remain fully aligned with the Hong Kong SAR Government's efforts to realise the five aspects of the Smart City blueprint.

We undertook 39 new projects in 2018-19, compared to 45 in the previous year. In total, 51 technologies were transferred to different industries, generating HK$99 million in income from those industries. Also during the year 2018-19, ASTRI filed over 66 patent applications in China, the US and other countries. In the same period, 54 new patents were granted to ASTRI.

Throughout the year, ASTRI participated in leading industry events in Hong Kong, Greater China and overseas, promoting its own innovation endeavours and championing Hong Kong's I&T development momentum. For the second year in a row, we took part in the world's largest innovation expo in Geneva, the International Exhibition of Inventions. ASTRI won 14 awards at the exhibition – the largest share among all the awards won by Hong Kong-based participants in the event. We also won multiple awards on other prestigious platforms during the year, including at the Hong Kong ICT Awards and the Hong Kong Awards for Industries.

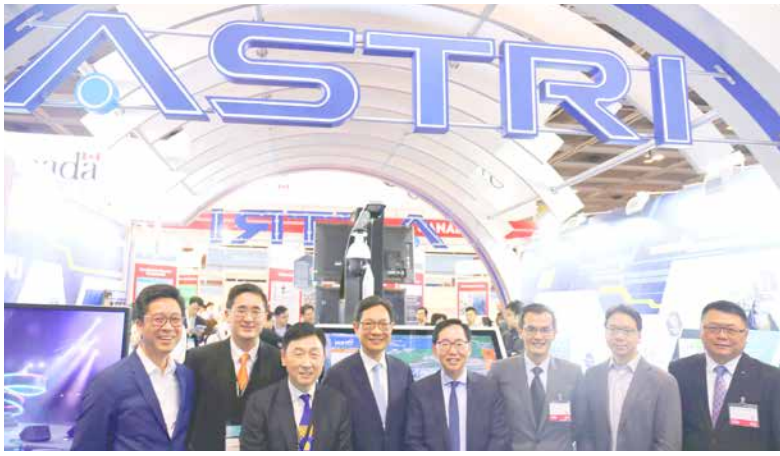
In November 2018, we organised the inaugural edition of what is now the largest event in ASTRI's calendar and its signature event – the ASTRI Technovation Summit. Set up to explore ways of applying AI to achieve a smart future for Hong Kong, the summit was attended by some 500 of the brightest technology minds from Hong Kong and around the world.

In the years to come, we will continue to partner with our ecosystem peers in Hong Kong and around the world – leveraging the power of technology to make Hong Kong more competitive and more successful. With support and encouragement from all of you, ASTRI will play a full part in Hong Kong's I&T promotion and Smart City development journey.

Here's to an even more exciting year ahead!

Hugh Chow Hin-poon

Chief Executive Officer

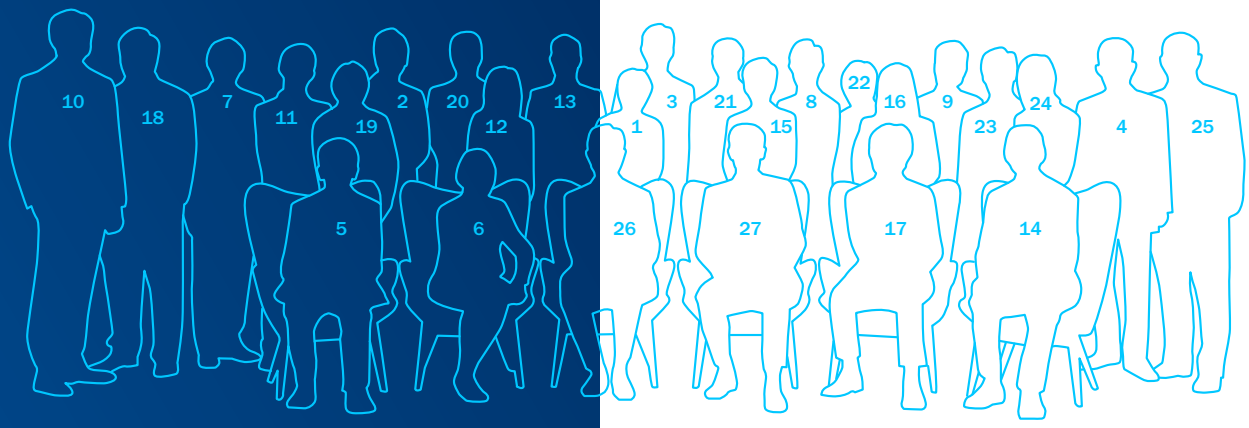


Board of Directors

Board of Directors

ASTRI is governed by a Board of Directors whose members are drawn from Hong Kong's academic, industrial and commercial sectors, as well as the wider community. Appointed by the HKSAR Government, the Directors are responsible for guiding and shaping ASTRI's leadership direction, strategic priorities and technology roadmap.

With support from ASTRI's Senior Management team, the Board guides ASTRI with its experience and expertise enabling ASTRI to benefit the right sectors and applications in today's ever-changing business environment. While ensuring that ASTRI demonstrates only the very best corporate practices and behaviours, the Board of Directors works to keep the focus of the institute firmly on meeting the requirements of the industrial and commercial sectors.



1. Ms Cally Chan Shan-shan
2. Mr Duncan Chiu
3. Mr Charles Chow Sai-keung
4. Mr Steve Chuang Tzu-hsiung
5. Mr Ha Yung-kuen, BBS
6. Ms Annie Choi Suk-han, JP
7. Mr Kwong Chi-keung, JP
8. Ir Dr Alan Lam Hiu-fung
9. Professor Lam Tak-wah
10. Mr Sunny Lee Wai-kwong, JP
11. Professor Liew Soung-chang
12. Professor Sabrina Lin Man-yee
13. Mr Andy Liu An-ting
14. Dr Davy Lo Kwok-wai
15. Ms Hera Siu Kit-wan
16. Ms Ada Wong Yin-man
17. Professor Roland Chin Tai-hong, BBS, JP
18. Mr Pindar Wong
19. Ms Cammy Yung
20. Dr MeiKei Ieong
21. Mr Stephen Ho Wai-chung
22. Dr Martin Szeto
23. Mr Tony Choi Siu-chow, JP
24. Ms Grace Hui
25. Mr Denis Tse Tik-yang
26. Mr Wong Ming-yam, SBS, JP
27. Mr Hugh Chow
28. Dr Archie Yeh Tsuei-chi

Composition of the Board

As of 31 March 2019, the Board was headed by a Chairman and included 19 other members, two of whom were ex-officio 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 of surname)	
Ms Cally Chan Shan-shan	General Manager, Hong Kong and Macau, Microsoft Hong Kong Limited
Mr Duncan Chiu	Chairman, Lai Yuen Company Limited
Mr Charles Chow Sai-keung	South China and Hong Kong Assurance Leader, PricewaterhouseCoopers
Mr Steve Chuang Tzu-hsiung	Chairman and Chief Executive Officer, ProVista Group
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
Professor Lam Tak-wah	Head, Department of Computer Science, The University of Hong Kong
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
Professor Sabrina Lin Man-yee	Vice-President for Institutional Advancement, The Hong Kong University of Science and Technology
Mr Andy Liu An-ting	CEO, CW Data Technologies and Vice Chairman, Hong Kong Biotechnology Organization CW Data Technologies
Dr Davy Lo Kwok-wai	Consultant
Ms Hera Siu Kit-wan	Chief Executive Officer, Greater China, Vice President, Cisco Technologies (Beijing) Co., Ltd.
Ms Ada Wong Yin-man	Executive Director, Wong's International Holdings Ltd
Dr Archie Yeh Tsuei-chi	-

***Mr Cheuk resigned from the Board on 12 April 2019 upon his retirement from the civil service.*
****Ms Choi was appointed as the Permanent Secretary for Innovation and Technology on 30 July 2019.*

Board Functional Committees

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

The members of the committees as at 31 March 2019 were as set out below.

Finance and Administration Committee
Mr Ha Yung-kuen, BBS (Chairman)
Ms Cally Chan Shan-shan
Mr Duncan Chiu
Ms Annie Choi Suk-han, JP
Mr Andy Liu An-ting
Dr Davy Lo Kwok-wai
Ms Hera Siu Kit-wan

Technology Committee
Mr Sunny Lee Wai Kwong, JP (Chairman)
Ms Cally Chan Shan-shan
Mr Duncan Chiu
Ms Annie Choi Suk-han, JP
Mr Steve Chuang Tzu-hsiung
Mr Ha Yung-kuen, BBS
Mr Stephen Ho Wai-chung
Professor Lam Tak-wah
Ir Dr Alan Lam Hiu-fung
Professor Liew Soung-chang
Professor Sabrina Lin Man-yee
Dr Davy Lo Kwok-wai
Mr Wong Ming-yam, SBS, JP
Dr Archie Yeh Tsuei-chi

Audit Committee
Dr Davy Lo Kwok-wai (Chairman)
Ms Annie Choi Suk-han, JP
Mr Charles Chow Sai-keung
Mr Kwong Chi-keung, JP
Ir Dr Alan Lam Hiu-fung
Ms Ada Wong Yin-man

Changes in Board Directors

New Directors

	Date of Appointment
Mr Charles Chow Sai-keung	21 October 2018
Mr Steve Chuang Tzu-hsiung	21 October 2018
Professor Lam Tak-wah	21 October 2018
Professor Sabrina Lin Man-yee	21 October 2018
Ms Ada Wong Yin-man	21 October 2018

Retired Directors

	Date of Retirement
Professor Roland Chin Tai-hong, BBS, JP	21 October 2018
Mr Humphrey Choi Chor-ching, JP	21 October 2018
Mr Tony Choi Siu-chow, JP	21 October 2018
Mr Denis Tse Tik-yang	21 October 2018
Mr Pindar Wong	21 October 2018

Meeting Attendance

A total of seven Board meetings were convened during the 2018-19 year. The attendance records of members at Board meetings as well as Board Functional Committee meetings held between 1 April 2018 and 31 March 2019 are as follows:

Board Meetings	11 Apr 2018	26 Jun 2018	24 Jul 2018	3 Oct 2018	29 Nov 2018	20 Dec 2018	28 Mar 2019
Total number of directors during the period	20	20	20	20	20	20	20
Total number of directors present at meeting	19	18	14	19	11	18	16
Total number of apologies	1	2	6	1	9	2	4
Percentage in attendance	95%	90%	70%	95%	55%	90%	80%

Finance and Administration Committee Meetings

	23 May 2018	29 May 2018	11 Sep 2018	22 Nov 2018	26 Feb 2019
Total number of directors during the period	8	8	8	7	7
Total number of directors present at meeting	5	5	6	6	4
Total number of apologies	3	3	2	1	3
Percentage in attendance	63%	63%	75%	86%	57%

Technology Committee Meetings

	13 Jun 2018	18 Sep 2018	5 Dec 2018	13 Mar 2019
Total number of directors during the period	13	13	14	14
Total number of directors present at meeting	11	11	8	11
Total number of apologies	2	2	6	3
Percentage in attendance	85%	85%	57%	79%

Audit Committee Meetings

	7 Jun 2018	7 Sep 2018	29 Nov 2018	7 Mar 2019
Total number of directors during the period	5	6	6	6
Total number of directors present at meeting	5	6	5	4
Total number of apologies	0	0	1	2
Percentage in attendance	100%	100%	83%	67%

Our organisation

Our organisation

ASTRI operates with a highly organised and professional structure that enables its endeavours. Functioning under the auspices of the Hong Kong SAR Government's Innovation and Technology Commission (ITC), ASTRI leverages investments made by the Hong Kong Government to develop innovative technologies that make lives easier and better for Hong Kong's people.

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.

Chain of command

ASTRI's operations are led by the Chief Executive Officer, who is accountable to the Board of Directors. The CEO is entrusted with all matters relating to the overall management of the organisation, and is assisted by a group of 'C-Officers' – Senior Management team members responsible for R&D, operations, finance, marketing, administration, and other supporting functions. In addition to the CEO and C-Officers, the Senior Management team also includes Technology Division Heads who, overseen by the Chief Technology Officer, lead ASTRI's seven R&D teams.

