

For discussion  
on 15 June 2021

**Legislative Council  
Panel on Commerce and Industry**

**Latest Progress Report on Research & Development Centres**

**PURPOSE**

This paper briefs Members on the operation of the five Research and Development (“R&D”) Centres under the purview of the Innovation and Technology Commission (“ITC”) in 2019-20 and 2020-21.

**BACKGROUND**

2. Since 2006, the Government has set up the following five R&D Centres to drive and coordinate applied R&D in selected focus areas -

- (a) Automotive Platforms and Application Systems R&D Centre (“APAS”);
- (b) Hong Kong Applied Science and Technology Research Institute<sup>1</sup> (“ASTRI”);
- (c) Hong Kong Research Institute of Textiles and Apparel (“HKRITA”);
- (d) Logistics and Supply Chain MultiTech R&D Centre (“LSCM”);  
and
- (e) Nano and Advanced Materials Institute (“NAMI”).

3. In June 2020, the Finance Committee (“FC”) of the Legislative Council (“LegCo”) approved an allocation of \$1,015.1 million from the Innovation and Technology Fund (“ITF”) to support the operation of four R&D Centres<sup>2</sup> up to 31 March 2025, averaging about \$250 million per year.

4. The R&D Centres play an important role in creating a vibrant innovation and technology (“I&T”) ecosystem. They act as a focal point for

---

<sup>1</sup> ASTRI was established in 2000 and designated as the R&D Centre for Information and Communications Technologies in 2006.

<sup>2</sup> The allocation excludes ASTRI since its operating expenditure is met separately from Government’s annual recurrent subvention.

technology collaboration among the Government, industry, academia and research sectors. The R&D Centres not only contribute to the applied research in key areas, but also work closely with the industry to encourage private investment in R&D in Hong Kong and drive the commercialisation of R&D results.

5. In addition, the R&D Centres actively participate in the Public Sector Trial Scheme (“PSTS”)<sup>3</sup> and promote the adoption of local technology products and services by public sector organisations. Throughout the years, the R&D Centres have also nurtured a lot of research talents and received numerous international awards for their innovations, making significant contribution in consolidating the capabilities of local scientific research teams.

## LATEST OVERVIEW OF THE OPERATION OF THE R&D CENTRES

6. The ensuing paragraphs provide an overview of the operation of the R&D Centres in 2019-20 and 2020-2021 on the following areas -

- (a) operating expenditure and staffing situation;
- (b) industry income and commercialisation; and
- (c) R&D projects and expenditure.

### (A) Operating Expenditure and Staffing Situation

7. The operating expenditure and staffing situation of the R&D Centres are as follows -

Table 1: Operating Expenditure (\$ million) and Staffing Situation

	Operating Expenditure (\$ million)					Number of Staff as at 31 March 2021
	2018-19 (a)	2019-20 (b)	2020-21 (c)	2019-21 average (d)	% change [(d) - (a)/ (a)]	
APAS	18.3	20.6	19.7	20.2	+10%	27
ASTRI	156.9	170.2	174.0	172.1	+10%	626
HKRITA	37.1	39.2	42.2	40.7	+10%	75
LSCM	37.2	42.5	45.6	44.1	+19%	164
NAMI	73.6	78.7	79.8	79.3	+8%	252

<sup>3</sup> PSTS is a funding scheme under the ITF which supports the production of prototypes/samples and conducting of trials in the public sector to facilitate and promote the realisation and commercialisation of R&D results for the ITF projects, those developed by incubatees and graduate tenants of the Hong Kong Science and Technology Parks Corporation and Cyberport, as well as other technology companies conducting R&D activities in Hong Kong.

	Operating Expenditure (\$ million)					Number of Staff as at 31 March 2021
	2018-19 (a)	2019-20 (b)	2020-21 (c)	2019-21 average (d)	% change [(d) - (a)/ (a)]	
<b>Total</b>	<b>323.1</b>	<b>351.2</b>	<b>361.3</b>	<b>356.3</b>	<b>+10%</b>	<b>1 144</b>

8. In 2019-20 and 2020-21, the average operating expenditure of the five R&D Centres was \$356.3 million. This represents an increase of about 10% as compared with that in 2018-2019. Some of the R&D Centres have hired additional R&D personnel and rented additional laboratory space for enhancing their in-house research capability. Some of the R&D Centres have allocated additional resources in commercialisation work, maintenance of their intellectual property (“IP”) portfolio and maintenance of equipment, etc.

### **(B) Level of Industry Income and Commercialisation**

9. As the R&D Centres are platforms for coordinating applied research and facilitating technology transfer to the industry, it is very important to gauge the level of support of the industry in their work. However, it is worth noting that in addition to conducting applied R&D in key areas, the R&D Centres also play an ancillary and platform role. For example, some of the research projects of the R&D Centres are relatively upstream (exploratory in nature) and midstream R&D. There is still a long way before reaching the commercialisation phase and it will take time to achieve outcomes. The industry income of the R&D Centres in 2019-20 and 2020-21, which mainly covers the industry contribution for their R&D projects and commercialisation income, is as follows -

Table 2: Industry Income Received (\$ million)

Industry Income Received (\$ million)					
	2018-19 (a)	2019-20 (b)	2020-21 (c)	2019-21 average (d)	% change [(d) - (a)/ (a)]
APAS	14	12.0	28.5	20.3	+45%
ASTRI	96.6	117.0	65.5	91.3	-5%
HKRITA	26.0	42.4	23.6	33.0	+27%
LSCM <sup>4</sup>	30.0	25.3	52.6	39.0	+30%

<sup>4</sup> Income of special contract service commenced for anti-epidemic work for the Coronavirus Disease 2019 in 2020-21 has not been included in the calculation.

<b>Industry Income Received (\$ million)</b>					
	2018-19 (a)	2019-20 (b)	2020-21 (c)	2019-21 average (d)	% change [(d) - (a)/ (a)]
NAMI	65.4	57.4	55.4	56.4	-14%

10. In 2019-20 and 2020-21, the five R&D Centres received an average of about \$239.9 million industry income per year, representing an increase of about 3% as compared with that in 2018-2019. Since 2017-18, we have adopted a new indicator on the level of industry income of the R&D Centres with a target of 30%<sup>5</sup>. The level of industry income of all R&D Centres in 2019-20 and 2020-21 exceeded the 30% target, and that of LSCM reached 80%. The results of the R&D Centres are as follows -

Table 3: Level of Industry Income *(Note)*

<b>Level of Industry Income</b>					
	2018-19 (a)	2019-20 (b)	2020-21 (c)	2019-21 average % (d)	Difference (Percentage points) (d) - (a)
APAS	49%	44%	41%	43%	-6%
ASTRI	36%	33%	34%	34%	-2%
HKRITA	34%	79%	31%	55%	+21%
LSCM	46%	94%	65%	80%	+34%
NAMI	55%	47%	42%	45%	-10%

*Note: The level of industry income is calculated as follows -*

$$\frac{\text{Industry Contribution Pledged} + \text{Other Sources of Financial Contribution Pledged} + \text{Commercialisation Income Received}}{\text{Approved Project Expenditure}} \times 100\%$$

11. Commercialisation income includes contract service income, licensing fees and royalties. In addition to conducting applied R&D in key areas, the R&D Centres also work closely with the industry to carry out applied R&D projects that suit the needs of the industry, and to transfer technologies to the industry, striving to commercialise R&D outcomes. In 2019-20 and 2020-21, the commercialisation income of the five R&D centres is as follows -

<sup>5</sup> The target level of industry contribution was 20% before 2017-18.

Table 4: Commercialisation Income (\$ million)

<b>Commercialisation Income (\$ million)</b>					
	2018-19 (a)	2019-20 (b)	2020-21 (c)	2019-21 average (d)	% change [(d) - (a)/ (a)]
APAS	1.87	2.58	2.21	2.40	+28%
ASTRI	21.16	25.88	10.03	17.96	-15%
HKRITA	10.98	29.30	5.62	17.46	+59%
LSCM	10.09	15.95	24.12	20.04	+99%
NAMI	17.11	12.25	17.74	15.00	-12%
<b>Total</b>	<b>61.21</b>	<b>85.96</b>	<b>59.72</b>	<b>72.84</b>	<b>+19%</b>

12. The average annual commercialisation income of the five R&D Centres in 2019-20 and 2020-21 increased about 20% as compared with that in 2018-19. Due to social incidents and the outbreak of the novel coronavirus disease in 2019-20 and 2020-21, it was not easy for commercialisation income to increase.

**(C) R&D Projects and Expenditure**

13. The R&D expenditure of the R&D Centres each year is as follows -

Table 5: R&D Expenditure (\$ million)

<b>R&amp;D Expenditure (\$ million)</b>					
	2018-19 (a)	2019-20 (b)	2020-21 (c)	2019-21 average (d)	% change [(d) - (a)/ (a)]
APAS	45.8	48.7	49.9	49.3	+8%
ASTRI	346.9	358.6	333.2	345.9	-0.3%
HKRITA	96.5	82.2	59.2	70.7	-27%
LSCM	82.0	96.7	86.7	91.7	+12%
NAMI	112.3	120.0	128.9	124.5	+11%
<b>Total</b>	<b>683.5</b>	<b>706.2</b>	<b>657.9</b>	<b>682.1</b>	<b>-0.2%</b>

14. In 2019-20 and 2020-21, the average total R&D expenditure of the five R&D Centres was \$682.1 million, which is similar to that in 2018-19.

15. The number of new projects commenced and the relevant project cost for the R&D Centres are as follows -

Table 6: Number of New Projects Commenced

	<b>Number of New Projects Commenced</b> <i>(Figures in brackets denote the numbers of new collaborative projects with the industry)</i>			
	2018-19	2019-20	2020-21	2019-21 average
APAS	16 (3)	16 (1)	19 (6)	18 (4)
ASTRI	39 (0)	46 (0)	34 (2)	40 (1)
HKRITA	23 (4)	12 (1)	22 (4)	17 (3)
LSCM	25 (2)	25 (4)	25 (4)	25 (4)
NAMI	43 (26)	43 (22)	42 (14)	43 (18)
<b>Total</b>	<b>146 (35)</b>	<b>142 (28)</b>	<b>142 (30)</b>	<b>142 (29)</b>

Table 7: Project Cost of New Projects Commenced (\$ million)

	<b>Project Cost of New Projects Commenced (\$ million)</b> <i>(Figures in brackets denote the project costs of new collaborative projects)</i>			
	2018-19	2019-20	2020-21	2019-21 average
APAS	65.5 (21.2)	48.1 (12.8)	101.6 (46.1)	74.9 (29.5)
ASTRI	333.4 (0)	504.3 (0)	281.9 (14.3)	393.1 (7.2)
HKRITA	93.5 (8.9)	61.9 (8.7)	87.5 (10.5)	74.7 (9.6)
LSCM	123.9 (2.6)	159.6 (16.7)	145.4 (15.3)	152.5 (16.0)
NAMI	151.3 (90.6)	158.0 (68.0)	172.1 (50.5)	165.1 (59.3)
<b>Total</b>	<b>767.6 (123.3)</b>	<b>931.9 (106.2)</b>	<b>788.5 (136.7)</b>	<b>860.2 (121.5)</b>

16. In 2019-20 and 2020-21, the R&D Centres commenced an average of 142 new projects per year, which is similar to that in 2018-19. The total project cost of newly commenced projects in 2019-20 and 2020-21 was about \$860.2 million on average. This represents an increase of about 12% as compared with that in 2018-19.

17. In 2019-20 and 2020-21, each of the R&D Centres commenced an average of 29 collaborative projects (namely projects that require industry contribution of at least 30% of the total project cost). This represents a decrease of 17% as compared with 35 collaborative projects in 2018-19. Nevertheless, the total project cost of collaborative projects commenced in 2019-20 and 2020-21 was about \$121.5 million on average, which is similar to that in 2018-19. This demonstrates that the R&D Centres continue to work closely with the industry to carry out applied R&D projects that suit the needs of the industry.

18. The number of on-going projects of the R&D Centres each year is as follows -

Table 8: Number of On-going Projects

	<b>Number of On-going Projects</b> <i>(Figures in brackets denote the numbers of on-going collaborative projects)</i>		
	As at 31 Mar 2019	As at 31 Mar 2020	As at 31 Mar 2021
APAS	51 (16)	56 (12)	67 (15)
ASTRI	71 (2)	69 (0)	69 (2)
HKRITA	54 (10)	48 (7)	58 (8)
LSCM	45 (2)	58 (6)	62 (7)
NAMI	67 (40)	70 (37)	80 (29)
<b>Total</b>	<b>288 (70)</b>	<b>301 (62)</b>	<b>336 (61)</b>

19. Many of the on-going projects involve industry contribution (both in cash or in kind) and participation, demonstrating that the projects could meet the needs of the industry. Short-term fluctuations in market demand and economic situation will affect the negotiation/discussion between the R&D Centres and their industry partners/sponsors. The number of on-going projects involving industry participation and the number of companies participating in on-going projects are as follows -

Table 9: Number of On-going Projects involving Industry Participation and Companies participating in On-going Projects

	No. of On-going Projects involving Industry Participation			Number of Companies participating in On-going Projects		
	As at 31 Mar 2019	As at 31 Mar 2020	As at 31 Mar 2021	As at 31 Mar 2019	As at 31 Mar 2020	As at 31 Mar 2021
APAS	21	22	29	23	31	43
ASTRI	47	41	34	151	104	91
HKRITA	41	37	46	81	77	98
LSCM	13	26	31	64	86	88
NAMI	46	45	49	56	57	73
<b>Total</b>	<b>168</b>	<b>171</b>	<b>189</b>	<b>375</b>	<b>355</b>	<b>393</b>

20. In addition, the R&D Centres also apply the technologies they developed in Government departments and public sector organisations with a view to serving the public.

## REPORT ON INDIVIDUAL R&D CENTRES

21. This section elaborates the key activities and highlights of each R&D Centre in 2019-20 and 2020-21.

### *APAS*

22. In 2019-20 and 2020-21, the average annual industry income was about \$20.3 million, which was a 45% increase comparing with 2018-19; while the overall industry income level was 44% and 41% respectively, exceeding the target of 30%. APAS commenced 35 new projects during the period, and filed 20 patent registrations and was granted 14 patents. Recent major R&D achievements of APAS are as follows -

- (a) *Swappable Battery E-Motor Minibus* - developed a 7-meter e-motor electric minibus with battery swapping feature. The components of the vehicle from powertrain system to the vehicle body were all designed in Hong Kong. The battery module could be swapped within ten minutes. The system won a Silver Medal at the International Exhibition of Inventions of Geneva in 2021;



- (b) *High Power Pantograph Charging System* - developed a 300kW pantograph high power charger (“HPC”) for electric commercial vehicles, delivering 6 to 8 times charging speed faster than the common 50kW quick chargers. Electric commercial vehicles can be charged at their charging terminus and top up 20kWh of power in 5 minutes for a driving distance of 40 km, fulfilling the market demand;
- (c) *Smart Taxi Meter* - developed a new generation of taxi meter with multiple functions, including a newly designed taxi meter, a telematics processing system, application software and a back-end cloud to provide novel functions. These include online ride-hailing, cost for and journey time estimation, real-time monitoring of driver’s behavior, electronic payment, passengers’ feedback on service quality, broadcast of emergency alert and data analysis to manage the operating efficiency of the fleet in a better way. The system has passed relevant tests and has obtained Transport Department’s preliminary approval;
- (d) *Autonomous Delivery Mover (“Mini Mover”)* - the system is equipped with a sensor suite comprising 3D LiDAR, camera, GPS, inertial Measurement Unit and ultrasonic sensor. It has been completed and has been extended to develop a new robot model which has been adopted by MTR for assisting station operators to do routine and regular inspection of the facility conditions such as lighting, signage and obstructions. The Mini Mover system won the Silver Medal at the Asia Exhibition of Invention in 2019 and a Silver Medal at the International Exhibition of Inventions of Geneva in 2021; and
- (e) *Smart Remote Autonomous Driving Technologies* - developed a smart remote automatic parking module and smart electric brake booster system for EVs for application on autonomous driving system, and is an important milestone for APAS in development of autonomous driving technologies.

23. Since the launch of PSTS in 2011, APAS has commenced a total of 31 PSTS projects, of which 7 projects were commenced during the past two years. The application of such technologies has received positive feedback from the users. Examples include -

- (a) *Intelligent Electric Bus (“eBus”)* - the intelligent eBus is equipped with lightweight body structure and a high efficiency

traction motor system. Two prototypes of eBus were completed. Pending type approval by the Transport Department, the Airport Authority Hong Kong will conduct trial use of one of the prototypes to provide transportation services for its staff within the airport; the other prototype will be provided to the Hong Kong Anti-Cancer Society for trial use;

- (b) *Advanced Driver-Assistance System (“ADAS”)* - the electronic system provides immediate alert to drivers to avoid over-speed and collision based on analytics of real-time image motion vectors of objects so as to enhance driving safety. It also uploads driving behaviours of drivers to a web-based application for further data analysis. The system has been installed in 23 vehicles of four non-governmental organisations (“NGOs”) for trial runs, including Tung Wah Group of Hospitals, the Hong Kong Society for the Blind, Hong Kong Anti-Cancer Society and Caritas Hong Kong; and
- (c) *Core Technology Platform of Image Processing and Recognition* - by using video analytics of object profiles and shapes, alert is provided to drivers to avoid improper lane departure, collision and over-speed with an aim to enhance driving safety. The driving behaviours will be uploaded to back-end system for analysis and record. The system was installed in 19 vehicles of four NGOs for trial use, including St. James' Settlement, Hong Kong Logistic Association, Baptist Oi Kwan Social Service and the Hong Kong Society for Rehabilitation.

24. APAS has actively promoted its R&D results for adoption by the industry as well as Government/public bodies. For example, APAS launched the “APAS Showcase 2019” in July 2019, with hundreds of guests from different industries and sectors including Government departments, universities, telecommunication companies, motors companies, automobile parts and accessories companies attended the events. In 2020-21, APAS jointly organised five rounds of “Online Technology Forum” with the Office of the Government Chief Information Officer and Hong Kong Science Park.

25. APAS signed Memoranda of Understanding with eight enterprises and organisations in 2019-20 to establish long term collaboration on development of autonomous vehicles, vehicle-to-infrastructure communication technology and 5G Solution in autonomous vehicles. These collaborations will help enhance Hong Kong’s automobile R&D level and application in the long term. For details of the work of APAS in 2019-2020 and 2020-2021, please refer to **Annex A**.

## ***ASTRI***

26. In 2019-20 and 2020-21, ASTRI had an average annual industry income of about \$91.3 million, decreased by about 5% when compared with that of 2018-19.; the level of income received from the industry was 33% and 34% respectively, which exceeded the target level of 30%. During the same period, ASTRI commenced 80 new projects, filed 132 patent applications, and 102 patents were granted.

27. ASTRI focuses on five research areas. Some significant examples are -

- (a) *Intelligent Manufacturing* - worked with industry players to develop a high-resolution optical inspection hardware system and deep learning-based defect classification software for quality control. Recently, ASTRI has also been working with an equipment manufacturer on high-precision 3D automatic optical inspection system for semi-conductor process inspection;
- (b) *Financial Technologies* - will collaborate with an international financial organisation on a Central Bank Digital Currency (“CBDC”) Proof-of-Concept System for the development of CBDC eWallets and related transaction verification technology. In addition, commissioned by the Hong Kong Monetary Authority (“HKMA”), ASTRI published a white paper titled “Alternative Credit Scoring of Micro-, Small and Medium-sized Enterprises (“MSMEs”)” in November 2020, which outlined how Fintech can be adopted to collect and utilise alternative data to evaluate borrowers’ creditworthiness. The scale of banks’ MSMEs financing services as well as the MSMEs’ access to finance could be improved. ASTRI has also collaborated with a commercial organisation to develop a data analytics platform serving financial institutions’ risk management requirements;
- (c) *Digital Health* - collaborated with a medical technology company to develop computer aided diagnosis (“CAD”) solutions that used Artificial Intelligence (“AI”) algorithm to help diagnose early gastric cancer during preliminary screening of white light gastroscopy. Besides, further development of ASTRI’s low-cost Optical Coherence Tomography (“OCT”) technology for the medical field is under discussion with a local university. ASTRI is also developing an AI analytics engine to better understand and analyse the behaviour of students with special education needs

(“SEN”), to support non-professional such as parents, relieving tension caused by a shortage of SEN therapists and high consultation fees. In addition, ASTRI is collaborating with the Customs & Excise Department to develop a portable non-contact healthcare multimetre with the integration of smartphone platform, miniature optical spectrometer and advanced algorithm. It can quickly test the types and concentrations of alcohol content of alcoholic disinfection products and tell whether they contain methanol, ensuring consumer safety and public health;

- (d) *Smart City* - leading in 5G technologies, and working closely with industry players and public organisations in making use of its wealth of professional knowledge accumulated through successful implementation of projects. In March 2021, ASTRI launched a nine-month Cellular Vehicle-to-Everything (“C-V2X”) public road test in Hong Kong, covering a 14 km route from Hong Kong Science Park to Sha Tin town centre. It would study and test the technology’s application scenarios on the roads of Hong Kong, as well as the network and infrastructure required for the application. The technology could enhance road safety and efficiency, as well as lay the groundwork for the development of autonomous vehicles. Augmented Reality (“AR”) has also become a major future technology development. ASTRI has collaborated with a commercial partner to develop AR smart glasses to assist in remote field support services. Frontline and support staff can communicate effectively and in real-time with a command centre, reducing costs and enhancing efficiency. In addition, ASTRI has developed an Internet of Things (“IoT”) surveillance system based on Long Range (“LoRa”) technology. By installing object detection sensors and IoT sensors to monitor water levels, chlorine gas leaks, collapsed trees or trespassing, the system makes Hong Kong’s water treatment works and meter reading system smarter by automatically generating alert messages to facilitate the Water Supplies Department to take follow-up actions; and
- (e) *Application Specific Integrated Circuits* - working with an enterprise to develop a high voltage energy collection system to enhance transport system efficiency. Moreover, ASTRI is collaborating with a power company to develop new Direct Current technologies to increase home and building energy efficiency.