From Left to Right

Mr Bill Zhang
Senior Director, Mixed Signal System IC

Mr Li Yiu-kei
Senior Director, Advance Digital Systems

Dr Lucas Hui
Senior Director, Security and Data Sciences

Ms Grace Hui
Chief Administrative Officer

Dr Justin Chuang
Vice President, Next Generation Network

Dr Meikei Ieong
Chief Technology Officer

Mr Hugh Chow
Chief Executive Officer

Dr Martin Szeto
Chief Operating Officer

Ms Cammy Yung
Chief Financial Officer

Dr Daniel Shi
Senior Director, Electronics Components

Dr Tsai Chen-jung
Acting Director, Intelligent Sensing Technology System

Dr James Lei
Acting Director, Intelligent Software and Systems

Headquarter Executives

In 2018-19, the following Headquarter Executives were members of the Senior Management team:

Mr Hugh Chow
Chief Executive Officer

Dr Meikei Ieong[1]
Chief Technology Officer

Dr Martin Szeto
Chief Operating Officer

Ms Cammy Yung
Chief Financial Officer

Ms Grace Hui[2]
Chief Administrative Officer

1. *Left ASTRI on 7 April 2019*
2. *Left ASTRI on 14 July 2019*

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 headed by the following heads in 2018-19:

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[3]
Senior Director, Mixed Signal Systems IC

Dr Daniel Shi
Senior Director, Electronics Components

Dr Tsai Chen-jung
Acting Director, Intelligent Sensing Technology System

Dr James Lei
Acting Director, Intelligent Software and Systems

3. *Left ASTRI on 31 March 2019*

Annual remuneration of senior executives

Post	Annual Remuneration* 1 Apr 2018 – 31 Mar 2019 (HK$)
Chief Executive Officer	3,866,400
3 level one executives	6,990,550
17 level two executives	27,657,400

Annual Remuneration* (HK$)	Number of Senior Executives
1,000,000 or below	2
1,000,001 to 1,500,000	5
1,500,001 to 2,000,000	8
2,000,001 to 2,500,000	3
2,500,001 to 3,000,000	0
3,000,001 to 3,500,000	2
3,500,001 to 4,000,000	1

* *The information covers actual remuneration (including base salary, salary adjustment, acting allowance, variable payment, and cash award i.e. Inventor Award)) for 2018-19 received by senior executives who were in service as of 31 March 2019. The figures have been rounded to the nearest HK$10. It also covers the remuneration of two senior executives who were appointed during the year i.e. Chief Operating Officer on 3 December 2018 and Head of Client Development on 10 December 2018.*

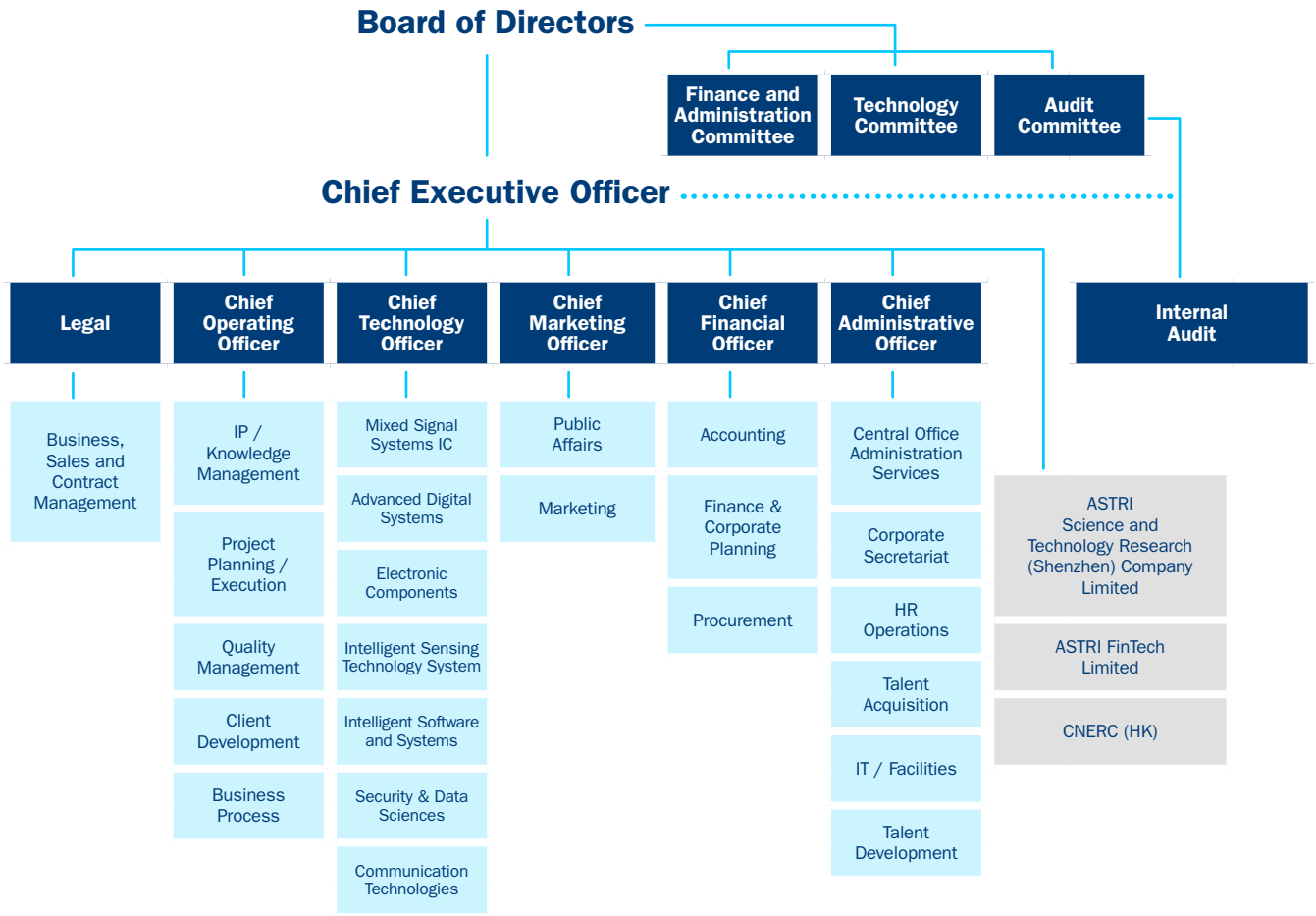
Teamwork turns our dreams into reality

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 77% 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.

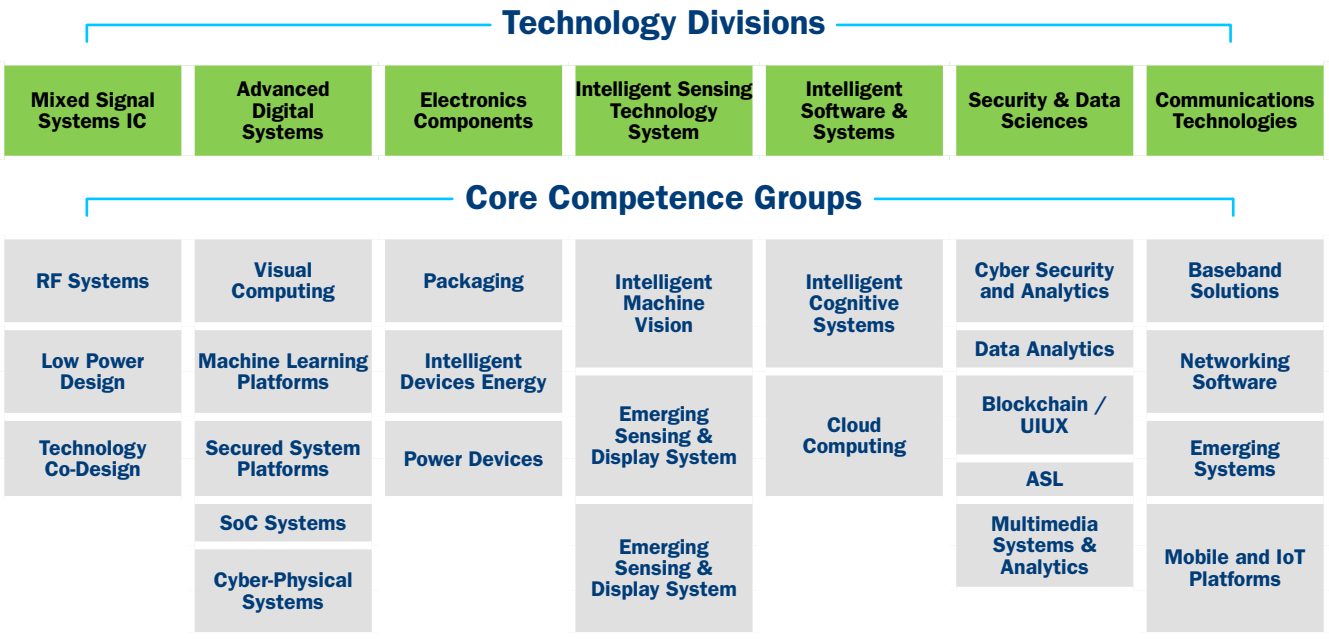
The support services and functions include Finance and Accounts, Marketing, Procurement, Legal, Information Technology, Facilities Management, Human Resources, Business Development, Intellectual Property and Knowledge Management, and Project Management.

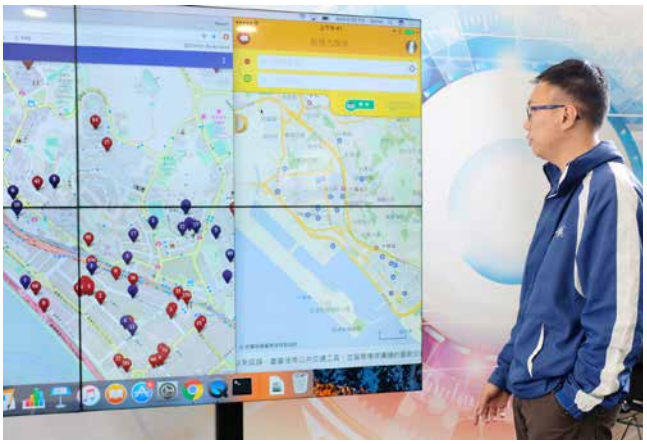
The following chart represents ASTRI's organisation structure as of 31 March 2019:

ASTRI Organisation Structure



ASTRI R&D Organisation Structure





We are growing

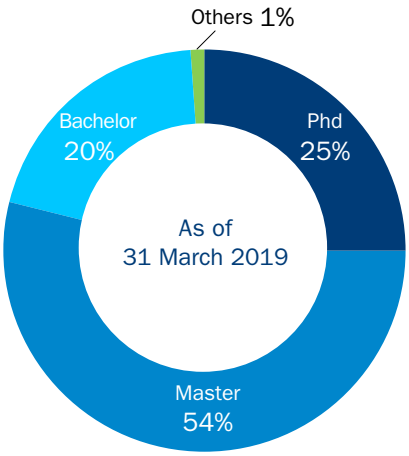
ASTRI offers career paths that suit scientists, researchers, engineers and professionals with diverse skills, backgrounds and aspirations from around the world. Developing new ideas keeps ASTRI at the forefront of technological excellence.

The following chart represents ASTRI's organisation structure as of 31 March 2019:

Employee Number by Function

Headquarters	89
Communications Technologies	117
Mixed Signal Systems IC	57
Advanced Digital Systems	72
Intelligent Software and Systems	78
Security and Data Sciences	81
Intelligent Sensing Technology System	49
Electronics Components	57
Others	23
Interns	37
Total	**660**

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.

Governance and Control

Governance and Control

As a publicly-funded R&D centre, ASTRI is committed to the highest standards of corporate governance. We act in line with our mission, in the interests of our stakeholders and the taxpayers of Hong Kong.

ASTRI adheres to its Corporate Governance Manual, which clearly articulates our policies and principles and guides the Board and Senior Management in their efforts to ensure ASTRI operates in a transparent and accountable manner.

The Manual contains comprehensive guidelines on:

- Organisation and management structure
- HR policies and staff conduct
- Financial management and control
- Internal control and external reporting
- Risk management

The Manual is updated periodically to strengthen our governance practice and enhance our efficiency. This is done to reflect developments needed to improve ASTRI's operations, and the changing terms and conditions of the business environment in which ASTRI operates.

The Manual is based mainly on:

- the existing Memorandum and Articles of Association of The Hong Kong Applied Science and Technology Research Institute Company Limited
- the Memorandum of Administrative Arrangements on the Administration of Government Subvention
- the Memorandum of Administrative Arrangements on the Administration of the Funding from the Innovation and Technology Fund signed between the HKSAR Government and ASTRI in 2002
- the prevailing policies and procedures approved by the Board of Directors; and
- existing ASTRI practices and guidelines

Internal audit

In 2003, ASTRI set up an Internal Audit Department (IAD) under the Audit Committee. The role of the IAD is to ensure effective corporate governance and to provide the Board with information about and assurance on the effectiveness of ASTRI's internal controls.

The IAD provides objective reviews and assurance that add value to ASTRI's endeavours and improve its operations, bringing a systematic, disciplined approach to evaluating and improving risk management, control and governance processes.

Over the past year, the IAD has conducted internal audit reviews on various areas of ASTRI's operations in line with the risk-based Internal Audit Annual Plan approved by the Audit Committee. These areas have included project management, corporate communications, secretariat support management, facilities management, receivables management and payroll management. While these reviews identified some areas for improvement, they confirmed that ASTRI had significant controls in place and that the existing regulations and procedures were being observed in all material aspects. The IAD regularly submitted reports of these reviews and their recommendations to the Audit Committee.

Compliance

As the Compliance Officer, the Head of Internal Audit helps the Board to ensure good governance by reporting any 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

ASTRI has very strict controls and safeguards in place against conflicts of interest. To ensure that potential conflicts are always declared and managed adequately, ASTRI regularly reviews and updates the Code of Conduct when necessary. The Code of Conduct for Employees which covers relevant information was recently updated, and changes communicated extensively to everyone in ASTRI.

Workplace policy

ASTRI has zero tolerance for discrimination and harassment. We organise regular seminars on relevant policies and regulations, with the aim of promoting equal opportunities and preventing discrimination and harassment in the workplace.