28. For more details of the work of ASTRI in 2019-20 and 2020-21, please refer to **Annex B**.

### ***HKRITA***

29. HKRITA develops new materials and advanced production technologies for the textiles and apparel industry, and conducts multi-disciplinary and industry-driven research projects. In 2019-20 and 2020-21, average annual industry industry was about \$33 million, a 27% increase as compared with 2018-2019. It achieved an overall industry income level of 79% in 2019-20 and 31% in 2020-21, both exceeding the target of 30%. During the same period, HKRITA commenced 34 new projects, filed 53 patent applications and 19 patents were granted.

30. Over the past two years, HKRITA continued to build on its research competence in textiles recycling and high-performance textiles technologies, with focus on sustainable development and environmental protection. This not only increased the competitive edge of the local textiles industry, but also benefited society as a whole by striving towards carbon neutrality. Examples of HKRITA's R&D work include -

- (a) *Cellulose-based PFC-free Functional Surface Finish* - this new water-repellent surface finish makes use of natural and recycled materials obtained from textiles waste, which is a safer alternative to PFCs. The finish is made through a two-step chemical process: firstly, a hydrophobic modification of the recycled cellulose powders to make them water repellent; secondly, adding functional additives to improve the washing durability properties of the fabric. The project won a Gold Medal with the Congratulations of the jury at the International Exhibition of Inventions of Geneva in 2021;
- (b) *Soft Electrochromic Yarns with Low Operating Voltage* - this project has developed a sustainable way of fabricating a soft electrochromic yarn which can exhibit changing of colours with low operating voltage on textiles for displaying numerical figures through different combinations. Not only does it provide a promising energy-saving technology for futuristic textiles display with wide and easy application in the textiles industry, but it also opens up opportunities for next-generation smart displays for fashion textiles. The project won a Gold Medal at the International Exhibition of Inventions of Geneva in 2021;

- (c) *Sleeping Comfort System for Identification of Comfort Zone* - the Sleeping Comfort System presents an evaluation system for identification of the comfort zone in terms of thermal, touch and biomechanical comfort for bedding. It consists of a hardware and a software system. By integrating the two systems, the chamber can adjust the microclimate of the bedding environment and biomechanical comfort, personalising one's sleeping comfort. The project won a Silver Medal at the International Exhibition of Inventions of Geneva in 2021; and
- (d) *A Novel Separation Method of Disentangled Textile Fibres* - to separate valuable disentangled protein fibres from synthetic textile materials, this invention is an environmentally friendly system which utilises the triboelectric properties of different kinds of textile fibres to perform the task. The process does not require use of any chemicals or water, thereby ensuring that no waste will be discharged to the environment. The collected clean and intact protein fibres are then ready for production of new functional or high value clothing to satisfy various market needs. The project won a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.

31. On commercialisation, HKRITA signed three and five licensing agreements in 2019-2020 and 2020-2021 respectively. HKRITA also initiated or facilitated 16 and 19 technology transfer activities to local companies, Government departments and NGOs in 2019-2020 and 2020-2021 respectively.

32. HKRITA also continued to promote the adoption of its R&D outcomes in the public sector. Three and two PSTS projects were conducted in 2019-20 and 2020-21 respectively. One of the projects was High Performance Sportswear and Devices for Hong Kong's Athletes. This project developed high performance sportswear and devices, including elbow support, knee support, ankle support, compression top, compression socks, shorts and on-field wear for more than 100 athletes of Hong Kong Sports Institute in consideration of the sport characteristics of Track & Field, Rowing, Bowling and Rugby. It aimed to provide suitable devices for athletes in intense training, participation in international competitions such as Tokyo Olympic Games and post-match recovery. It is expected that these sportswear and devices would be able to enhance their performance, provide protections, support cooling down and recovery after exercise and prevent injuries.

33. Over the past two years, HKRITA organised, supported and participated in a series of conferences and technology seminars to share the results of its work, facilitate knowledge transfer and forge closer ties with its

stakeholders. The events included “World Intellectual Property Day Reception”, “SmartBiz Expo” and “Gerontech and Innovation Expo”. The COVID-19 pandemic poses an unprecedented impact on the globe over the last year. A lot of works were carried out through the internet. HKRITA organised two webinars entitled “Sustainability Solutions - Big Ideas to Make a Big Difference” and “The Future of Fashion: Reimagine, Regenerate and Close the Loop” to share the latest technology development with the industry. HKRITA won 11 international and local awards, which demonstrated the international peers’ and the industry’s recognition of its R&D results. At the International Exhibition of Inventions of Geneva in 2021, HKRITA won seven medals which are a Gold Medal with the Congratulations of the Jury, along with two Gold Medals and four Silver Medals. For more details of the work of HKRITA in 2019-20 and 2020-21, please refer to **Annex C**.

### ***LSCM***

34. During the two-year period from 2019-20 to 2020-21, LSCM had an average annual industry income of about \$39 million, increased by about 30% when compared with that of 2018-19. The level of income received from the industry were 94% and 65% respectively, which exceeded the target level of 30%. In addition, LSCM commenced 50 new projects and successfully applied for 25 patents. Some significant achievements of the Centre’s R&D work and technology adoption include -

- (a) *“Together, We Fight the Virus!”* - in 2020, to combat the COVID-19 epidemic, LSCM developed a Bluetooth Low Energy electronic wristband and a monitoring solution to support the implementation of mandatory home quarantine measure. Coupled with the “StayHomeSafe” mobile app developed by a local technology start-up that adopts geo-fencing technology, the solution is effectively monitoring whether persons under quarantine are staying at their designated premises. The “StayHomeSafe” electronic wristband and surveillance system has already been adopted by other places. LSCM has shipped about 15 000 electronic wristbands to Bermuda and Hawaii, etc. Other countries such as Chile, Turkey, Israel and Saudi Arabia, are currently running trials on the system. This application was awarded a Gold Medal at the International Exhibition of Inventions of Geneva in 2021;

Developed a stringent system for the Universal Community Testing Programme, integrating QR code/barcode identifiers, electronic seal, bluetooth and global positioning system into a control network for real-time tracking of all the specimen boxes and delivery vehicles to ensure that the specimens arrive at the laboratories safely. When the Government implemented the COVID-19 Vaccination

Programme in February 2021, LSCM made use of locally researched and developed e-Lock technology and mobile technology in applied logistics and inventory management to develop relevant systems for vaccine procurement, consignment monitoring and handling, so as to render assistance to the Food and Health Bureau in managing the supply, delivery and use of vaccines;

- (b) *Construction* - jointly developed with a local university a technology using computer vision and machine learning to automate the existing quality management process which relies heavily on manual operation and records. The technology will analyse images of site activities captured real-time by surveillance cameras and utilise machine intelligence to determine if there are any quality deviations and/or defects. The application has been successfully trialled in a number of construction sites and was awarded a Gold Medal at the International Exhibition of Inventions of Geneva in 2019;
- (c) *E-commerce* - collaborated with a local start-up to develop a system using blockchain technology for the insurance industry. It has effectively allowed different insurance companies to share and track insurance policy information and verify customer claims records. This has not only made the process smoother and saved operating costs, but also avoided problems such as false insurance policies and improved the overall efficiency and accuracy of the process. The start-up is currently working on the commercialisation of this “Next InsurChain” system. This application was awarded a Silver Medal at the International Exhibition of Inventions of Geneva in 2021;
- (d) *Smart City* - jointly developed with a local university an integrated solution that uses the Differential Global Navigation Satellite System (“DGNSS”) to integrate Micro-Electro Mechanical System (“MEMS”) inertia sensors and 3D street models to improve serious positioning errors in dense urban areas. These errors are usually caused by factors such as signal occlusion. This application was awarded a Silver Medal at the International Exhibition of Inventions of Geneva in 2021 and was successfully trialled in the Civil Engineering and Development Department. The Lands Department also used this technology to establish a Web-based Datum Transformation Tool to provide the public with real-time conversion between different coordinate systems. As of March 2021, the tool has recorded a total usage of 180 million times; and
- (e) *Smart Warehouse* - developed an Autonomous Guided Vehicle (AGV) system with self-balancing technology to tackle the problem of limited space and dense storage of local warehouses. Upon



receipt of a pickup request from the picker, the system will coordinate the fleet of AGVs to move the racks and send the required rack directly to the picker. The AGV would also calculate the centre of gravity of the rack to prevent the rack from toppling. This system reduces labour costs and increases the utilisation of the space of the warehouse by eliminating the corridor area for pickers to access individual racks. This technology has been adopted by the local mini-storage industry.

35. For the details of the work of LSCM in 2019-20 and 2020-21, please refer to **Annex D**.

### ***NAMI***

36. In 2019-20 and 2020-21, NAMI commenced 85 new projects. The total project cost has on average increased by 9.1% compared with that of 2018-19. Of the total new projects, 54 are with industry sponsorship, and the total project cost has on average increased by 7.1% compared with that of 2018-19. The level of income from industry is 47% and 42% respectively, which are above the target level of 30%. During the same period, NAMI has filed 153 patent applications, and 45 patents have been granted.

37. NAMI focuses on commercialising project outcomes, and has launched more than 30 new products. These include printed battery with high power output for IoT applications, long lasting battery for high power IoT devices, biocide-free germ-repellent varnish for paper products and self-cleaning antimicrobial vitreous enamel panel. Besides, in 2019-20 and 2020-21, NAMI has undertaken 19 projects under the Public Sector Trial Scheme, benefitting more than 40 public organizations.

38. NAMI has close collaboration with various government departments on applications of new materials and innovative technologies. Through the Public Sector Trial Scheme, relevant technologies have been put on trial in facilities of various departments, accelerating technology commercialization and enhancement of work efficiency of the departments concerned, bring benefit to the society. These include collaboration with the Architectural Services Department and the Electrical and Mechanical Services Department (“EMSD”) in adopting NAMI’s self-cleaning antibacterial vitreous enamel panel in the Legislative Council Complex, Tin Shui Wai Temporary Market and the EMSD Headquarters respectively, providing a cleaner and safer environment.

39. NAMI has also successfully developed an ozone nano bubble generator which is being used in the flushing water system of the public toilet in Tonkin Street, Cheung Sha Wan managed by the Food and Environmental

Hygiene Department, which can effectively disinfect the flushing water, reduce the spread of bacteria and viruses and the odor caused by excrement in the toilet, thus ensuring the environmental hygiene. The relevant system can be widely applied in other public toilets.

40. Besides, with the support of Highways Department, NAMI has developed an innovative self-leveling and self-compacting backfill material which can help enhance productivity and pavement quality. This may also be adopted as a new standard for the industry to optimize pavement backfilling. The backfill material has been applied in Central Kowloon Route - Kai Tak East project, as well as the landslip prevention and mitigation trial carried out by the Geotechnical Engineering Office of the Civil Engineering and Development Department.

41. In 2019-21 and 2020-21, NAMI's technologies have won 40 international awards<sup>6</sup>, including Edison Awards, R&D 100 Awards, CES Innovation Awards and International Exhibition of Inventions of Geneva. The following are some of the breakthrough technologies:

- (a) *A Green Battery Printed on LoRa IoT Devices* - This primary battery is designed for high power pulsing applications like LoRa IoT devices. The battery is developed with materials optimized for printability, high electrochemical performance and stability. It supports high pulse current and offers many advantages over conventional batteries, meeting the needs of IoT electronic devices for high power output and extended service life. The technology has won the above four international awards;
- (b) *HPC Battery for Extreme Temperature IoT Trackers* - This battery is developed with the engineering of advanced nanomaterials to improve the ionic conductivity and charge retention under extreme temperature for superior extreme temperature tolerance under high pulse discharge and ultra-low self-discharge current, allowing stable power output and long lifespan for IoT trackers and sensors under harsh environment; and
- (c) *Ultrasound Nano Bubble Cold Brew Coffee and Tea Machine* - This fast and energy efficient cold brew coffee and tea machine is a breakthrough by using nano bubble technology where air nano bubbles generated in water and ultrasound

---

<sup>6</sup> For a summary of awards won by the R&D Centre, please visit <https://www.nami.org.hk/tc/awards>.

energy expedite the extraction of antioxidant from coffee or tea, significantly shortening the steeping time from 12 to 24 hours using traditional method to within ten minutes, and reducing the risk of bacterial growth and contamination in prolonged refrigeration.

42. For details of the works of NAMI in 2019-20 and 2020-21, please refer to **Annex E**.

## **POSITIONING AND IMPACT OF THE R&D CENTRES**

43. ITC has all along closely monitored the operation and work progress of the R&D centres to ensure the proper use of public money. In addition, to analyse the roles, positioning and impact of the five R&D centres, ITC has commissioned an independent consultant to carry out a study. The consultant has engaged over 470 stakeholders of the R&D Centres, including industry sponsors and clients in the past five years, through interviews, focus group discussions and survey.

44. The consultant also interviewed industry sponsors to understand and project the economic impact of the R&D Centres. Figures show that over the past three years, the economic contribution brought about by the R&D Centres have increased from \$4,060 million to \$4,350 million, demonstrating the positive impact of the R&D Centres towards Hong Kong's economy -

	<b>APAS</b>	<b>ASTRI</b>	<b>HKRITA</b>	<b>LSCM</b>	<b>NAMI</b>
<b>Total Economic Impact of R&amp;D Centre (\$million<sup>7</sup>)</b>					
<b>2017-18</b>	\$130	\$2,660	\$125	\$332	\$822
<b>2018-19</b>	\$111	\$2,655	\$159	\$418	\$1,005
<b>2019-20</b>	\$119	\$2,460	\$215	\$540	\$1,015

45. Also, the average client cost saving and revenue growth, as well as further sale of R&D outcomes to other business partners for the R&D Centres in percentages are as below -

<sup>7</sup> Calculated based on 2019 price level.

	<b>APAS</b>	<b>ASTRI</b>	<b>HKRITA</b>	<b>LSCM</b>	<b>NAMI</b>
<b>Impact on Clients' Operations arising from R&amp;D Centres' R&amp;D Outcomes/Services Provided</b>					
<b>Average Client Cost Saving</b>	15%	20%	12%	5%	10%
<b>Average Client Revenue Growth</b>	31%	34%	9%	26%	45%
<b>Clients who Further Sold R&amp;D Outcomes to Other Business Partners</b>	50%	50%	64%	42%	79%

46. With reference to the consultancy study, the five R&D Centres have clear positioning, each serve specific purposes in terms of applied research, technology transfer and commercialisation, bringing more innovative technologies to local industries, thereby strengthening the advantages of Hong Kong enterprises. A brief summary is as follows -

- (a) APAS has over the years commercialised its R&D outcomes in collaboration with the industry, universities and technology institutes, thereby promoting the development of automotive technologies. APAS is the only R&D Centre in Hong Kong specialising in end-to-end research support for local companies in the automotive field. Hong Kong's unique traffic conditions and rapid development of the automotive industry has resulted in increasing demand for green transportation, smart mobility and intelligent systems. APAS is able to align with the trend of sustainable and autonomous driving, assisting the local automotive industry to enhance their research capabilities and develop localised products that suit market needs. In addition, the innovative technologies have been applied to automotive parts, creating further business opportunities as well as opening up Mainland and overseas markets for local industries;
- (b) ASTRI's technology R&D is mainly applied across the five areas of smart city, financial technologies, intelligent manufacturing, digital health, and application specific integrated circuits. The trend of digital transformation benefits different industries (such as manufacturing, financial services, healthcare, etc.) and brings about business

opportunities. There is increasing demand from these industries for cutting-edge technological solutions, particularly across multiple technology disciplines. As such, ASTRI has focused on developing different technologies that meet society's development trends and can be widely applied to the industries, and at the same time providing cross-functional and one-stop collaboration opportunities that successfully help companies solve complex technical problems. In addition, ASTRI has helped various enterprises expand their international network, and facilitated cooperation among universities, the industries and public sector organisations;

- (c) HKRITA is the only R&D centre in Hong Kong specialising in textiles and clothing, providing one-stop services for applied research, technology transfer and commercialisation. Through R&D and technology transfer, HKRITA helps the textiles and fashion industry move towards high value-added production and services, and enhance their competitiveness. By making use of its high efficiency in research and extensive network of supply chain partners, HKRITA achieved remarkable results in introducing sustainable materials and textiles recycling technologies, promoting 'Industry 4.0' and caring for the community (such as developing a garment-to-garment recycling system and wearables for elderlies and athletes);
- (d) LSCM focuses on the development of core competencies in logistics and supply chain related technologies. The logistics industry contributed to 3.1% of Hong Kong's GDP in 2018 and provided 176 900 job opportunities. With the development of the Greater Bay Area and smart city initiatives, Hong Kong requires more innovative technologies in the field of logistics and supply chain to meet the development needs of the industry. As the industry may not have the related research knowhow, LSCM has actively collaborated with universities, businesses (SMEs in particular) and the public sector to tackle the challenges faced by its partners on Internet of Things, e-commerce and other logistics and supply chain related issues. LSCM has responded quickly to public needs, for example on anti-epidemic efforts, the StayHomeSafe system and electronic wristbands developed by LSCM has effectively supported the Government's home quarantine measures; and

- (e) NAMI is dedicated to conducting market-driven and demand-led R&D in nanotechnology and advanced materials. The nanotechnology and advanced materials industry is changing rapidly and local companies (especially SMEs) do not have in-house research capabilities and facilities. Therefore, NAMI collaborated with the local industry to promote technology upgrading and commercialisation, and successfully introduced innovative technologies (such as brand new materials, nano and advanced materials) to the industry through different collaborative projects. Apart from enhancing the industry's core competitiveness, NAMI has made remarkable achievements in assisting industries to make use of the technologies to develop new products. The centre's R&D outcomes are widely applied in various industries including construction, healthcare, and energy.

47. The consultancy study shows that the R&D Centres have a clear work direction. Apart from promoting the development of the industry and society through applied research in their respective technology field, the R&D Centres have positive impact on various areas including economic contribution, commercialisation and technology transfer. ITC will continue to review the work and performance of the R&D Centres to ensure that they remain relevant to the need for, and the pace of, Hong Kong's development.

## **MONITORING MECHANISM**

48. We will closely monitor the operation and performance of the R&D Centres, and will continue to submit the R&D Centres' progress reports to this Panel regularly. As a standard practice, the R&D Centres are required to submit the following for approval by their respective Board of Directors and ITC every year -

- (a) an annual R&D plan of the R&D Centre, including the annual expenditure budget and performance indicators;
- (b) quarterly reports on their operation, covering the staffing position, major activities and expenditure position; and
- (c) annual audited accounts of the R&D Centre's operation and its R&D projects.

## **ADVICE SOUGHT**

49. Members are invited to note the latest progress of the R&D Centres.

**Innovation and Technology Bureau  
Innovation and Technology Commission  
June 2021**

## Annex A

### **Automotive Platforms and Application Systems Research and Development Centre ("APAS")**

#### **Highlight of Operation in 2019-20 and 2020-21**

#### **I. New Research and Development ("R&D") Projects and Industry Contribution (in \$million)**

	<u>2018-19</u>			<u>2019-20</u>			<u>2020-21</u>		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform <sup>1</sup>	1	7.4	1.3	5	14.8	3.0	4	23.0	3.1
Collaborative <sup>2</sup>	3	21.2	10.8	1	12.8	6.5	6	46.1	23.2
Seed <sup>3</sup>	8	18.8	n/a	5	11.8	n/a	7	17.8	n/a
Total:	12	47.4	12.1	11	39.4	9.5	17	86.9	26.3
Public Sector Trial Scheme	4	18.1	n/a	5	8.7	n/a	2	14.7	n/a

#### **II. Operating Expenditure (in \$million)**

	2018-19	2019-20	2020-21
Staffing	10.7	13.3	11.5
Accommodation	2.9	3.1	3.1
Equipment	1.0	1.0	1.3
Others	3.7	3.2	3.8
Total :	18.3	20.6	19.7

<sup>1</sup> Platform projects require industry contribution of at least 10% of the total project cost.

<sup>2</sup> Collaborative projects require industry contribution of 30-50% of the total project cost.

<sup>3</sup> Seed projects are projects which are more forward-looking and exploratory in nature. No industry contribution is required.