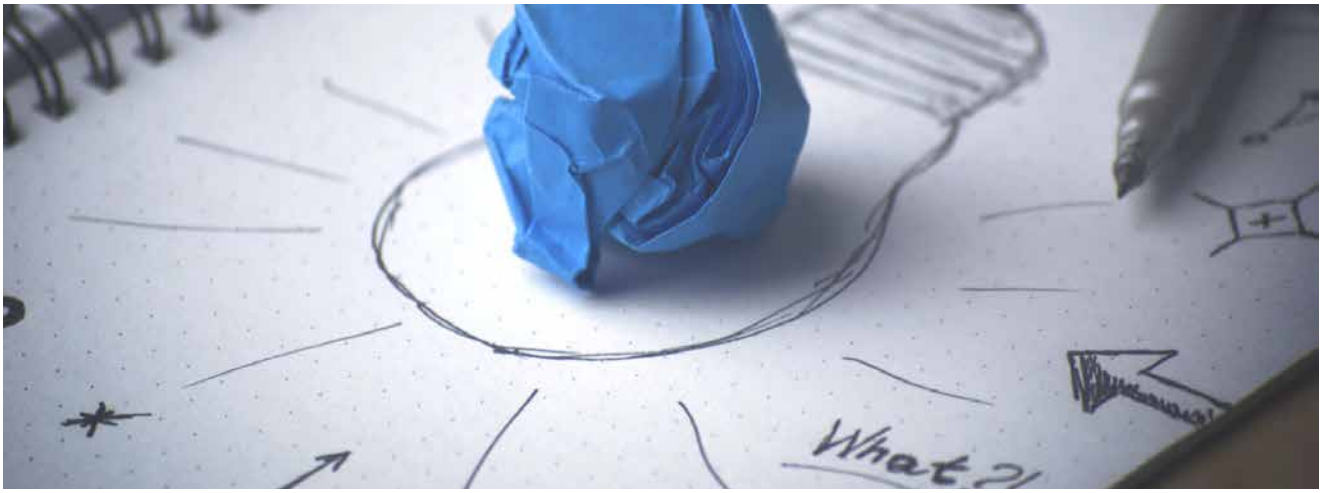
Risk management

ASTRI has a Risk Management (RM) framework in place to identify, evaluate and mitigate risks. It has been designed based on ASTRI's RM policy, which covers issues such as the roles and responsibilities of different parties, the RM process, and risk communication.

A Risk Register is also maintained to keep track of various risks that ASTRI encounters. The Risk Register covers the following broad thematic categories:

- Strategy and partnership
- Corporate governance and ethics
- Compliance
- Corporate communications and relations
- Research and development
- Human resources
- Finance
- Information technology
- Health and safety, premises and facilities
- Reporting

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



Quality management system

For ASTRI, quality is paramount for all its research deliverables. The quality of our research and innovation work in different technology areas is supported by our organisation-wide adoption of the ISO 9001 Quality Management standard.

The four objectives for ASTRI's quality management system are:

- Transparency
- Speed
- User-friendliness
- Governance

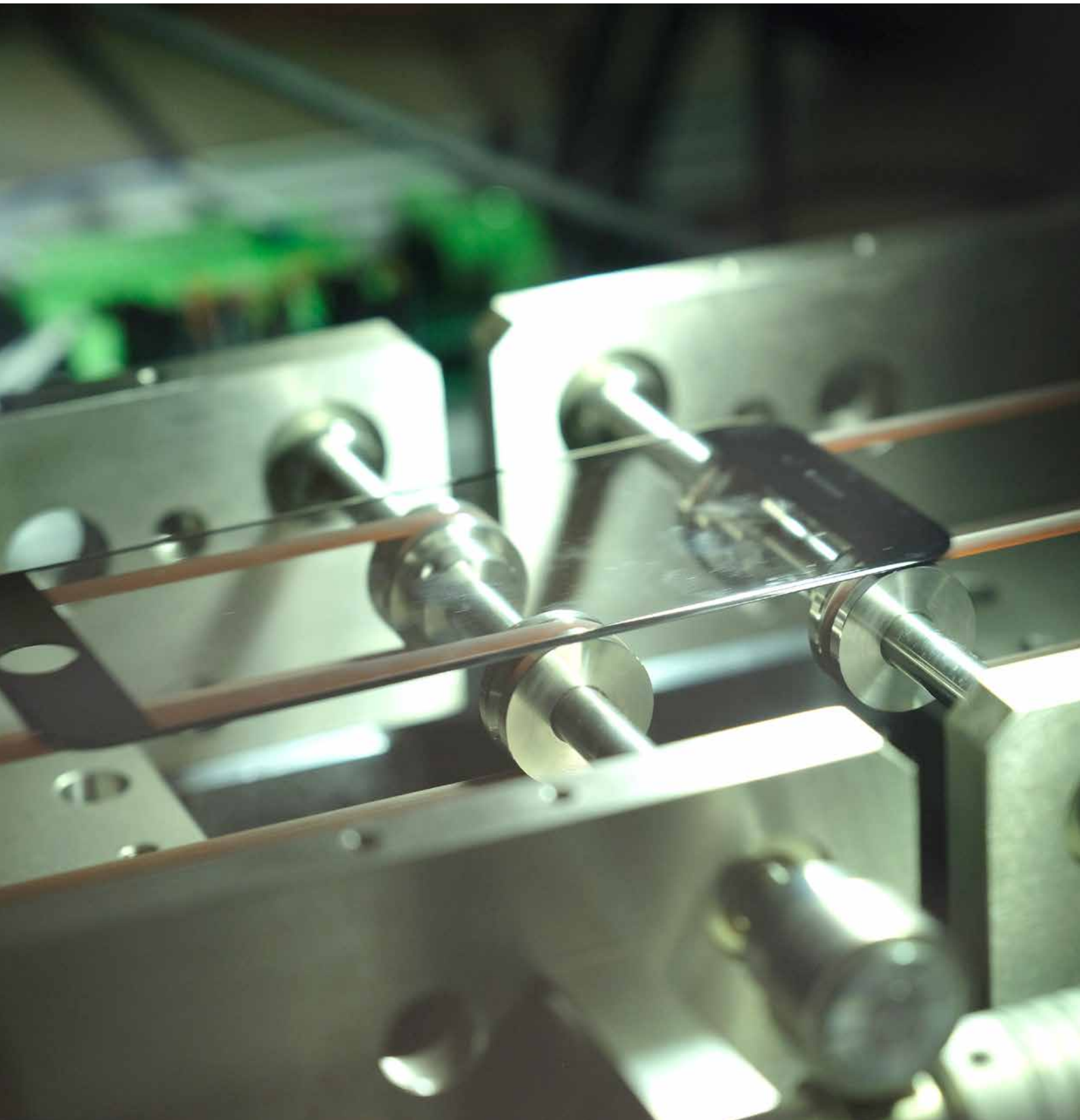
The ISO 9001 standard helps ASTRI to deliver consistently high-quality products and services that meet the expectations and enhance the satisfaction of our clients and partners. In June 2018, international quality assurance body Bureau Veritas Certification conducted an ISO 9001 surveillance audit on ASTRI's operations. The Audit certified that ASTRI's operations were fully compliant with the standards, noting zero non-conformance.

Through effective communication and exchanges with all stakeholders, ASTRI also actively seeks opportunities to improve the quality of its operations.

Information security management system

Cyber-crime poses one of the gravest threats to financial services, research, public services, industries and business sectors. ASTRI has adopted the ISO 27001 Information Security Management standard for its R&D endeavours in Financial Technologies to safeguard the confidentiality, integrity and accessibility of information. This standard is helping us mitigate cybersecurity risks and improve our cyber-defence capabilities. Our FinTech R&D professionals regularly attend information security awareness training sessions on the latest and most advanced tools for mitigating cyber-risks. Every quarter, an external consultancy company performs vulnerability assessment and penetration tests on ASTRI's Information Technology infrastructure and network equipment to help strengthen our security controls. In October 2018, the certification body SGS Hong Kong Limited conducted an ISO 27001 certification audit of ASTRI's operations, and found no non-conformance. ASTRI is continuing to improve and strengthen its data, information and operations, staying abreast of the latest technologies to combat evolving cybersecurity risks.

Achievements



Achievements

Awards and recognitions

14 awards follow inaugural appearance at world's largest innovation expo

ASTRI came away with a total of 14 awards from the 46th International Exhibition of inventions of Geneva in April 2018, three of them accompanied by 'Congratulations of the Jury'. This made ASTRI the most awarded of all the Hong Kong participants at the Exhibition.

Held annually in Geneva, the International Exhibition of Inventions is the most respected specialist event of its kind in the world. It attracts exhibitors from around the globe who showcase their inventions and innovations to a large global audience. The Hong Kong delegation, comprising around 15 institutions and universities, won 98 awards in total.

As part of the Hong Kong delegation, ASTRI won three Gold Medals with 'Congratulations of the Jury', eight Gold medals and three Silver medals, making ASTRI the most awarded organisation of all the Hong Kong exhibitors. The three ASTRI projects to win Gold Medals with 'Congratulations of the Jury' were: the B-TrunC Base-station that enables fast, reliable, low-latency communications for mission critical communications; the Advanced Safety Design for Rechargeable Battery, which prevents accidents caused by overheating of batteries during recharging; and the Non-invasive Bloodless Glucometer.

ASTRI honoured for three exceptional innovations

The Hong Kong Awards for Industries 2018 attracted a total of 259 entries. Three of these won awards for ASTRI for its innovation excellence. At the presentation ceremony, at which Mrs Carrie Lam, Chief Executive of the Hong Kong SAR officiated, ASTRI accepted a Technological Achievement Award for its Narrowband Internet of Things solutions; an Equipment and Machinery Design Certificate of Merit for its All-in-one Virtual Reality Head Mount Display; and an Equipment and Machinery Design Award for the Collaborative Mobile Manipulator for Industrial Head Clean Room, jointly developed with its partner SAE Magnetics (Hong Kong) Limited.

Palm Fusion Biometric Authentication solution wins Gold at Hong Kong ICT Awards

At the Hong Kong ICT Awards 2018, the Gold Award for Information Security in the Smart Business Award category was won by the Palm Fusion Biometric Access Control System, developed by ASTRI and its partner Smart Secure ID from Switzerland. This Gold Award was achieved in the category "Smart Business Award – Information Security", organised by the Hong Kong Computer Society, one of eight award categories at the event.

ASTRI's award-winning solution has already been adopted by European preschools and other related institutions. It provides reliable support for user identification, making for more effective management of student affairs in areas such as managing daily in-and-out registration for students, verifying students' identity for examinations, and keeping track of the learning progress of individual students.

ET Net Smart City Awards recognise ASTRI's pursuit of innovation

Three of ASTRI's Smart City innovations were honoured at the Smart City Awards 2018 organised by ET Net, which recognises innovation in six categories – Smart Economy, Smart Environment, Smart Living, Smart Mobility, Smart People and Smart Government. Determined by an esteemed jury panel headed by the Honourable Charles Peter Mok, JP, Member of the HKSAR Legislative Council, the awards won by ASTRI were for its Outstanding Internet of Vehicles (IoV) Management System (Smart Mobility), its Outstanding Internet of Things (IoT) for Smart Water Management (Smart Environment), and its Outstanding Text Correction System on Mobile Devices (Smart Economy).

ASTRI's eldercare innovation wins prestigious Asia-Pacific Eldercare Innovation Award

In partnership with two other Hong Kong SAR Government-subvented R&D centres, ASTRI has developed a tracking and monitoring system that protects vulnerable groups like the elderly. The system, which has been applied in 11 elderly day care centres of the Tung Wah Group of Hospitals, was chosen as the "Best Smart Care Technology Solution" at the 6th Asia Pacific Eldercare Innovation Awards.

Leading expos and industry events

International ICT Expo 2018

From 13 to 16 April 2018, ASTRI took part in the International ICT Expo 2018, organised by the Hong Kong Trade Development Council. Located at the Hong Kong Convention and Exhibition Centre, the fair attracted over 600 organisations and was visited by more than 30,000 people. ASTRI's pavilion showcased a number of its innovative R&D projects that aligned with the Expo's theme, "Smart City: The Way of the Future". The ASTRI pavilion presented its projects under the three broad categories of Smart Economy, Smart Mobility and Smart Living.

Latest ASTRI technologies showcased at PT EXPO China 2018 in Beijing

At the PT EXPO China 2018 in Beijing, ASTRI showcased its latest technologies developed to deliver 'Intelligence' along with 'Connected' and 'Trusted' solutions. The technologies on display included some that are facilitating the deployment of competitive services and innovative solutions across Hong Kong and the Greater Bay Area and in international markets. The PT EXPO was hosted by the Ministry of Industry and Information Technology of the People's Republic of China, and organised by the China National Postal and Telecommunications Appliances Corporation.

Enabling the 5G Ecosystem: ASTRI demonstrates latest 5G and V2X technologies at MWC Shanghai 2018

In collaboration with with Fu Huake Precision Industry (Shenzhen) Co. Ltd. (a subsidiary of Foxconn Industrial Internet Co. Ltd.), Fujian Sunnada Network Technology Co. Ltd., Rohde & Schwarz, and Hewlett Packard Enterprise (HPE), ASTRI showcased its latest 5G, Narrowband Internet of Things (NB-IoT) and Vehicle to Everything (V2X) technologies at the Mobile World Congress (MWC) Shanghai 2018.

ASTRI attends MWC Barcelona for the 8th Year with 5G and Cellular V2X technologies

ASTRI showcased a series of important 5G communications technologies at the Mobile World Congress (MWC) Barcelona 2019. It did this by putting on joint technology demonstrations at the expo, in collaboration with Anktion (Fujian) Technology Co. Ltd. (previously known as Sunnada Network), Intel Corporation, Quanta Cloud Technology (QCT) Inc., Fu Huake Precision Industry (Shenzhen) Co. Ltd. (a subsidiary of Foxconn Industrial Internet Co. Ltd.), Rohde & Schwarz, Keysight Technologies and Spirent Communications.