### III. Industry Income (in \$million)

	2018-19	2019-20	2020-21
Industry Contribution	12.1	9.5	26.3
Licensing/Royalty	0.01	0.03	0.2
Contract Services	0.8	2.5	1.2
Others	1.1	0.04	0.8
Total :	14.0	12.0	28.5
Project Cost :	28.6	27.6	69.1
Level of Industry Income :	49%	44%	41%



### IV. Other Performance Indicators

	2018-19	2019-20	2020-21
Number of Organisations Benefitting from the Public Sector Trial Scheme	17	23	18
Number of Interns Engaged	25	29	54
Number of Patents Filed	10(5)	6(4)	14(10)





*Note : Figures in brackets denote the numbers of patents granted.*




**Progress of Selected Projects on R&D, Commercialisation and Use of R&D Outcomes in the Public Sector in 2019-2020 and 2020-2021**


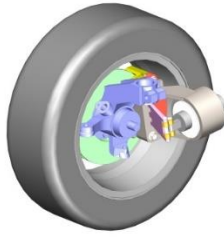
Project / Technology	Status / Progress
<p><b>1. Swappable Battery E-Motor Minibus</b></p> 	<p>Co-operating with a local automotive company, APAS designed and developed this brand new 7-meter minibus. It has several first-of-the-kind features fulfilling the unique, tough and busy operational needs in Hong Kong and other metropolitan cities.</p> <p>The minibus has a low-floor height of 300 mm only, which enables passengers to get on/off easily and safely with only one step. The electric minibus is equipped with two swappable battery packs. When the minibus is about to run out of power, the charged batteries can be swapped within 10 minutes. This feature avoids long recharging time and makes this zero-emission e-minibus capable of coping with busy public transportation operation in Hong Kong. The e-minibus has 20 passenger seats to fulfill the high passenger capacity demand. It is also equipped with a series of smart features like remote reporting of the current conditions of the minibus (e.g. the number of passengers, vehicle speed, battery usage and other in-vehicle information) so that minibus operators can optimise their fleet scheduling. Approval of the electric minibus is targeted to be completed by end of 2021.</p> <p>The project team converted the electric minibus into an electric lorry (same electric e-minibus body but without passenger seats), and has completed the approval process of the Transport Department. The project sponsor is promoting the sale of electric lorries in the Hong Kong market. The R&amp;D outcome won a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.</p>



Project / Technology	Status / Progress
<p><b>2. High Power Pantograph Charging System</b></p>  	<p>Long battery recharging time has always been a major factor hindering the application of electronic vehicles (“EVs”) in public transportation. In this collaborative project, a 300kW pantograph High Power Charger (“HPC”) plus a modular HPC vehicle platform kit had been developed for electric commercial vehicles. The HPC delivers 6-8 times charging speed faster than common 50kW quick chargers. Electric commercial vehicles can be charged at their charging terminus, with 20kWh charged within 5 minutes and can travel about 40km. This enables commercial EVs to sustain a continuous operation without having to stop specially for a long time to recharge.</p>

Project / Technology	Status / Progress
<p><b>3. Smart Taxi System</b></p>  <p>The image shows two smartphones at the top. The left one displays a taxi app interface with a map and a phone number '85200902135'. The right one shows a 'SmartTaxi Driver' app with a map and various icons. Below the phones is a black taxi meter device with a digital display showing '2020-10-23 14:38:31', 'FARE 0.0', 'EXTRAS 0.0', 'TIME 00:00:00', and 'DISTANCE 0.0'. The device also has a QR code and a 'SCAN' button. At the bottom of the device, there is a smaller screen and the Chinese text '汽车行驶记录仪' (Car Driving Recorder).</p>	<p>Hong Kong taxi system has a long history and is convenient and safe. However, many hardware facilities are outdated and could only provide limited functions. This is not competitive enough as compared with other places.</p> <p>To enhance service quality and competitiveness, APAS has introduced a smart taxi system. The solution consists of a newly designed taxi meter, a telematics processing system, application software and a back-end cloud to provide a series of novel functions. These include online ride-hailing, journey cost and time estimation, real-time monitoring of driver's behavior, electronic payment, passengers' feedback on service quality, broadcasting of emergency alert and data analysis, to manage the operating efficiency of the fleet in a better way. These functions benefit all stakeholders in the taxi industry, including taxi drivers, taxi operators as well as passengers.</p> <p>The project has completed system hardware and software development and has passed relevant tests. APAS is working closely with a local taxi company to develop a usable and flexible system based on their needs. The project's ultimate goal is to provide safe, fair, and convenient services to passengers and improve the quality of Hong Kong's taxi service.</p>

Project / Technology	Status / Progress
<p><b>4. Autonomous Delivery Mover (“MiniMover”)</b></p>  	<p>The MiniMover is equipped with a sensor suite comprising 3D LiDAR, lens, GPS, Inertial Measurement Unit and ultrasonic sensors. Through technologies like deep learning and sensor fusion, MiniMover is capable of planning suitable moving paths that can avoid collision with stationary or moving obstacles in crowded and dynamic environments, such as inside or outside buildings, parks or warehouses, in order to carry out short-distance delivery tasks autonomously.</p> <p>The project team even used this platform to develop inspection robots used in MTR stations, responsible for regular inspections in MTR stations such as lighting, signage and obstacles.</p> <p>The R&amp;D outcome won the Silver Medal in the “2019 Asia Exhibition of Invention - Hong Kong” and a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.</p>
<p><b>5. Smart Remote Autonomous Parking System</b></p>  	<p>This project realises remote autonomous parking in specific areas for vehicles with autonomous driving function, and improves parking efficiency.</p> <p>This project has completed function tests in the Hong Kong Productivity Council and a local university. The modified vehicle is equipped with wired control, multiple sensors and intelligent algorithms. During the entire parking process, steering, gear shifting and braking of the vehicle can be under full autonomous control. The vehicle can navigate itself from the car park entrance into a parking space autonomously with no driver intervention involved.</p>

Project / Technology	Status / Progress
<p><b>6. Smart Electric Brake Booster for EV</b></p>   	<p>This project researches and develops a vacuum-source independent, electric brake booster that meets the demand of a modern braking system for use in EVs / autonomous vehicles. This kind of electric brake booster has small volume and is therefore flexible in installation. Its booster performance curve can be adjusted by software to achieve different pedal feelings. Moreover, it could achieve regenerative braking in high proportion that increases mileage up to 20%; the fast pressure building feature helps shorten the emergency braking distance and enhance vehicle safety. The system is particularly suitable for EVs and autonomous vehicles.</p> <p>The project has completed functional laboratory test and is undergoing preliminary on-vehicle test, which has proven that the speed of braking is 2 to 3 times faster as compared with the traditional system. The next step is to collaborate with sponsors to complete a more reliable and enhanced system by the end of 2022 and conduct small batches of trial production.</p>

Project / Technology	Status / Progress
<p><b>7. Electric Intelligent Anti-lock Braking System for EV</b></p>  	<p>This project researches and develops an all-electric intelligent Anti-lock Braking System (“ABS”) for use on EVs which completely replaces traditional mechanical brake as well as hybrid braking system comprising electric brakes and mechanical brakes. It greatly enhances the reaction speed and shortens the braking time and distance, thereby improving the braking performance.</p> <p>The sponsoring company is planning to set up a new company and partner with a car manufacturer in the Mainland to develop minibus manufacturing business. The project team is in active discussion with the sponsoring company on the licensing of the technology.</p> <p>The deliverable won a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.</p>

Project / Technology	Status / Progress
<p><b>8. Sandwich Hybrid Metal-Plastic/ Fiber Sheet Forming Technology</b></p>  	<p>This project enables the production of sandwich hybrid material sheet with aluminium or steel alloys as the surface layers, and lightweight plastic and its composite materials such as carbon/glass fibre as the intermediate layer. Comparing with aluminum and steel alloy sheet with the same strength, the weight of the sandwich hybrid material sheet can be reduced up to 60% and has significant shock absorption and sound insulation effect on noise commonly generated by vehicle body vibration below 10Hz.</p> <p>The project has completed and its technical feasibility has been confirmed. It can now be used as a prototype for manufacturing small sized sandwich sheet auto parts and for small batch production. Two local manufacturers have carried out trial production and the results were satisfactory. APAS is planning to cooperate with organisations like the Hong Kong Auto Parts Industry Association to develop machinery for industrial scale production of medium and large sized sandwich sheets for efficient production of sandwich sheets of different material composition. The trial production of medium and large sized sandwich sheets by Hong Kong manufacturers will demonstrate the advantages of sandwich sheets in terms of lightweight and shock absorption, promoting commercialisation as well as market application of the technologies.</p>



**Hong Kong Applied Science and Technology Research Institute (“ASTRI”)  
Highlight of Operation in 2019-20 and 2020-21**

**I. New Research and Development (“R&D”) Projects and Industry Contribution  
(in \$million)**

	<u>2018-19</u>			<u>2019-20</u>			<u>2020-21</u>		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform <sup>1</sup>	17	272.4	75.5	27	439.0	91.2	15	218.0	48.8
Collaborative <sup>2</sup>	0	0	0	0	0	0	2	14.3	7.2
Seed <sup>3</sup>	21	58.0	n/a	17	47.3	n/a	14	39.1	n/a
Total:	38	330.4	75.5	44	486.3	91.2	31	271.4	56.0
Public Sector Trial Scheme	1	3.0	n/a	2	18.0	n/a	3	10.5	n/a

**II. Operating Expenditure (in \$million)**

	2018-19	2019-20	2020-21
Staffing	83.2	97.6	104.2
Accommodation	28.5	30.6	31.6
Equipment	5.0	3.4	3.6
Others	40.2	38.6	34.6
Total :	156.9	170.2	174.0

<sup>1</sup> Platform projects require industry contribution of at least 10% of the total project cost.

<sup>2</sup> Collaborative projects require industry contribution of 30-50% of the total project cost.

<sup>3</sup> Seed projects are projects which are more forward-looking and exploratory in nature. No industry contribution is required.

### III. Industry Income (in \$million)


	2018-19	2019-20	2020-21
Industry Contribution	75.5	91.2	56.0
Licensing/Royalty	0.6	2.1	3.0
Contract Services	20.4	23.7	7.0
Others	0.2	0.1	0.0
Total :	96.6	117.0	65.5
Project Cost :	266.4	360.2	190.2
Level of Industry Income :	36%	33%	34%



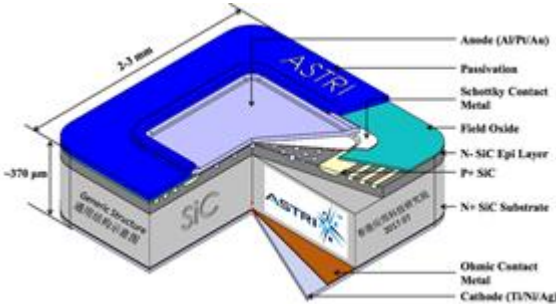
### IV. Other Performance Indicators



	2018-19	2019-20	2020-21
Number of Organisations Benefitting from the Public Sector Trial Scheme	2	4	7
Number of Interns Engaged	67	125	178
Number of Patents Filed	66(54)	66(45)	66(57)