ASTRI's intelligent display solutions in the spotlight at CES Asia 2018

From 13 to 15 June 2018, ASTRI participated in CES Asia – one of the largest events of the Asia-Pacific electronics industry. This year, the event attracted over 40,000 visitors and more than 500 exhibiting institutions. Spearheaded by the Optoelectronics Technology Division, the ASTRI team showcased the most recent and exciting developments in its intelligent display R&D at the event. Held at the Shanghai New International Expo Centre (SNIEC), the event proved a superb showcase for the latest and most advanced solutions being developed in areas such as Smart City, Artificial Intelligence, Smart Vehicles and Robotics.

Recent technological achievements unveiled at two leading exhibitions in Shanghai

In 2019, ASTRI showcased some of its most recent technological achievements at two major exhibitions held in Shanghai – Vision China (Shanghai) 2019 and Laser World of Photonics China 2019. ASTRI presented a range of cutting-edge technologies at the events, including a 3D Automated Optical Inspection System, a UV Fluorescence Analyser for Jewellery, an LCoS spatial light modulator device, an optical beam steering module for advanced displays, a laser windshield head-up display (HUD), a large FOV head-mount display (HMD), and a number of others.

Setting standards, creating networks

‘World first’ citywide demonstration of C-V2X-based connected car system at World IoT Expo 2018

In September 2018, ASTRI was privileged to take part in a remarkable ‘first’ at the World IoT Summit 2018 held in the city of Wuxi. In partnership with equipment maker Huawei, auto manufacturers Audi and other ecosystem partners, ASTRI conducted the world’s first-ever citywide demonstration of a 5G-powered Smart Mobility system. The expansive test site spanned around 170 km² in total, covering most areas of the Wuxi city including open roads.

- **Enhanced road safety for both vehicles and pedestrians**
- **Efficient and accurate traffic management**
- **Low-latency communication (~15ms while 3GPP standard requirement is 20ms)**
- **Most advanced alert system covering all potential scenarios (17 use cases)**
- **Tested through world’s first citywide deployment (Wuxi 2018)**
- **Accepted as national standard in Mainland China, currently being explored by Hong Kong’s Transport Department**

HKT and ASTRI pursue Smart City solutions for Hong Kong through innovation partnership

In November 2018, HKT and ASTRI established the HKT-ASTRI Smart City Joint Laboratory to pursue advanced technologies and solutions for making Hong Kong into a Smart City. HKT is providing financial support to the joint laboratory, which will leverage ASTRI’s R&D expertise in next generation communications technologies and sophisticated data solutions.

Hong Kong’s first-ever Smart Open Data Advancement Consortium

The ‘Smart Open Data Advancement Consortium’ was officially launched on 1 November 2018 during Hong Kong FinTech Week. The Consortium aims to revolutionise data-driven innovation endeavours and create tangible impacts by developing a secure and user-friendly platform for leveraging open data effectively. The Consortium’s founding members are ASTRI, City University of Hong Kong, Deloitte, FORMS SYNTRON, JETCO, and Nova Credit. An ecosystem-driven initiative, the Consortium will enable public sector and commercial organisations in Hong Kong – and subsequently in the Greater Bay Area – to develop and implement data-driven smart applications and services that will boost productivity and enhance user satisfaction.

Helping create China's third-generation semiconductor power electronics roadmap

The China Advanced Semiconductor Industry Innovation Alliance released the country's first 'Third-generation Semiconductor Power Electronics Technology Roadmap' in July 2018. ASTRI played a significant part in the process of the Roadmap development, by providing professional advice, communicating with relevant overseas institutions, and helping with the essential drafting and compilation work. ASTRI was the only institution from Hong Kong involved in the development process for the Roadmap.

Representing Hong Kong, ASTRI witnesses release of global 5G standards

A plenary meeting of the 3rd Generation Partnership Project (3GPP) took place in the US city of San Diego on 13 June 2018. As the sole R&D organisation representing Hong Kong, ASTRI's delegation at that meeting included Dr Justin Chuang and Dr Eric Tsang, Vice President and Director respectively of Next Generation Network. At the 3GPP plenary meeting, the standalone standards for 5G NR were agreed upon by more than 600 delegates from the world's major telecom operators, network, terminal and chipset vendors, internet companies and other vertical industry companies. The standards are now acting as an industry benchmark for the forthcoming worldwide rollout of 5G services. Based on the new 3GPP standards, regulators, operators and manufacturers can now finalise their 5G launch plans – from building the network to sourcing equipment to deploying 5G services for consumers.

Partnership architect and innovation enabler

Inspiring a 'Smarter Future Empowered by AI' at Technovation Summit 2018

As Hong Kong's largest applied research and development centre, ASTRI has a mission to enhance Hong Kong's competitiveness in technology-based industries through applied research. To this end, we hosted the ASTRI Technovation Summit 2018 in December, which brought together over 30 thought leaders and experts from Government agencies, the research community and industry. The Summit attracted over 400 experts, entrepreneurs and top-level industry executives, who explored ideas and opportunities for building a smart, innovation-led Hong Kong.

> "Artificial Intelligence is an important technology area that is unlocking a whole new world of potential, and Hong Kong definitely has an edge in developing AI. Hong Kong will play a crucial role in developing more AI applications to make life better for our citizens in the future."
>
> The Honourable Mr Nicholas W Yang, GBS, JP,
> Secretary for Innovation and Technology,
> in his opening remarks at the Summit

Exploring a 'Connected Hong Kong Powered by 5G & IoT'

ASTRI and the Hong Kong Science and Technology Parks Corporation (HKSTP) co-organised a forum on 5G and IoT technologies on 11 March 2019. The forum took place at the Charles K. Kao Auditorium in the Science Park. Present on the occasion were Mr Hugh Chow, Chief Executive Officer of ASTRI, Mr George Tee, Chief Technology Officer of HKSTP, senior leaders from Government and industry, and other key figures from the technology and communications industry, including HKT, China Mobile Hong Kong, Hutchison Hong Kong and Huawei.

Inspiring a smart future for Hong Kong at InnoCarnival 2018

ASTRI was a participant in InnoCarnival 2018, organised by the Innovation and Technology Commission of the HKSAR Government, where it showcased a number of smart technologies that will help transform Hong Kong into a world-class Smart City. ASTRI has taken part in the HKSAR Government's annual 'InnoTech Month' campaign since 2010, and InnoCarnival is part of this campaign. The 2018 edition of InnoCarnival took place at the Hong Kong Science Park. ASTRI's pavilion showcased a number of Smart City technologies that included Vehicle-to-Everything (V2X), Palm Fusion Biometric Authentication, Blockchain for financial services, Naked-eye 3D and other display technologies, Smart Pole, Narrowband Internet-of-Things (NB-IoT), Smart Parking, Smart Community, and Mixed Language Chatbot. In addition, ASTRI helped to inspire a tech-powered future for Hong Kong by facilitating four workshops for over 200 primary and secondary students, where 'Smart City and IOT' were explained to the generation who will build and shape Hong Kong's future. We also facilitated two seminars on 'Connected Cars and V2X Technology' and 'Multifaceted Applications of 5G', each attended by around 50 people.

ASTRI and Cyberport partnership helps AI and Blockchain start-ups unleash their potential

ASTRI and Cyberport partnered for 'ASTRI Technovation Day', when ASTRI was introduced to Cyberport tenant companies, and particularly technology start-ups in FinTech, Blockchain, HealthTech and Artificial Intelligence (AI). Over 40 start-ups took part in the event, which included insightful sessions on Blockchain Applications, Artificial Intelligence (AI) and Data Analytics, along with a facilitated business matching session for AI and Blockchain stream start-ups. ASTRI Technovation Day had a clear mission of fostering collaborations, boosting technological capabilities, sharing useful information about funding resources, and updating participants on ASTRI's technology partnership models.

Partnering in the Blockchain Accelerator Programme for start-ups

ASTRI has partnered with the Hong Kong Science and Technology Parks Corporation (HKSTP) and Molecular Hub to launch a Blockchain-focused accelerator programme for start-ups. The programme was launched on 13 July 2018. As a key partner in the programme, ASTRI will build up and enhance the technological know-how and capabilities of the participating start-ups, providing them with Blockchain-related training. The start-ups will also be able to leverage ASTRI's R&D infrastructure by accessing the facilities of the Smart City Innovation Centre operated by ASTRI.

Helping to build a FinTech talent pipeline for Hong Kong

The FinTech Career Accelerator Scheme (FCAS) aims to nurture Hong Kong's financial and technological talents to meet the emerging and ever-evolving needs of industry. Along with Hong Kong Cyberport and Hong Kong Science Park, ASTRI is a co-organiser in this scheme, which is being spearheaded by the Hong Kong Monetary Authority. FCAS Participants go through a year-long programme of technical and regulatory training, internship placements in Hong Kong and Shenzhen, as well as a gap-year industry placement.

Cultivating students' interest in sport with the help of technology

ASTRI has partnered with the Hong Kong Jockey Club and the Chinese University of Hong Kong in the 'Fun to Move @ JC' initiative – a five-year pilot programme to develop a sustainable model for enhancing the level of physical activity among primary students. The programme aims to improve students' efficiency and motivation in sports by creating systemic changes in their lifelong attitudes and habits related to physical activities. The initiative is serving over 30,000 students from 35 primary schools in Hong Kong.

Technology Divisions

Advanced Digital Systems

The Advanced Digital Systems (ADS) Division is active in the areas of advanced algorithm research, system specifications, virtual prototypes and modelling, IC implementation and testing, and state-of-the-art 'System on Chip' design, among others. The ADS Core Competence Groups (CCGs) create valuable silicon IPs that target emerging IC applications. The Division plays a significant role as part of the Chinese National Engineering Research Centre for Application Specific Integrated Circuit Systems (Hong Kong branch).

The Division is also active in applications-centric research on Distributed Ledger Technology (DLT), or Blockchain. It has helped the Hong Kong Monetary Authority (HKMA) with two whitepapers on DLT applications, and is developing Blockchain solutions in partnership with various industry players.

Industries served

Solutions developed by the ADS Division are being commercialised across a wide range of commercial and professional sectors in Hong Kong and the Greater Bay Area. The Division utilises both in-house research and research conducted at local universities on circuit actualisation and customisation to create commercialised solutions which give its industry partners a competitive edge.

- **Digital signage, media and entertainment**
- **Smart camera, intelligent image signal processor, and video surveillance and analytics**
- **Powerline communication and smart meters**
- **Robotics and Intelligent Machines for Advanced Manufacturing**
- **Blockchain technologies for financial services and other industries**

Core Competence Groups

- Visual Computing
- Machine Learning Platforms
- Secured System Platforms
- SoC Design
- Cyber-Physical Systems

Visual Computing

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

Machine Learning Platforms

The Machine Learning Platforms CCG develops hardware-accelerated solutions for deep learning enabled applications. The team has strong specialisations in neural network optimisation and dataflow neural network processor design. It also innovates hardware-enabled solutions for intelligent video production, object recognition, and various computer vision applications.

Secured System Platforms

The Secured System Platforms CCG develops Blockchain system protocols and applications that evaluate and optimise Blockchain security, performance and scalability. It also carries out research on hardware accelerators to improve Blockchain performance.

SoC Design

The SoC Design CCG realises IC product ideas through innovative design. It works closely with customers and 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.

Cyber-Physical Systems

The Cyber-Physical Systems CCG develops digital-physical twins based on the model-based systems engineering principle. This CCG is concerned with system-level design, synthesis and validation of AI-enabled robotic systems in smart factories.

Key technologies

- 3D immersive VR and 4K/8K Video
- SoC Design Services
- Neural network and video accelerators
- Cyber-Physical Systems
- Machine learning
- Blockchain and secured systems

R&D Highlight

Model-Based Deep Reinforcement Learning Robotic System

The ADS team planned, designed, implemented and tested a robotic system for Robotics Robotics Limited that involved robotic arms, a robotic vision system, robotic system software, machine learning algorithms and convolutional neural networks. This Model-Based Deep Reinforcement Learning Robotic System has significantly improved the operational speed, accuracy and efficiency of industrial assembly lines.

Operation Workflow Blockchain System

Tasked with delivering a Blockchain-based solution for New World Development Company Limited, the ADS team developed the first property-purchase Blockchain platform in Hong Kong. The platform enhances customer experience by seamlessly integrating mortgage services into the customer's property purchase journey. In this particular project, the team developed the system and the operational workflow using Blockchain technology.

Other R&D projects

Project	Focus
Intelligent Video Accelerator (IVA)	Application Specific Integrated Circuits
Wideband Smart Meter System-on-Chip (SoC)	Application Specific Integrated Circuits
Immersive 3D Video Accelerator	Application Specific Integrated Circuits
Blockchain-based Distributed ID Management System	Financial Technologies
Blockchain-based Cross System Autonomous Smart Contracts	Financial Technologies
Hardware Acceleration for VR Video Streaming	Smart City
Dedicated Visual Intelligence Platform	Application Specific Integrated Circuits
Model-based Deep Reinforcement Learning Robotic System	Intelligent Manufacturing
Industrial Deployable Robotic Manipulation System	Intelligent Manufacturing
Immersive Audio Technologies for 3D content	Application Specific Integrated Circuits

Communications Technologies

The Communications Technologies (CT) Division delivers cutting-edge tools and applications based on 5G and other next generation network solutions. Its innovative applications are helping equipment manufacturers and operators to introduce advanced services for customers and subscribers, benefiting both the industries and the community. The CT Division works closely with agencies of the Hong Kong SAR Government, telecommunication service providers, universities, and R&D institutions to deliver market-driven and commercial-quality solutions.

The Division supports Hong Kong's overall Smart City development in terms of standards, solutions and infrastructure, especially in pre-5G and 5G related transformations. Its Core Competence Groups (CCGs) develop open broadband wireless networks and applications, as well as pre-5G and 5G small-cell infrastructure. They focus on creating new technology infrastructure and platforms for a wide range of sectors and applications. The Division also offers end-to-end system solutions to various players at different levels of the value chain in the industry ecosystem.

Industries served

The CT Division develops hardware and software solutions for telecom operators and top-tier equipment manufacturers that are particularly relevant for the transition from pre-5G to 5G standards. It also works with local, national and international regulators to set standards and develop technology platforms.

In Hong Kong, the CT Division has worked with the Office of the Communications Authority (OFCA), the Energising East Kowloon Office, as well as leading telecommunications operators HKT and China Mobile Hong Kong. It also works closely with various Government departments and agencies responsible for transport, electrical and mechanical services, urban renewal and land. It has also helped charitable and social entities concerned with school children, the elderly population and other healthcare recipients.

Beyond Hong Kong, it works with Government bodies and industry regulators in Mainland China, leading global industry players as well as international bodies including 3GPP and GSMA.

Core Competence Groups

- Networking Software
- Baseband Solutions
- Emerging Systems
- Mobile and IoT Platforms

Networking Software (NSOFT)

The expertise of the NSOFT team in networking software helps the development of end-to-end networks that leverage next generation network connectivity. Its services include:

i. Network Functions Virtualisation (NFV) and network orchestration technologies

ii. Standards-compliant core network and mobile edge solutions and networking components

iii. Solutions for smart roadside infrastructure, smart mobility and other smart city projects, including Cellular Vehicle-to-Everything (C-V2X) and Internet of Things (IoT)

iv. 3GPP 15 compliant C-V2X networking system for safer roads, intelligent transportation systems, efficient traffic and highway management, and other smart mobility service scenarios

Baseband Solutions

The Baseband Solutions CCG develops reference designs for industry players, tested by inter-operability tests run by various infrastructure vendors and operators. This CCG specialises in baseband algorithms, and L1-L3 embedded software/DSP Reference Design on SoC Platforms. It has developed cutting-edge pre-5G, 5G, and radio communications systems, as well as baseband algorithms, L1-L3 Embedded Software/DSP reference designs on SoC Platforms, and Broadband Trunking Communications (BTrunC) solutions. These technologies are meeting the increasing demand for high-speed data and voice communications, and are enabling higher quality services in both public and private telecommunication networks.

Emerging Systems

The Emerging Systems CCG develops next generation network technologies for 5G cellular systems that are increasing spectrum efficiency, and thereby reducing both hardware costs and energy consumption. This CCG also works on enhancing existing Device-to-Device (D2D) technologies to develop pre-5G and 5G C-V2X solutions for connected car applications, with the aim of enhancing road safety and paving the way for an even wider range of Smart City applications.

Mobile and IoT Platforms

This CCG develops technologies and total system solutions that realise the potential of mobile applications and IoT. Its innovations are enabling communication systems to accommodate the 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 CCG focuses on developing and advancing proximity, geographic information, and real time telemetric-related technologies for applications such as positioning, navigation, map rendering, sensors data processing, smart distributed gateways, IoT Blockchain and advanced IoT tracking systems.

Key Technologies

- 5G base stations
- 5G Core Network
- Mobile Edge Computing
- Cellular Vehicle-to-Everything (C-V2X)
- Networking system for smart mobility
- Internet-of-Things

R&D Highlight

C-V2X Networking System for Smart Mobility

This industry-leading C-V2X Networking System supports 17 road safety use cases. These include: roadside edge gateways, vehicle on-board unit software and display applications. The system represents a breakthrough innovation for Hong Kong and beyond. The project involved undertaking Hong Kong's first-ever C-V2X trial, in collaboration with HKT, and carrying out the world's largest and first-ever city-wide C-V2X deployment in Wuxi in partnership with leading industry players. The system supports 17 use cases that have been accepted as a national standard in Mainland China.

Mobile Core leading to 5G Service-based Architecture

This innovative new 5G core network solution, created in partnership with Intel, supports 5G standalone deployments (AMF, SMF, UPF). It offers a compelling 5G core network performance, with over 200Gbps throughput on a single server, showcased at Intel's booth at the Mobile World Congress (MWC) Barcelona 2018.

Next Generation Ultra-Dense Networks: PHY Core, Procedures and Interworking

The 5G Ultra-Dense Networks (UDN) technologies delivered in this project include 5G UDN base station with PHY layer reference design, as well as PHY procedures and interworking on the Cloud-RAN platform. The team also completed an infrastructure test to validate and verify standards requirements.

Other R&D projects

Project	Focus
Service Aware Virtualised Mobile Core Network	Smart City
Open 5G Innovation Platform for end-to-end 5G network platform and 5G use cases in VR and V2X	Smart City
Smart IoT Platform for Activity Tracking	Smart City
Procedures and Interworking for Next Generation Ultra-Dense Networks	Smart City
Vehicle-to-Everything (V2X) Networking System for Smart Mobility	Smart City
Vehicle-to-Everything (V2X) Communication System	Smart City
Next Generation Ultra-Dense Networks - PHY Core	Smart City
Software-Defined Wide Area Network	Smart City
Mobile Core towards Service-Based Architecture	Smart City
Evolution of Mission Critical and Reliable Communications	Smart City
Next Generation Mobile Core for Vertical Applications	Smart City
Evolution of Mobile Broadband with 5G	Smart City
Next Generation NB-IoT Baseband Solution	Smart City
Evaluation of V2X Edge Architecture and Management	Smart City
Studies of 5G RAN Technologies for Smart Industrial IoT	Smart City
Smart Indoor and Outdoor Geographic Information System	Smart City
Next Generation Mission Critical Communications	Smart City
5G Access Technologies for Next Generation Heterogeneous Networks	Smart City
NR Ultra-Reliable and Low-Latency Communications (URLLC) Technology for Industrial Automation Control	Intelligent Manufacturing
Evolution of Connected Vehicle Wireless Technology - Study and Module Design for Connected Vehicle Communications Engine	Smart City

Electronics Components

The Electronics Components (EC) Division develops market-driven solutions for the advanced power electronics and smart energy storage industries. It specialises in 3rd generation semiconductor technologies, which have a wide range of applications in areas such as power devices, advanced packaging, power modules, and next generation energy storage systems. The Division possesses leading-edge core competencies in advanced value-added power electronics technologies that are delivering significant cost and performance improvements for various industrial products and services.

The Division also delivers advanced solutions for improving environmental performance, and works to facilitate the wider adoption of smart power devices and energy sources that are creating a secure and sustainable future for all.

Industries served

The Division caters to various technology-centric market verticals including data centres, telecommunications, electric vehicles, charging piles, new energy systems, and high-speed trains.

- 3rd generation semiconductors
- Electric vehicles
- Energy and smart power systems
- Data centres
- Smart City infrastructure

Core Competence Groups

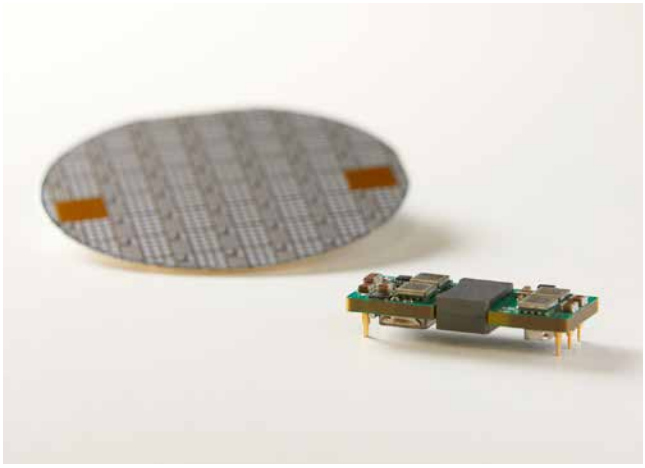
- 3D integration
- Intelligent Energy System
- Smart Power Device & System

3D Integration (3DI)

The 3DI Group provides comprehensive advanced solutions for power electronics products, with specialisation in Silicon Carbide (SiC) and Gallium Nitride (GaN) based packages, modules, and subsystems. The application domains served by the Group include 5G network and infrastructure, new energy vehicles, power and charging systems, data storage and transfer, and railway transportation.

Intelligent Energy System (IES)

The IES Group develops robust energy storage technologies and solutions, helping Smart City and industrial applications to become more energy-efficient and eco-friendly.



Smart Power Device & System (SPDS)

The SPDS Group innovates to develop advanced semiconductor power devices that will enhance energy efficiency and optimise power usage in Smart City development. It also focuses on wide-bandgap technologies and applications with SiC and GaN devices.

Key Technologies

- Energy storage systems
- Smart power hubs
- DC building
- High-density power modules
- Wireless power transfer

R&D Highlight

High Frequency Power Converter with 3D Package-embedded Inductors

Smart City development is largely driven by intelligent infrastructure, devices and communication systems, all of which consume significant amounts of power. By adopting a 3D Package Embedded Inductor, the project improved power density by 50%. Furthermore, it developed a Multi-Ingredient Composite (MIC) that minimised power loss and thermal resistance by 30%. For high-density and high-volume power connections in Smart City applications, these innovations offer eco-friendly and energy-efficient solutions.

Silicon Carbide (SiC) Compact Module (SCM) for Electric Vehicle

This project is developing a next generation, compact power module based on the advanced SiC Metal Oxide Semiconductor Field Effect Transistor (SiC MOSFET). It aims to achieve strong system integration and high-voltage, high-frequency and high-efficiency operations.

Robust Battery Module for Light Electric-drive Vehicles

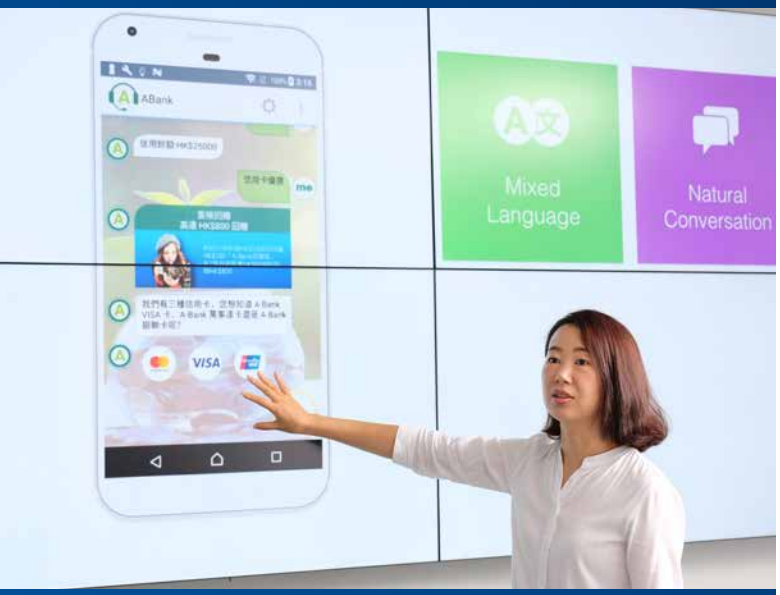
This project provides next generation electric vehicles with an efficient and safe solution for power modules. This involves developing an Electric Conducive Enhancer (ECE) and a Self-Shutdown Layer (SSL) that improves efficiency and minimises the likelihood of hazards arising. Electric Vehicle batteries equipped with the project prototype have delivered positive results.

Other R&D projects

Project	Focus
Next Generation Power Electronics as an Enabler for Electric Vehicles and Robots	Intelligent Manufacturing
Medium-Range Wireless Power Transfer Technology for Smart Homes	Smart City
Advanced Ceramic Substrate for High-Power and High-Frequency Applications	Intelligent Manufacturing
Next Generation SiC-based Matrix Converters	Intelligent Manufacturing
GaN-based High-Density Power Module for Next Generation Power Conversions	Smart City

Intelligent Software and Systems

The Intelligent Software & Systems (ISNS) Division focuses on technology applications such as multimedia processing, mobile computing, Internet of Things (IoT), and Artificial Intelligence (AI). Over the past decade, ISNS has been closely following regional and international technology trends, coming up with innovative end-to-end hardware and software solutions to meet customers' business needs. The Division's core R&D competencies include actionable intelligence, cognitive reasoning and real-time AI. It pursues applied R&D on core technologies, including devices and sensors data, connectivity and digital ecosystems, cloud computing, machine learning and cognitive computing.



Industries Served

The ISNS Division works closely with industry partners, various public and private sector organisations, and technology developers to contribute to overall Smart City development in Hong Kong and the Greater Bay Area.

- Financial services
- Smart City
- Healthcare
- Marketing and infotainment
- Retailing, e-commerce and customer service
- Surveillance and security

Core Competence Groups

- Cloud Computing
- Multimedia Systems & Analytics
- Intelligent Cognitive Systems

Cloud Computing

The Cloud Computing CCG focuses on smart metering and monitoring systems for utilities, Blockchain and AI-based FinTech solutions, smart wearables, and more. It also develops high-performance, large-scale distributed computational cloud platforms. Solutions developed by this CCG support a wide range of applications from media broadcast and digital rights management to FinTech solutions like internet finance and financial trading.