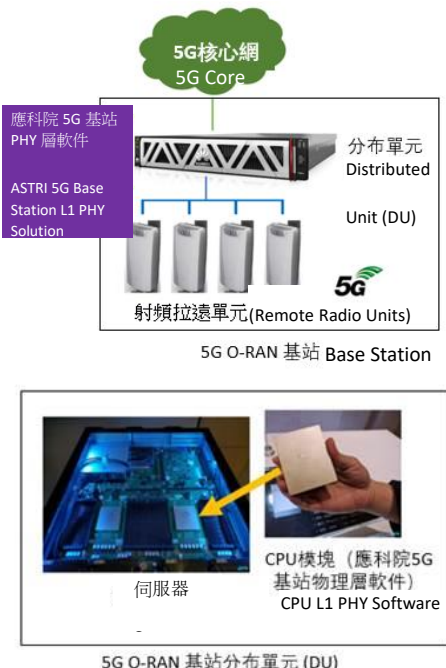
*Note : Figures in brackets denote the numbers of patents granted.*


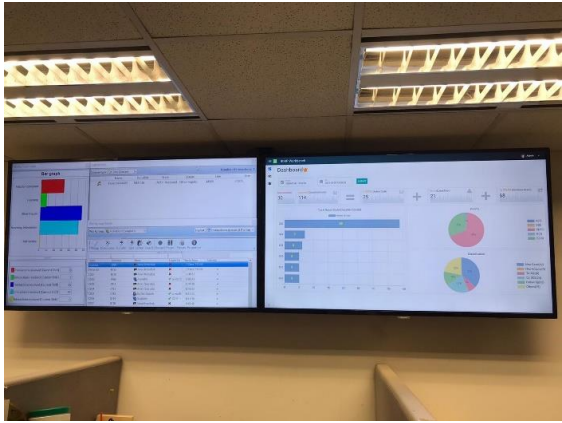
**Progress of Selected Projects on R&D, Commercialisation and Use of R&D Outcomes in the Public Sector in 2019-2020 and 2020-2021**

Project / Technology	Status / Progress
<p><b>1. Cellular Vehicle-to-Everything (“C-V2X”) technology for Hong Kong</b></p> 	<p>The C-V2X technology developed by ASTRI is a low-latency communication system between vehicles and vehicles, vehicles and pedestrians, vehicles and road infrastructure, and vehicles and networks. Through the real-time information transmission in the Internet of Vehicles system, people, vehicles and road infrastructure are connected and coordinated, and road users receive reports and warnings in real time to enhance road safety and assist driving. At the same time, the C-V2X technology can be applied to real-time traffic monitoring, incident management, and route planning to improve traffic efficiency. In the long run, C-V2X can facilitate the development of autonomous driving technology, assist the detection of hidden dangers and improve road safety.</p> <p>In March 2021, ASTRI launched a nine-month C-V2X road tests, covering a 14 km route from Hong Kong Science Park to Sha Tin town centre. It would study and test the technology’s application scenarios on the roads of Hong Kong, as well as the network and infrastructure required for the application.</p>

Project / Technology	Status / Progress
<p><b>2. Artificial Intelligence (“AI”) Analytic Engine for Providing Tailor-made Trainings targeting SEN Students</b></p>  	<p>ASTRI is developing an AI analytics engine to better understand and analyse the behaviour of students with special education needs (“SEN”), to support non-professional such as parents, relieving tension caused by a shortage of SEN therapists and high consultation fees.</p> <p>The engine can help educational psychologists speed up the evaluation process and design a tailor-made educational plan more efficiently. The client expected that engine could help cost reduction by 50% and provide more service to SEN students.</p>
<p><b>3. SiC Diode Chip and Full SiC-Based Power Module Design</b></p> 	<p>ASTRI has developed the Next Generation SiC-based Matrix Converters (“NSM”), aimed at developing next generation matrix converter modules using SiC devices. The deliverables consist of two key technologies: design and fabrication of SiC devices; advanced chip and module packaging technology.</p> <p>The ultimate goal is not only to deliver a technology platform but also to offer a tangible solution beneficial to the Greater China regional players to meet the increasing market demands and help enhance their technological competitiveness. The solution has been applied and deployed by a local technology company.</p>



Project / Technology	Status / Progress
<p><b>4. Biometrics Optical See-Through Head-Mounted Display Device</b></p>  	<p>ASTRI has developed a head-mounted display device featuring a partially transparent display, with eye gaze tracking capability for use in the human computer interface system and iris recognition for individualised interface and biometrics security. The technology has a wide range of applications in real life, such as using eye gaze to issue computer commands. The device employs a full HD Augmented Reality (“AR”) micro-display projection system which can enable small size spectacle-based head-mounted display (“HMD”). Its 60-degree field of view is among the widest available for microdisplay-based projector HMD. Its low cost is one of its major advantages. The device is at prototype stage for testing and evaluation by potential customers.</p> <p>The invention received an “Equipment and Machinery Design Award” at the Hong Kong Awards for Industries in 2019.</p>

Project / Technology	Status / Progress
<p><b>5. iGem Guard Raman Spectrometer</b></p> 	<p>Applying state-of-the-art mini three-band laser spectroscopy technology, ASTRI's iGem Guard is equipped with adaptive and accurate sensors and intelligent algorithms. Through the process of one-touch optical inspection, the device can swiftly determine whether a diamond is natural or synthetic; whether a jadeite is classified as "Grade A" or chemically-processed ("Grade B" or "Grade C"); and whether a pearl is formed in freshwater or saltwater, etc. The device is at prototype stage for testing and evaluation by potential customers.</p> <p>The spectrometer received a "Silver Award for Smart Living" from the Hong Kong Information and Communications Technology Awards (ICT Awards) 2020. The relevant patented mini-spectrometer technology was awarded the Gold Medal with the Congratulations of the Jury at the International Exhibition of Inventions of Geneva in 2019.</p>
<p><b>6. 5G Base Station L1 PHY Reference Design</b></p>  <p>5G核心網 5G Core</p> <p>應科院 5G 基站 PHY 層軟件 ASTRI 5G Base Station L1 PHY Solution</p> <p>分布單元 Distributed Unit (DU)</p> <p>射頻拉遠單元(Remote Radio Units)</p> <p>5G</p> <p>5G O-RAN 基站 Base Station</p> <p>伺服器</p> <p>CPU模块 (应科院5G 基站物理层软件) CPU L1 PHY Software</p> <p>5G O-RAN 基站分布單元 (DU)</p>	<p>ASTRI has developed "5G Base Station L1 PHY Reference Design" for a telecommunications equipment company in the Mainland. Its O-RAN – O-DU has achieved the industry standard defined in "3GPP Release 15".</p> <p>The technology can benefit the customer in enhancing their product development in 5G base station, 5G terminal and 5G test tool.</p>

Project / Technology	Status / Progress
<p><b>7. Electronic Road Pricing</b></p> 	<p>ASTRI has developed a technology combining C-V2X and Ultra-wideband (“UWB”) to enable precise positioning for the Electronic Road Pricing (“ERP”) system. By using existing roadside infrastructure, the technology has eliminated the need to build expensive gantries and the laying of optical fibres as well as reduced the number of sensors required. In addition, the system is easy to install and transfer, thus effectively reducing the time and cost in adopting the ERP system.</p> <p>The technology received a “Bronze Award for Smart Mobility” from the Hong Kong Information and Communications Technology Awards (ICT Awards) 2020.</p>
<p><b>8. Intelligent Knowledge Management Platform – by AI and NLP for Smart Government</b></p> 	<p>Through the trial project of “Intelligent Knowledge Management Platform - by AI and Natural Language Processing (“NLP”) for Smart Government”, ASTRI has established an intelligent system for the Environmental Protection Department to analyse and classify daily enquiries and complaint emails, and integrate them into their internal systems for follow-up. This system helps reduce manual processing.</p>

Project / Technology	Status / Progress
<p><b>9. Multilingual Speech Transcribing on Specialised Domains</b></p> 	<p>Through the Public Sector Trial Scheme, ASTRI is respectively cooperating with the Hong Kong Police Force and a non-profit charitable organisation to develop an intelligent speech recognition system of multilingual speech transcribing specialised domains. The R&amp;D team applies technologies such as artificial intelligence, deep learning, speech recognition, and natural language processing algorithms to the system to process a series of mixed-language voices in professional areas. After continuous learning and enhancing domain-specific knowledge, the speech recognition system can transcribe speech into text with high accuracy. Another use case is to support deaf children to learn in classroom real-time, breaking communication barriers.</p>
<p><b>10. Next Generation Cold Food Import Safety Management (CFISM) Platform</b></p> 	<p>The “Next Generation Cold Food Import Safety Management (“CFISM”) Platform” is a proof-of-concept platform that ASTRI has developed for Food and Environmental Hygiene Department (“FEHD”) and Centre for Food Safety (“CFS”). The platform combines Distributed Ledger Technology (“DLT”) and Internet of Things (“IoT”) technology to provide traceability for the cold food import process and simplify the documentation process. The technology has passed the on-site trial and functional verification with FEHD and CFS at Man Kam To Food Control Office in 2021.</p>
<p><b>11. Portable Gas Sensing Device</b></p> 	<p>ASTRI is now collaborating with the Fire Services Department to develop a portable remote gas sensing device based on infrared multispectral technology. It will allow firemen to monitor the concentrations of explosive gases, such as CH<sub>4</sub> and CO, at a safe distance.</p>



Project / Technology	Status / Progress
<p><b>12. Smart Water Treatment Works and Meter Reading</b></p> 	<p>ASTRI has developed an IoT surveillance system based on Long Range (“LoRa”) technology. By installing object detection sensors and IoT sensors to monitor water levels, chlorine gas leaks, collapsed trees or trespassing, the system makes Hong Kong’s water treatment works and the meter reading system smarter. It automatically generates alert messages to the Water Supplies Department for follow-up actions.</p>
<p><b>13. Portable Smart Alcohol Multimeter</b></p> 	<p>ASTRI is collaborating with the Customs and Excise Department to develop a portable smart alcohol multimeter. With the integration of smartphone platform, miniature optical spectrometer and advanced algorithm, the portable device can carry out fast screening of alcoholic disinfection products by measuring the composition and concentration of alcohols in transparent containers. It can thus quickly identify products with toxic methanol to help ensure consumer safety and public health.</p>

**Hong Kong Research Institute of Textiles and Apparel (“HKRITA”)  
Highlight of Operation in 2019-20 and 2020-21**

**I. New Research and Development (“R&D”) Projects and Industry Contribution  
(in \$million)**

	<u>2018-19</u>			<u>2019-20</u>			<u>2020-21</u>		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform <sup>1</sup>	12	66.7	13.0	7	45.2	8.8	14	65.2	12.6
Collaborative <sup>2</sup>	4	8.9	4.6	1	8.7	4.4	4	10.5	5.4
Seed <sup>3</sup>	4	11.2	n/a	1	2.8	0.1	2	5.6	n/a
Total:	20	86.8	17.6	9	56.7	13.3	20	81.3	18.0
Public Sector Trial Scheme	3	6.7	n/a	3	5.2	n/a	2	6.2	n/a

**II. Operating Expenditure (in \$million)**

	2018-19	2019-20	2020-21
Staffing	23.9	25.3	28.7
Accommodation	3.0	4.7	5.4
Equipment	2.5	0.9	0.7
Others	7.7	8.3	7.4
Total :	37.1	39.2	42.2

<sup>1</sup> Platform projects require industry contribution of at least 10% of the total project cost.