Multimedia Systems & Analytics

This CCG specialises in Machine Learning and AI-based solutions. Its R&D work has applications in Health Tech (e.g. Medical Image Analytics and Medical Imaging Device Development), Smart City (e.g. Virtual and Augmented Reality, Intelligent Video Analytics), and FinTech (e.g. Biometric Authentication and Intelligent Character Recognition). The team has strong expertise in embedded systems and machine learning technologies.

Intelligent Cognitive Systems

The Intelligent Cognitive Systems CCG innovates user experience solutions using machine learning technologies, and develops scalable solutions for smart systems. Its solutions include handwriting and image recognition and 3D motion data analysis, and the Group also works on integrating existing equipment with IoT technology.

Key Technologies

- AI Chatbots
- Blockchain-based systems for privacy, security and data integrity
- Industrial IoT Platforms
- Smart eForm solutions
- Intelligent Data Management Systems (iDMS)
- Eldercare solutions
- Scheduling and Operations of Autonomous Devices
- Cybersecurity service for the education sector
- Data and Video Analytics for safe driving
- Cloud-Edge AI engine for name entity recognition
- News and indices data aggregator and analytics
- Smart wealth management platform
- Smart behaviour analytics with machine learning for utilities applications

R&D Highlight

Artificial Intelligence Chatbot for banking

This AI-based chatbot uses a sophisticated speech recognition engine to manage both pure Cantonese and mixed usage of Cantonese and English. Its Natural Language Processor can understand and interpret colloquial Cantonese expressions. The dialogue system can efficiently provide replies. The project has delivered both text-based and voice-based chatbots that are suitable for banking, retailing and many other service sectors.

Intelligent Companion for Elderly

The ISNS team has collaborated with experts from sectors such as geriatric healthcare, social and charitable services and facilities developers for this project. The intelligent companion for the elderly is designed to improve the psychological and physiological health of ageing people through the use of different types of sensors and embedded interactive functions. The project aims to minimise the healthcare and supervision cost burden of the elderly population, and improve quality of life by tracking and monitoring important health parameters.

Data and Video Analytics for Safe Driving

The project leverages data and video analytics tools on driving behaviour, identifying safe versus risky driving practices in order to minimise road accidents. It uses an innovative visualisation platform to evaluate driving performance. The project has been tested on a public transport service operator's fleet in the Greater Bay Area.

Other R&D projects

Project	Focus
Industrial IoT Platform with Dnp3 And Lora	Smart City
Smart e-Form Server	Smart City and Financial Technologies
Intelligent Data Management System (IDMS)	Smart City and Financial Technologies
Intelligent Platform for Scheduling and Operations of Autonomous Devices	Smart City
Cybersecurity Service for The Education Sector	Smart City
Cloud-Edge AI Engine for Name Entity Recognition	Smart City and Financial Technologies
Chinese Language News and Financial Data Aggregator, Summary and Analytics Solution	Smart City and Financial Technologies
Smart Wealth Management Platform	Financial Technologies
Blockchain-Based Fintech Applications with Strong Focus on Data Privacy	Smart City and Financial Technologies
Smart Behaviour Analytics Platform With Machine Learning for Utilities Applications	Smart City

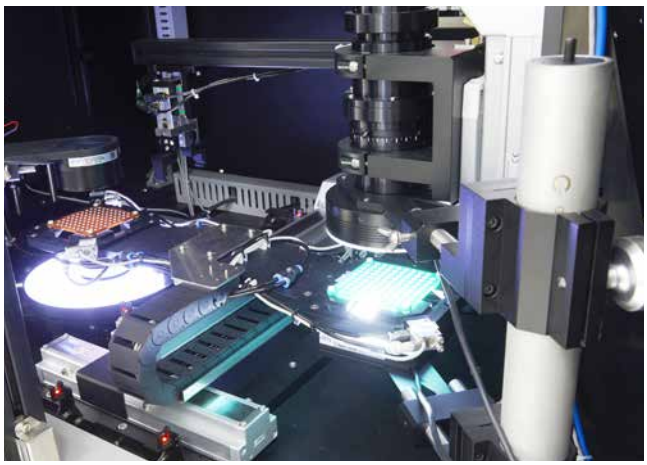
Intelligent Sensing Technology Systems

The Intelligent Sensing Technology Systems (ISTS) Division develops and commercialises market-driven solutions through three core competence groups: Intelligent Machine Vision, Emerging Sensing & Display Systems, and Sensing Devices & Integration. Over the years, the team has been granted over 200 invention patents and transferred over 160 technologies to the industries. The Division has been exploring promising and emerging domains such as palm fusion biometric sensing technology for authentication and security, deep learning based defects classification technology for intelligent manufacturing, and mini-spectroscopy technology for smart living.

Industries served

The ISTS Division serves many different industries in Hong Kong, the Greater Bay Area and beyond. Its innovations support smart factories and a wide range of smart city applications by providing sophisticated sensing and optical solutions that enable automation and boost productivity.

- Smartphones and other electronic gadgets
- Electronic and optical components for the manufacturing sector
- Head-mounts and other wearable display systems
- Authentication and access control systems that use biometric sensing
- Solutions for the automotive industry
- Quality, testing and inspection services



Core Competence Groups

- Intelligent Machine Vision (IMV)
- Emerging Sensing and Display System (ESDS)
- Sensing Devices and Integration (SDI)

Intelligent Machine Vision

The Intelligent Machine Vision CCG focuses on vision technology, dealing with advanced and miniaturised optical engines as well as image understanding and deep learning algorithms. This CCG leverages three major technology platforms: (i) Intelligent Industry Robots, (ii) 2D/3D Intelligent Automatic Optical Inspection (AOI), and (iii) Medical & Healthcare Image Sensing. The Intelligent Industry Robot team focuses on developing intelligent 2D/3D vision sensing modules and recognition & cognition methodologies for industry robot and intelligent manufacturing related applications, with the aim of realising Industry 4.0 smart factory standards. During the year, the team continued with its R&D efforts in 3D Random Bin Picking technology (3D-RBP) for industrial robot application. The Machine Vision Inspection team is currently focused on developing Machine Learning and deep learning based algorithms for defect inspection and classification of cover glass, lenses and wafers. Furthermore, the team has been working to encourage tier-1 manufacturers to adopt ASTRI's novel 2D/3D automatic optical inspection (AOI) system for their production lines, a system that can reduce labour costs as well as enhancing product quality. The Medical and Healthcare Image Sensing team works on advanced HealthTech solutions.

Emerging Sensing and Display Systems (ESDS)

The Emerging Sensing and Display System CCG develops smart devices for various applications. This CCG relies on three key technologies: (i) Diffractive & Holographic Optics for display and sensing, (ii) Human Centric Sensing Fusion for biometrics and human-machine interaction, and (iii) Next Generation Mixed Reality Displays.

Sensing Devices and Integration

The Sensing Devices and Integration CCG develops integrated optical modules for environmental sensing and the manufacturing process. Three major technological platforms are being explored by this team: (i) Sensing devices and modules integration for environment sensing, (ii) Hyperspectral imaging for industrial inspections, and (iii) Mobile phone-based spectroscopy.

Key Technologies

- **Defect detection and classification**
- **Flexible display inspection system for OLED/Micro-LED lighting-on test**
- **Industrial robot with 2D/3D eye-in-hand visual sensing**
- **Biometric sensing devices**
- **Diffractive nanostructures**
- **Augmented Reality (AR) display technologies for wearable display**
- **Automotive head-up display**
- **Human-centric sensing fusion platform**
- **Mobile spectroscopy and hyperspectral imaging on smartphones, applicable for environmental sensing and testing materials in daily lives**

R&D Highlight

Deep Machine Vision Platform

This project significantly improves the capabilities for defect inspection and quality control in automated production lines, and involves a rapid machine vision application for inspection software and systems. The deep learning based defect detection technology can accurately detect defects without manual intervention. The solution carries out advanced defects analysis, and robustly supports 2.5D/3D glass surface inspection at smartphone production facilities.

Automotive Holographic Head-up-Display (HUD)

This project delivers a uniquely efficient and convenient mode of displaying driving assistance information on the windshields of vehicles. The holographic HUD uses a sub-pixelated Liquid Crystal-on-Silicon (LCoS) phase modulator that provides drivers with a stable, see-through display. The project is helping to advance the development of automotive HUD products and technologies in Hong Kong and the Greater Bay Area, helping to position the region as a leading R&D and industrial hub for this technology.

Smartphone-based Mini-spectrometer for Healthy Living

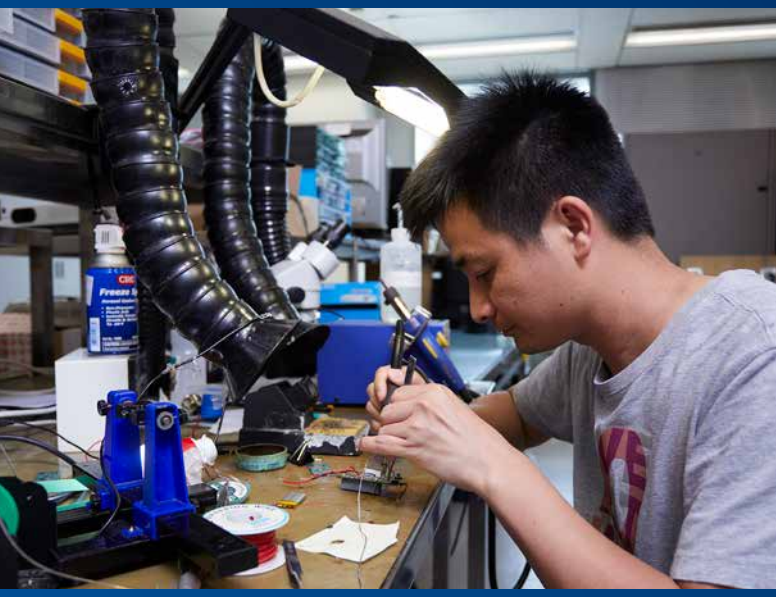
The innovative mini-spectrometer uses features available in most common models of modern smartphones to provide accurate and efficient checks on the composition and structure of different materials. The compact spectrometer has a reflective wedge structure. This mini-spectrum scanning device allows high-resolution images to be captured at low cost and with high accuracy. This truly handy solution can be applied in multiple areas, including consumer electronics, health monitoring, food and water quality inspection, and even jewellery testing.

Other R&D projects

Project	Focus
3D Random Bin Picking Technology for Industrial Robot	Intelligent Manufacturing
On-chip Spectrometer for Chemical Sensing	Intelligent Manufacturing, Health Technologies and Smart City
Diffractive and Holographic Optics for See-through AR Display (DHOD)	Intelligent Manufacturing and Smart City
Sensor Fusion for Environmental Monitoring	Intelligent Manufacturing, Health Technologies and Smart City
Active Geometric Phase Device for AR Display and Sensing	Intelligent Manufacturing and Smart City
Eye-in-Hand (EiH) Flexible Visual Inspection System	Intelligent Manufacturing
Feasibility Study of Active Illumination Enhanced Hyperspectral Imaging Platform	Intelligent Manufacturing
Biometric Sensing Fusion For AR/VR Display	Intelligent Manufacturing and Smart City

Mixed Signal Systems

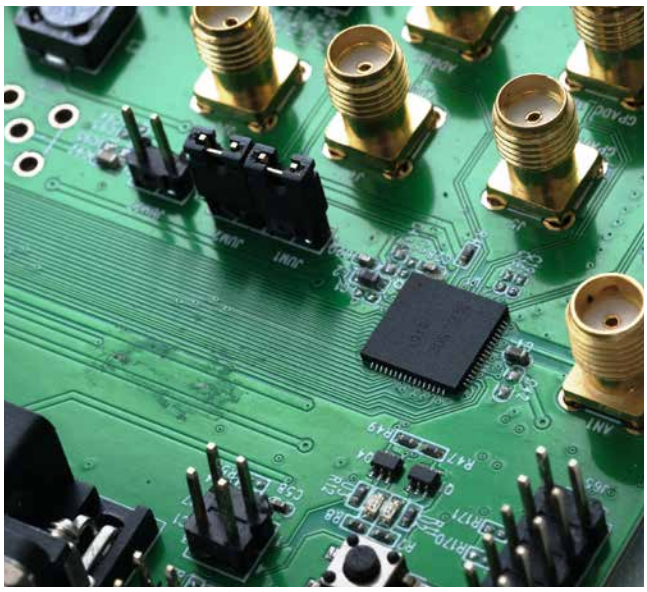
Researchers in the Mixed Signal Systems (MSS) Division are dedicated to developing leading-edge solutions in Integrated Circuits (ICs) and related areas. The Division is a key constituent of the first-ever Hong Kong branch of the Chinese National Engineering Research Centre (CNERC), located within ASTRI and focusing on Application Specific Integrated Circuits. The targeted IC applications cover Internet of Things (IoT), wireless communications, and sensor signal processing.



Industries served

The MSS Division offers competitive Intellectual Property (IP) and other practical solutions related to IC design across various industries and sectors. These include Wireless IoT System-on-Chip (SoC) design, Ultra Low Power IC design, Electrostatic Discharge (ESD) and Input/Output (I/O) design technology.

- Semiconductor design
- Electronic appliances
- Telecommunications



Core Competence Groups

- RF Systems
- Low Power Design
- Technology Co-Design

RF Systems

The RF Systems CCG provides wireless connectivity solutions with state-of-the-art low power integrated circuit design. These include Narrowband Internet of Things (NB-IoT) and the latest Bluetooth Low Energy (BLE) technologies. In addition to facilitating the development of Smart City applications, NB-IoT enables a wide range of connectivity solutions for personal, industrial, and other connected appliances.

Low Power Design

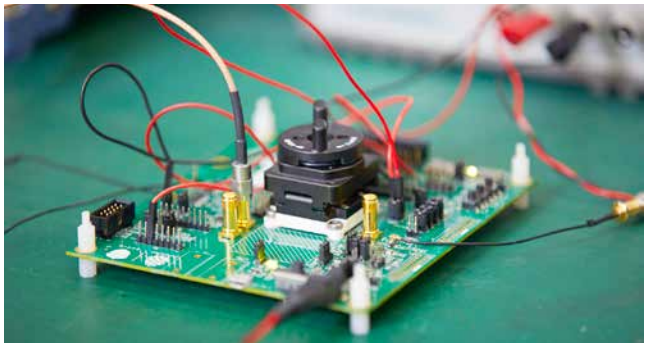
The Low Power Design CCG has developed a full range of silicon-proven IPs for low-power sensor signal processing. These IPs have been widely adopted and implemented in applications such as Hall sensors, wireless electrocardiography, uncooled infrared micro-bolometers, and G-sensors. Many of these IPs have already been licensed to industrial customers for mass production.

Technology Co-Design

The Technology Co-Design CCG develops and models advanced semiconductor devices. It provides solutions for ESD protection devices, semiconductor sensors, and other novel semiconductor devices. Its technological core competence includes virtual fabrication and compact model extraction. 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. It collaborates closely with IC foundries and design houses to develop unique advanced devices and model IPs using Complementary Metal-Oxide-Semiconductor (CMOS) technologies. It has successfully delivered device and model IPs from 0.5nm to 16nm FinFET processes.

Key technologies

- 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
- NB-IoT



R&D Highlight

Low Capacitance ESD Structures for RF Applications

This project designed an On-chip ESD and CDM protection structure for various electrical and electronic applications. The On-board ESD and surge protection structure is designed to provide maximum safety and efficiency.

Advanced Bluetooth Low Energy SoC

Bluetooth Low Energy technology is a power-efficient solution that supports connectivity of a very large number of devices. This System-on-Chip IP offers an excellent solution for connecting smart devices in the most efficient way using low-energy Bluetooth connections.

System-on-Chip for Narrowband Internet of Things

This project delivers a unique solution for smart devices that use Narrowband Internet of Things (NB-IoT) connectivity. This System-on-Chip design supports low-power NB-IoT technology developed under the latest 3GPP standards, enabling its use in a wide range of smart devices and services.

Other R&D projects

Project	Focus
Dual-Mode RF Transceiver for Enhanced eMTC and NB-IoT	Smart City, Intelligent Manufacturing and Application Specific Integrated Circuits
Cross Platform IO Design for FinFET Technology	Smart City, Intelligent Manufacturing and Application Specific Integrated Circuits
Feasibility Investigation of Deep Learning in Device Modelling	Smart City, Intelligent Manufacturing and Application Specific Integrated Circuits

Security & Data Sciences

Among its other mandates, a key task of the Security & Data Sciences (SNDS) Division is to help to position Hong Kong as a premier international FinTech hub. The SNDS team is made up of top security, data science, and multimedia professionals from around the region. The research being undertaken by this Division is providing comprehensive protection for modern IT systems that contain large amounts of textual and multimedia data.

Industries served

The division's five Core Competence Groups (CCGs) are ASTRI Security Lab, Applied Cryptosystems, Cybersecurity and Analytics, Data Analytics and Multimedia Systems and Analytics. They support financial services and other industries by delivering advanced knowledge, insights and applications in the fields of cyber-defence and data analytics. The Division's research expertise is applied across a wide variety of sectors and industries, including banking, insurance, retail, logistics, law enforcement, public services and telecommunications.

- Public sector
- Financial services
- Healthcare
- Insurance
- Manufacturing
- Telecommunications

Core Competence Groups

- ASTRI Security Lab
- Applied Cryptosystems
- Cybersecurity and Analytics
- Data Analytics
- Multimedia Systems and Analytics

ASTRI Security Lab

This year, the ASTRI Security Lab team developed a cybersecurity information sharing platform and a cloud security platform with advanced encryption technology. Along with platform development, ASL provides cyber-attack intelligence, in-depth cyber-threat assessment, and third-party reviews to various industries. The team also works on Blockchain applications on major platforms, and works to enhance security for Blockchain consensus algorithms and networks.

Applied Cryptosystems

The Applied Cryptosystems team explores technologies related to the applications of cryptography in different industry sectors. The team's R&D experts focus on developing software and hardware cryptosystems for Fintech security, IoT security and Multimedia analysis.

Cybersecurity & Analytics

Professionals in the Cybersecurity & Analytics team conduct cyber-threat hunting and analysis. In an age where the bulk of business, institutional and personal data is stored online, the increasing frequency and sophistication of cyber-attacks poses a major threat to society. To help businesses and the community cope with this, the CSA team applies data analytics, machine learning and AI-powered tools to combat cyber threats, combining human skills with advanced hardware-software capabilities.

Data Analytics

The Data Analytics team specialises in developing scalable, real time big data analytics platforms and advanced AI solutions

using deep learning / machine learning technologies to support various industries. The team develops technologies throughout the whole data lifecycle, from data acquisition to data storage, data management, data analytics and visualization. The team's current technical focuses include financial risk analytics, fraud detection, time-series data analytics, knowledge graph and graph analytics, to support industry partners in Fintech, RegTech, Intelligent Manufacturing and digital marketing.

Multimedia Systems and Analytics

The Multimedia Systems and Analytics team engages in multimedia system development and unstructured data analytics. It specialises in developing hardware, firmware, software, and algorithms for analysing various multimedia content. The team's current focus areas include Optical Character Recognition (OCR), intelligent document processing, medical imaging and computer-aided diagnosis, Virtual Reality and Augmented Reality (VR and AR), behaviour and biometrics authentication, and video analytics.

Key Technologies

- Data analytics
- Multimedia analytics
- Machine Learning for data and multimedia analytics
- Handwritten and printed OCR
- Image / Video / Form Document processing and analytics

R&D Highlight

Next Generation Capsule Endoscopy System

The project is developing a compact capsule localisation and navigation system that combines magnetic sensing, inertial measurement unit and multi-body magnetic actuation. The solution provides simultaneous localisation and mapping technology for fast, accurate, convenient and affordable stomach endoscopy.

Intelligent Media Analytics System for Financial Institutions

This end-to-end real-time analytics platform can read and analyze data from various channels by leveraging advanced algorithms based on up-to-date NLP, machine learning, and deep learning technologies. The solution is helping several industries to better utilise the external data sources to enhance their operational efficiency especially in making more efficient and intelligent advertising strategies.

Automated Content Processing Platform through Deep Learning

This platform enhances an organisation's ability to detect fraud in the form of fake insurance claims. Its Image-based Comparison Algorithm (IBCA) compares similarities between submitted claims in image formats. This in turn helps insurers to verify the authenticity of submitted claims, and to easily compare similar claimant submissions. The solution is also helping to verify claim statements with the contents extracted from supporting images.

Other R&D projects

Project	Focus
Cybersecurity Assessment System for Financial Services and Securities Institutes	Financial Technologies
Real-time IoT Data Analytics Platform for Manufacturing and Other Industrial Sectors	Smart City and Intelligent Manufacturing
Mobile Visual Computing Platform	Smart City and Intelligent Manufacturing
Security Analytics Platform for Financial Services Industry	Financial Technologies
Deep Learning Facilitated Medical Image Data Analytics	Health Technologies
Automated Form Processing System	Smart City and Financial Technologies
Hong Kong Trade Repository (HKTR) Viewing System	Financial Technologies
Support Tools for Automated Form Processing System	Smart City and Financial Technologies
Handwritten Chinese Character Recognition System	Smart City and Financial Technologies
Trial: Intelligent Automated Document Processing	Smart City and Financial Technologies

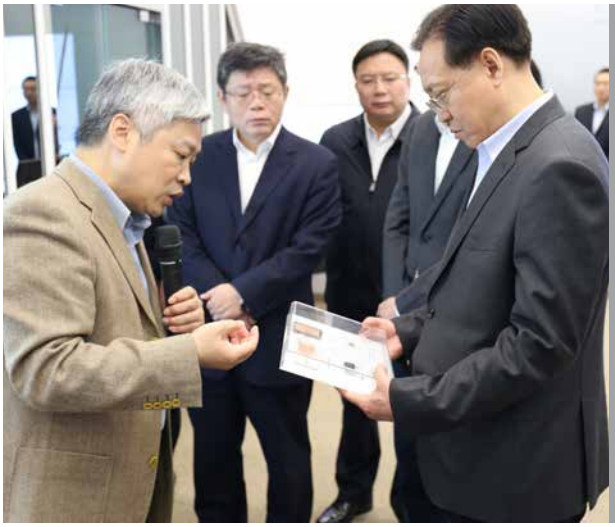
Engaging with the Community

Mr Wang Zhigang, National Minister for Science and Technology, visits ASTRI

Mr Paul Chan Mo-po, Financial Secretary of the HKSAR Government, visits ASTRI to learn about its latest R&D innovation and endeavours

Dr Tan Tieniu, Deputy Director of the Central Government's Liaison Office in Hong Kong, visits ASTRI

Mr Miao Deyu – Deputy Director-General, Policy Planning Department of the Ministry of Foreign Affairs, People's Republic of China visits ASTRI's Smart City Innovation Centre



Mr Lin Nianxiu, Vice Chairman of National Development and Reform Commission visits ASTRI

Rockets, jet engines, and an ambitious future for Hong Kong: Professor Joseph Hui captivates the audience in a Tech-Talk session organised by ASTRI

Mr Qiao Xiaoyang, Chairman of the 12th NPC Law Committee, visits ASTRI

VTC Chairman Dr Roy Chung visits ASTRI

Forum hosted by ASTRI and HKSTP explores a Connected Hong Kong Powered by 5G & IoT

Chairman of Dashun Group Ir Dr Raymond Ho and his delegation take keen interest in ASTRI's smart city technologies

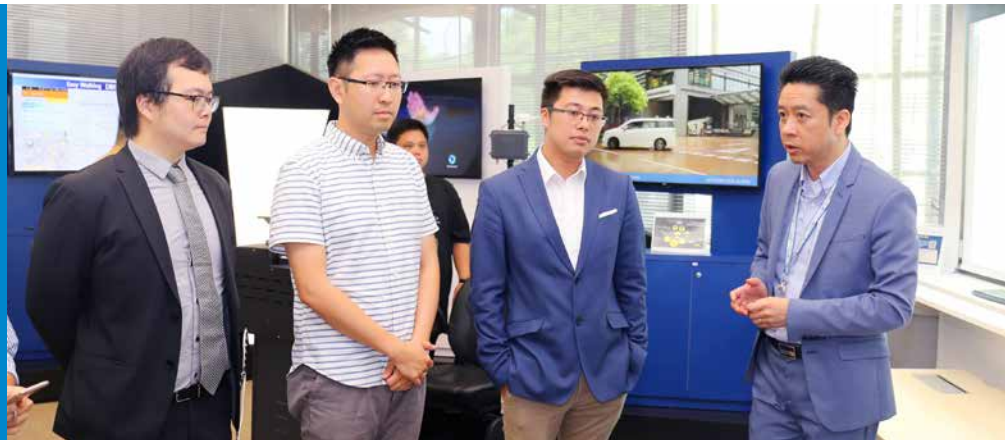
Dr Lam Ching-choi, Member of the Executive Council, HKSAR Government visits ASTRI

ASTRI helps boost technical capabilities of participating start-ups in the Accenture FinTech Innovation Lab Asia-Pacific

Dr Christoph Wolff, Head of Future of Mobility System, World Economic Forum visits ASTRI and experiences its V2X skill

Senior leaders from Swiss Government visit Smart City Innovation Centre at ASTRI and explore technological collaboration potential

Delegation of Young Democratic Alliance for the Betterment and Progress of Hong Kong visits ASTRI



ASTRI partners with HKSTP and Molecular Hub in organising Blockchain Accelerator Programme for start-ups

ASTRI gets onboard the 'Fun to Move@ JC' programme to cultivate students' interest in sport with the help of technology

SCC delegation, led by LegCo member Hon Dr Elizabeth Quat, visits ASTRI and experiences its smart city R&D efforts

ASTRI and its partners join the launch ceremony of INDEX: FHKI's latest initiative to support start-ups

Austrian Government and business delegations visit ASTRI to explore collaboration opportunities

The HKT-ASTRI Smart City Joint Laboratory pursues advanced technologies and solutions for Smart City development

FCAS 2.0 Induction Day gives participants a taste of what to expect from the exciting year-long programme

ASTRI's innovation that protects the elderly from wandering risk wins prestigious Asia-Pacific Eldercare Innovation Award

Vice President of OneTV Media Global Limited, and 'Elite One-on-One' programme's host, Ms Jane Chen interviewed ATSRI's CEO Mr Hugh Chow, to discuss how Hong Kong could retain I&T talents

Delegation from Beijing Union University visits ASTRI

Performance

Performance

ASTRI is dedicated to developing innovative technologies that can improve community life and strengthen business performance. Its success can be measured through the scale of its innovations, the economic impact of its solutions, and the tangible improvements it brings to people's lives. In order to address the unique needs of customers and communities in meaningful and tangible ways, ASTRI has placed the commercialisation of its technologies as its central focus.