<sup>2</sup> Collaborative projects require industry contribution of 30-50% of the total project cost.

<sup>3</sup> Seed projects are projects which are more forward-looking and exploratory in nature. No industry contribution is required.

### III. Industry Income (in \$million)



	2018-19	2019-20	2020-21
Industry Contribution	17.6	13.3	18.0
Licensing/Royalty	0.2	0.6	2.2
Contract Services	6.3	26.8	2.2
Others	4.4	1.9	1.2
Total :	26.0	42.4	23.6
Project Cost :	75.6	53.9	75.7
Level of Industry Income :	34%	79%	31%

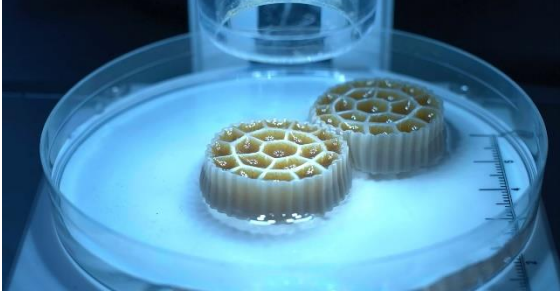
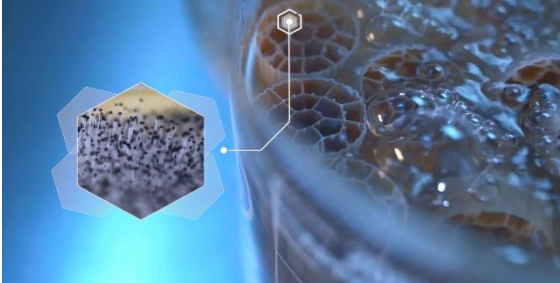
### IV. Other Performance Indicators

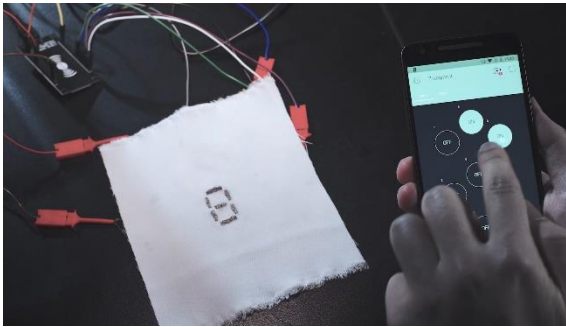

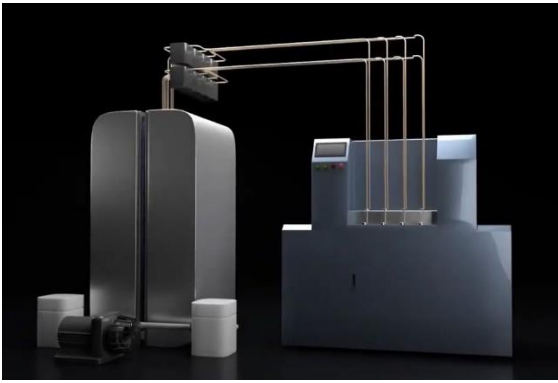
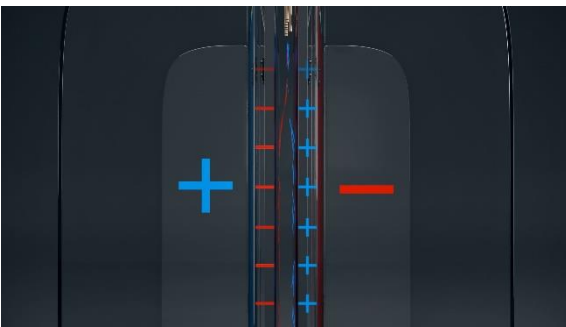
	2018-19	2019-20	2020-21
Number of Organisations Benefitting from the Public Sector Trial Scheme	13	14	12
Number of Interns Engaged	77	89	90
Number of Patents Filed	37(6)	29(7)	24(12)

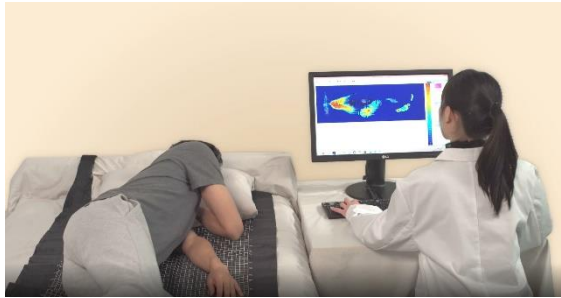



*Note : Figures in brackets denote the numbers of patents granted.*


## Progress of Selected Projects on R&D, Commercialisation and Use of R&D Outcomes in the Public Sector in 2019-20 and 2020-21

Project / Technology	Status / Progress
<p><b>1. Cellulose-based perfluorochemicals (“PFC”)-free Functional Surface Finish</b></p>  	<p>Traditionally, water-repellent surface finishes are achieved by using PFCs, which are toxic chemicals hazardous to humans and the environment.</p> <p>This new water-repellent surface finish developed in this project makes use of natural and recycled materials obtained from textile waste, which is a safer alternative to PFCs. The finish is made through a two-step chemical process: firstly, a hydrophobic modification of the recycled cellulose powders to make them water repellent; secondly, adding functional additives to improve the washing durability properties of the fabric.</p> <p>The project won the Gold Medal with the Congratulations of the Jury at the International Exhibition of Inventions of Geneva in 2021.</p>

Project / Technology	Status / Progress
<p><b>2. Cultivation of Aniline-degrading Bacteria to Enhance Textile Dyeing Wastewater Treatment</b></p>  	<p>This project demonstrates a solution to the treatment of textile dyeing wastewater that is both sustainable and economical. It enhances biological treatment through an innovative process that integrates taxonomy analysis and biodegradation performance to cultivate the specialised aniline-degrading bacteria for textile dyeing wastewater treatment. The specialised microbial strains, cultivated and immobilised through this process, can enhance the biodegradation of aniline compounds up to an undetectable level of concentration in textile dyeing wastewater.</p> <p>A trial was conducted in a textiles plant of a Hong Kong enterprise located in the Greater Bay Area. This taxonomic identification method provides a detailed understanding of microbial populations in biological wastewater treatment environments.</p> <p>This project won a Gold Medal at the International Exhibition of Inventions of Geneva in 2021.</p>

Project / Technology	Status / Progress
<p><b>3. Soft Electrochromic Yarns with Low Operating Voltage</b></p>  	<p>This project develops a sustainable way of fabricating a soft electrochromic yarn for use in a numeric textile display prototype. The soft electrochromic materials can exhibit changing of colours with low operating voltage on textiles for displaying numerical figures through different combinations.</p> <p>Not only does it provide a promising energy-saving technology for futuristic textile display, with wide and easy application in the textile industry, but it also opens up opportunities for next-generation smart displays for fashion textiles.</p> <p>The project won a Gold Medal at the International Exhibition of Inventions of Geneva in 2021.</p>
<p><b>4. A Novel Separation Method of Disentangled Textile Fibres</b></p>  	<p>To separate valuable disentangled protein fibres from synthetic textiles materials, this invention is an environmentally friendly system which utilises the triboelectric properties of different kinds of textile fibres to perform the task.</p> <p>The process does not require use of any chemicals or water, thereby ensuring that no waste will be discharged to the environment. The collected clean and intact protein fibres are then ready for production of new functional or high value clothing to satisfy various market needs.</p> <p>The project won a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.</p>

Project / Technology	Status / Progress
<p><b>5. Sleeping Comfort System for Identification of Comfort Zone</b></p>  	<p>The Sleeping Comfort System presents an evaluation system for identification of the comfort zone in terms of thermal, touch and biomechanical comfort for bedding.</p> <p>It consists of a hardware and a software system. By integrating the systems, the chamber can adjust the microclimate of the bedding environment and biomechanical comfort, personalising one's sleeping comfort.</p> <p>This project has received the sponsorship from a local bedding products company. This company is also the industry partner at the seed research stage of the project.</p> <p>The project won a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.</p>
<p><b>6. Bionic Functional Footwear for Pregnant Women</b></p>  	<p>Weight gain and relaxing hormone increases during pregnancy can lead to swollen feet and arch drop for pregnant women. This project develops bionic functional footwear by adopting the advance technologies of 3D hybrid knitting-printing-moulding materials and biometric ergonomic design, as well as imitate the features of terrestrial animal and human foot structures</p> <p>The bionic functional shoes can adapt to foot dimensional variations, enhance arch support and reduce peak plantar pressure, thus relieving foot pain and improving foot health.</p> <p>This project was developed in partnership with one local university and won a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.</p>

Project / Technology	Status / Progress
<p><b>7. Trial: High Performance Sportswear and Devices for Hong Kong's Athletes</b></p>  <p>The image shows two mannequins wearing dark blue athletic tops. The top on the left is long-sleeved, and the top on the right is short-sleeved. Both tops feature red piping along the shoulders, sleeves, and hem. A small red logo is visible on the chest of each top.</p>	<p>This project develops high performance sportswear and devices, including elbow support, knee support, ankle support, compression top, compression socks, shorts and on-field wear for more than 100 athletes of Hong Kong Sports Institute in consideration of the sport characteristics of Track &amp; Field, Rowing, Bowling and Rugby. It aims to provide athletes with suitable devices for intense training, participation in international competitions such as Tokyo Olympic Games and post-match recovery. It is expected that these sportswear and devices are able to enhance their performance, provide protections, support cooling down and recovery after exercise and prevent injuries.</p>



**Logistics and Supply Chain MultiTech  
Research and Development Centre (“LSCM”)  
Highlight of Operation in 2019-20 and 2020-21**

**I. New Research and Development (“R&D”) Projects and Industry Contribution  
(in \$million)**

	<u>2018-19</u>			<u>2019-20</u>			<u>2020-21</u>		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform <sup>1</sup>	6	73.5	18.7	4	63.8	3.4	10	99.3	19.6
Collaborative <sup>2</sup>	2	2.6	1.3	4	16.7	6.0	4	15.3	7.7
Seed <sup>3</sup>	6	16.7	n/a	10	31.6	3.7	7	18.3	0.4
Total:	14	92.8	20.0	18	112.1	13.1	21	132.9	27.7
Public Sector Trial Scheme	11	31.1	n/a	7	47.5	n/a	4	12.5	n/a

**II. Operating Expenditure (in \$million)**

	2018-19	2019-20	2020-21
Staffing	23.9	28.4	28.0
Accommodation	9.7	12.4	17.2
Equipment	0.8	1.7	0.4
Others	2.8	0	0
Total :	37.2	42.5	45.6

<sup>1</sup> Platform projects require industry contribution of at least 10% of the total project cost.

<sup>2</sup> Collaborative projects require industry contribution of 30-50% of the total project cost.