ASTRI measures its performance annually against three quantitative benchmarks:

1 Number of patent applications filed and granted

2 Number of technologies transferred to industry

3 Income generated from industry

Patents

Patents reflect the originality and value of our innovations. They also serve as a foundation for technology transfers to industry. In the year 2018-19, ASTRI filed 66 innovative patents in the US, Mainland China, and other territories.

Number of patents filed by Technology Division			
Technology Division	**2018-19**	**2017-18**	**2016-17**
Advanced Digital Systems	6	4	8
Communications Technologies	18	16	10
Electronics Components	14	11	14
Intelligent Software and Systems	7	9	11
Mixed Signal Systems IC	6	8	6
Intelligent Sensing Technology Systems	11	16	11
Security and Data Sciences	4	0	0
Total	**66**	**64**	**60**

Number of patents granted by Technology Division			
Technology Division	**2018-19**	**2017-18**	**2016-17**
Advanced Digital Systems	3	1	4
Communications Technologies	15	10	7
Electronics Components	9	8	7
Intelligent Software and Systems	6	4	4
Mixed Signal Systems IC	8	13	9
Intelligent Sensing Technology Systems	12	13	26
Security and Data Sciences	1	4	2
Total	**54**	**53**	**59**

Number of patents granted by Territory			
Territory	**2018-19**	**2017-18**	**2016-17**
US	35	26	33
Mainland China	17	27	25
Others	2	0	1
Total	**54**	**53**	**59**

Technology Transfers

The commercialisation of cost-effective, innovative, and market-compatible technologies is one of ASTRI's most important objectives. Our technologies are transferred to industry through technology licensing, Industry Collaborative Projects, contract services, and other legal arrangements.

Number of technology transfers by Technology Division

Technology Division	2018-19	2017-18	2016-17
Advanced Digital Systems	8	9	9
Communications Technologies	10	18	11
Electronics Components	6	7	7
Intelligent Software and Systems	7	20	9
Mixed Signal Systems IC	3	5	2
Intelligent Sensing Technology Systems	7	8	11
Security and Data Sciences	10	5	11
Total	**51**	**72**	**60**

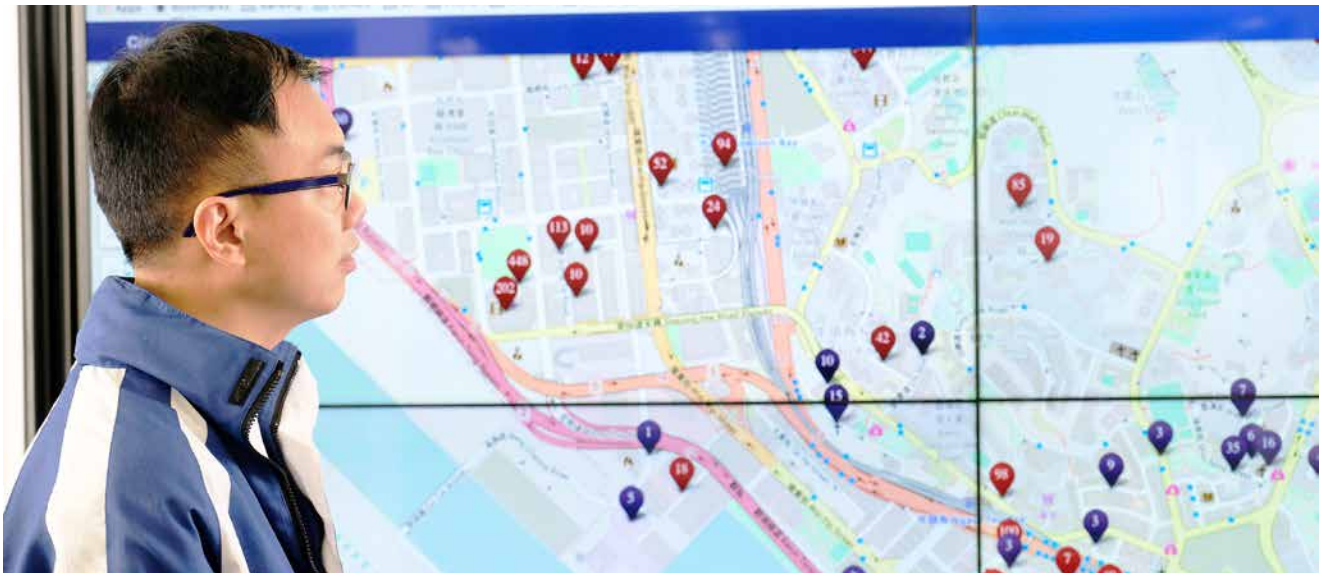
Number of technology transfers by channel

Channel	2018-19	2017-18	2016-17
Industry Collaboration Projects	-	3	4
Contract Research	32	43	31
Licensing Agreements	19	26	25
Total	**51**	**72**	**60**

Certain licensing agreements consist of contract research services provided by ASTRI

Number of projects undertaken by Technology Division			
Technology Division	**2018-19**	**2017-18**	**2016-17**
Advanced Digital Systems	13	17	17
Communications Technologies	21	21	17
Electronics Components	9	9	10
Intelligent Software and Systems	25	25	26
Mixed Signal Systems IC	6	9	10
Intelligent Sensing Technology Systems	13	13	14
Security and Data Sciences	14	13	13
Total	**101**	**107**	**107**

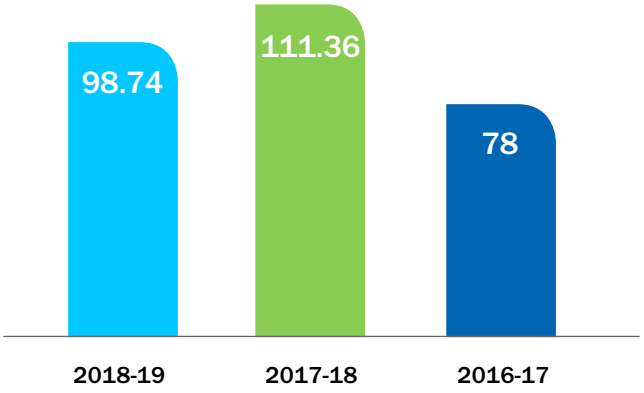
Number of projects undertaken by project type			
Project Type	**2018-19**	**2017-18**	**2016-17**
Platform Projects	54	52	44
Seed Projects	40	44	44
Industry Collaboration Projects	5	9	11
Public Sector Trial Scheme Projects	2	2	8
Total	**101**	**107**	**107**



Income from Industry

Projects undertaken by ASTRI generated income amounting to HK$98.74 million in 2018-19. The income received from industry in the past three years is shown below.

Income from Industry (HK$M)



Including cash and in-kind contributions

Income from Industry (HK$M) by Technology Division

Technology Division	2018-19	2017-18	2016-17
Advanced Digital Systems	8.11	21.74	10.98
Communications Technologies	29.00	22.96	15.59
Electronics Components	13.51	9.39	8.4
Intelligent Software and Systems	10.24	16.23	10.41
Mixed Signal Systems IC	11.41	18.29	10.94
Intelligent Sensing Technology Systems	14.29	9.75	12.57
Security and Data Sciences	12.18	12.98	6.65
Headquarter	-	0.02	2.46
Total	**98.74**	**111.36**	**78.00**

Including cash and in-kind contributions

Financial Report

Financial Report

Overview

For 2018-19 financial year, the consolidated income and expenditure of ASTRI amounted to HK$539,860,622 and HK$539,024,671 respectively, resulting in a surplus of HK$835,951.

The funds from the Government comprised HK$155,994,758 from recurrent subvention, HK$265,748,569 from ITF project funds ("ITF"), HK$1,920,409 from ITF General Support Programme ("GSP"), HK$1,520,255 from ITF Public Sector Trial Scheme ("PSTS"), HK$529,710 from Ministry of Science and Technology of the People's Republic of China, HK$8,400,841 from ITF Internship/researcher/postdoctoral hub and HK$4,780,162 from ITF for Chinese National Engineering Research Centre for Application Specific Integrated Circuit System (Hong Kong Branch). In 2018-19 financial year, the income from the industry amounted to HK$100,965,918. The total expenditure of recurrent subvention amounted to HK$158,517,145, which represented an increase of HK$15,498,244 (10.8%) 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$348,844,965, of which 77% of the expenditure was spent on manpower and 23% 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 71 full projects, 49 seed projects, two GSP projects and two PSTS projects. Meanwhile, the Internship/researcher/postdoctoral hub expenditure amounted to HK$8,400,841, which represented the actual cash outflow of salary payment for interns/researchers/postdoctoral talent engaged in 30 full projects and 10 seed projects.

The consolidated financial statements of ASTRI for the year ended 31 March 2019 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 74-75.

Consolidated Statement of Income and Expenditure and Comprehensive Income

Year ended 31 March 2019	2019 (HK$)	2018 (HK$)
SUBVENTION		
Income from Government subvention	155,994,758	137,907,891
Administrative expenses	(158,517,145)	(143,018,901)
Deficit on subvention	(2,522,387)	(5,111,010)
PROJECT FUNDING FROM INNOVATION AND TECHNOLOGY FUND AND INDUSTRY CONTRIBUTIONS		
Project fund income		
- Innovation and Technology Fund	265,748,569	240,930,117
- Industry contributions	79,607,732	69,861,026
Project expenditure	(345,356,301)	(310,791,143)
Balance on project funding	-	-
Project fund income - General Support Programme		
- Innovation and Technology Fund	1,920,409	1,555,064
- Industry contributions	48,000	70,000
Project expenditure	(1,968,409)	(1,625,064)
Balance on project funding	-	-
Project fund income - Public Sector Trial Scheme		
- Innovation and Technology Fund	1,520,255	4,552,506
Project expenditure	(1,520,255)	(4,552,506)
Balance on project funding	-	-
PROJECT FUNDING FROM MINISTRY OF SCIENCE AND TECHNOLOGY OF THE PEOPLE'S REPUBLIC OF CHINA		
Project fund income	529,710	-
Project expenditure	(529,710)	-
Balance on project funding	-	-
INTERNSHIP/RESEARCHER/POSTDOCTORAL HUB FUNDING FROM INNOVATION AND TECHNOLOGY FUND		
Internship/researcher/postdoctoral hub fund income	8,400,841	4,638,692
Internship/researcher/postdoctoral hub expenditure	(8,400,841)	(4,638,692)
Balance on internship/researcher/ postdoctoral hub 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	(4,780,162)	(5,019,784)
Amount for reimbursement	4,780,162	5,019,784
OTHER INCOME, NET		
Other income	21,310,186	36,206,983
Other expenses	(16,654,639)	(20,244,339)
Other income, net	4,655,547	15,962,644
AMOUNT RETURN TO THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION	**(1,297,209)**	**(7,404,218)**
Surplus before tax	835,951	3,447,416
Income tax expense	-	(1,308,585)
SURPLUS FOR THE YEAR	**835,951**	**2,138,831**
OTHER COMPREHENSIVE LOSS THAT MAY BE RECLASSIFIED TO SURPLUS OR DEFICIT IN SUBSEQUENT PERIODS		
Exchange differences arising on translation of foreign operations	(39,564)	(10,944)
TOTAL COMPREHENSIVE INCOME FOR THE YEAR	**796,387**	**2,127,887**

Consolidated Statement of Financial Position

31 March 2019	2019 (HK$)	2018 (HK$)
NON-CURRENT ASSETS		
Property, plant and equipment	26,154,890	14,752,664
CURRENT ASSETS		
Accounts receivable, contract assets, prepayments and deposits	33,766,201	32,273,800
Amount due from the Government of the Hong Kong Special Administrative Region	4,527,231	4,677,665
Tax recoverable	1,215,326	-
Cash and cash equivalents	224,911,696	244,105,059
	264,420,454	**281,056,524**
CURRENT LIABILITIES		
Accounts payable, other payables and accruals	77,869,568	61,331,713
Deferred government grants	8,701,427	-
Receipts in advance	94,119,927	127,153,829
Amount due to the Government of the Hong Kong Special Administrative Region	802,688	7,701,044
Tax payable	14,018	1,311,742
Provision	-	1,500,000
	181,507,628	**198,998,328**
NET CURRENT ASSETS	**82,912,826**	**82,058,196**
TOTAL ASSETS LESS CURRENT LIABILITIES	**109,067,716**	**96,810,860**
NON-CURRENT LIABILITY		
Provision	11,460,469	-
Net assets	**97,607,247**	**96,810,860**
EQUITY		
Share capital	2	2
Reserves	97,607,245	96,810,858
Total equity	**97,607,247**	**96,810,860**

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 2019 and 31 March 2018, included in the Consolidated Statement of Income and Expenditure and Comprehensive Income, and the Consolidated Statement of Financial Position set out on pages 74-75, 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.

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Hong Kong Applied Science and Technology Research Institute Company Limited

5/F, Photonics Centre, 2 Science Park East Avenue, Hong Kong Science Park, Shatin, Hong Kong
Tel: (852) 3406 2800 Fax: (852) 3406 2801 Email: corporate@astri.org

Room 220, 2/F, Chinese Overseas Scholars Venture Building, Shenzhen Hi-tech Industrial Park, Nanshan, Shenzhen
Tel: (86 755) 8632 9394 Fax: (86 755) 8632 9394 Email: corporate@astri.org