<sup>3</sup> Seed projects are projects which are more forward-looking and exploratory in nature. No industry contribution is required.

### III. Industry Income (in \$million)

	2018-19	2019-20	2020-21
Industry Contribution	20.0	13.1	27.7
Licensing/Royalty	0.4	0.3	0.3
Contract Services	9.6	15.6	23.8
Others	0.1	0.1	0.0
Total :	30.0	25.3	52.6
Project Cost :	64.6	26.9	80.9
Level of Industry Income :	46%	94%	65%

*Note : Income of special contract service commenced for anti-epidemic work for the Coronavirus Disease 2019 in 2020-21 has not been included in the calculation.*

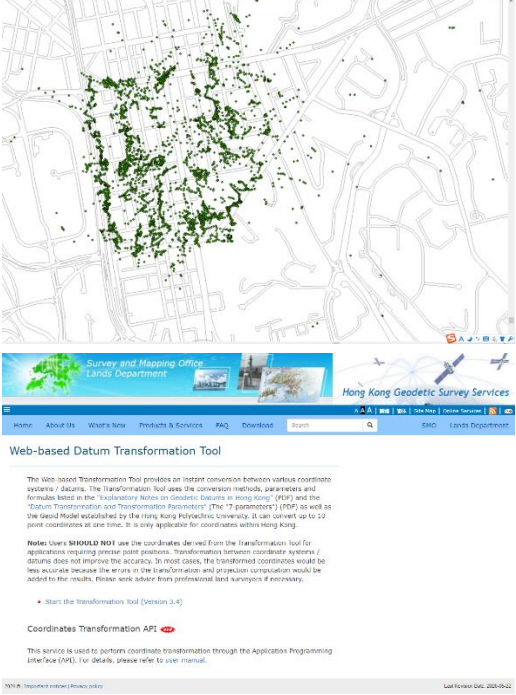


### IV. Other Performance Indicators

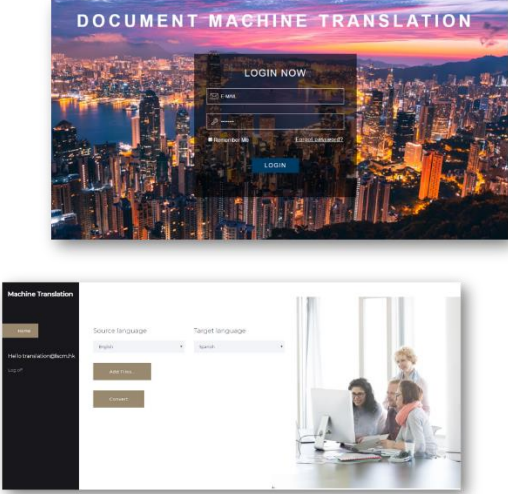
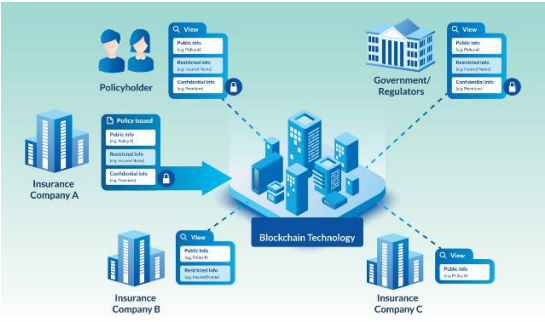
	2018-19	2019-20	2020-21
Number of Organisations Benefitting from the Public Sector Trial Scheme	31	33	24
Number of Interns Engaged	13	13	15
Number of Patents Filed	46(5)	47(7)	45(18)




*Note : Figures in brackets denote the numbers of patents granted.*



**Progress of Selected Projects on R&D, Commercialisation and Use of R&D Outcomes in the Public Sector in 2019-2020 and 2020-2021**

Project / Technology	Status / Progress
<p><b>1. “StayHomeSafe” electronic wristband and monitoring solution</b></p>  	<p>To combat the COVID-19 epidemic, LSCM developed a Bluetooth Low Energy electronic wristband and a monitoring solution to support the implementation of mandatory home quarantine measure. Coupled with the “StayHomeSafe” mobile app developed by a local technology start up that adopts geo fencing technology, the solution is effectively monitoring whether persons under quarantine are staying at their designated premises.</p> <p>The “StayHomeSafe” electronic wristband and surveillance system has already been adopted by other places. LSCM has shipped about 15 000 electronic bracelets to Bermuda and Hawaii, etc. Other overseas countries such as Chile, Turkey, Israel and Saudi Arabia, are currently running trials on the system.</p> <p>This application was awarded a Gold Medal at the International Exhibition of Inventions of Geneva in 2021.</p> <p>LSCM developed a stringent system for the Universal Community Testing Programme, which integrates QR code/barcode identifiers, electronic seal, bluetooth and global positioning system into a control network for real-time tracking of all the specimen boxes and delivery vehicles to ensure that the specimens arrive at the laboratories safely. When the Government implemented the COVID-19 Vaccination Programme in February-2021, LSCM made use of locally researched and developed e Lock technology and mobile technology in applied logistics and inventory management to develop relevant systems for vaccine procurement, consignment monitoring and handling, so as to render assistance to the Food and Health</p>

Project / Technology	Status / Progress
<p><b>2. Using DGNSS to provide more accurate positioning service</b></p>  <p>The Web-based Transformation Tool provides an instant conversion between various coordinate systems / datums. The Transformation Tool uses the conversion methods, parameters and formulas based on the "Transformation Model on Coordinate Systems in Hong Kong" (TMHK) and the "Datum Transformation and Transformation Parameters" (The "7 parameters") (DTP) as well as the Geoid Model established by the Hong Kong Hydrographic Surveyors. It can convert up to 50 point coordinates at one time. It is only applicable for coordinates within Hong Kong.</p> <p><b>Notes: Users SHOULD NOT</b> use the coordinates derived from the Transformation Tool for applications requiring precise point positions. Transformations between coordinate systems / datums does not improve the accuracy. In most cases, the transformed coordinates would be less accurate because the errors in the transformation and projection computation would be added to the results. Please seek advice from professional land surveyors if necessary.</p> <p>• Start the transformation tool (Version 3.4.2)</p> <p>Coordinates Transformation API </p> <p>This service is used to perform coordinate transformation through the Application Programming Interface (API). For details, please refer to User Manual.</p> <p>© 2018 Government of the Hong Kong SAR. Last revised: 2024-02-22</p>	<p>Bureau in managing the supply, delivery and use of vaccines.</p> <p>LSCM and a local university jointly developed an integrated solution that uses the Differential Global Navigation Satellite System (DGNSS) to integrate Micro-Electro Mechanical System (MEMS) inertia sensors and 3D street models to improve serious positioning errors in dense urban areas. These errors are usually caused by factors such as signal occlusion.</p> <p>This application was awarded a Silver Medal at the International Exhibition of Inventions of Geneva in 2021 and was successfully trialed in a government department. Another government department also used this technology to establish a Web-based Datum Transformation Tool to provide the public with real-time conversion between different coordinate systems. As of March 2021, the tool has recorded a total usage of 180 million times.</p>
<p><b>3. Delivery robot with end-to-end navigation policies</b></p> 	<p>LSCM has developed mid-range navigation policies for autonomous robots to tackle the challenges of coordinating a team of robots and performing point-to-point navigation in such dynamic and complex environments as airport and warehouse.</p> <p>Leveraging deep learning, a delivery robot equipped with LiDAR and “end-to-end mid-range navigation policies” will be able to predict dynamic scene changes even in a crowded environment, avoid obstacles and deliver items to its destination.</p> <p>This application was awarded a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.</p>

Project / Technology	Status / Progress
<p><b>4. A cloud base e-commerce/ e-logistic platform with smart contracts, blockchain and artificial intelligence</b></p>  <p>The image shows two screenshots related to machine translation technology. The top screenshot is a login page for 'DOCUMENT MACHINE TRANSLATION' with a 'LOGIN NOW' button and a 'LOGIN' button. The bottom screenshot shows a 'Machine Translation' interface with 'Source language' and 'Target language' dropdown menus, and a 'Translate' button. In the background, there is an image of people working at a computer.</p>	<p>As more and more MSMEs are trying to establish and expand their businesses on the Internet, LSCM is developing a series of solutions to facilitate enterprises to complete contracts, delivery, and payment arrangements for commercial transactions through the Internet. These solutions include a translation engine that uses artificial intelligence (AI) and deep learning to more accurately translate business documents in professional domains (such as marketing) and transcribe virtual meeting discussions therefore enabling transaction parties to communicate in different languages.</p> <p>At present, a government department is using this technology to translate promotional materials into foreign languages such as Italian and Spanish, thus reducing the manpower and time resources required in the translation process.</p> <p>This technology will consolidate Hong Kong's advantages in the Greater Bay Area and the international market, and strengthen Hong Kong's position as an international hub.</p>
<p><b>5. Next InsurChain</b></p>  <p>The diagram illustrates the 'Next InsurChain' system. It features a central 'Blockchain Technology' hub. Surrounding it are five main entities: 'Policyholder', 'Insurance Company A', 'Insurance Company B', 'Insurance Company C', and 'Government/Regulators'. Each entity has a 'View' button and a 'Policy Issued' button. The 'Policy Issued' buttons are connected to the central hub, indicating that policy information is shared and tracked across the network. The 'View' buttons allow for verification of customer claims records.</p>	<p>LSCM has collaborated with a local start-up to develop a system using blockchain technology for the insurance industry. It has effectively allowed different insurance companies to share and track insurance policy information and verify customer claims records. This has not only made the process smoother and saved operating costs, but also avoided problems such as false insurance policies and improved the overall efficiency and accuracy of the process. The start-up is currently working on the commercialisation of this “Next InsurChain” system.</p>

Project / Technology	Status / Progress
	<p>This application was awarded a Silver Medal at the International Exhibition of Inventions of Geneva in 2021.</p>
<p><b>6. The Future Warehouse of Hong Kong</b></p> 	<p>LSCM has developed the “Follow-me” robot and platooning technology especially for local warehouses, factories and large retail stores to help improve warehouse efficiency.</p> <p>The “Follow-me” robot can help warehouse operators carry large and heavy items so that they only need to retrieve the goods from the shelves, which can ensure occupational safety and reduce labour costs.</p> <p>This R&amp;D achievement was awarded a silver award in the 2nd Asia Exhibition of Inventions Hong Kong in 2019.</p>
<p><b>7. Self-coordinating and balancing technology for Autonomous Guided Vehicles in Warehouses</b></p> 	<p>Tackling the problem of limited space and dense storage of local warehouses, LSCM has developed an Autonomous Guided Vehicle (AGV) system with self-balancing technology. Upon receipt of a pickup request from the picker, the system will coordinate the fleet of AGVs to move the racks and send the required rack directly to picker. The AGV will also calculate the centre of gravity of the rack to prevent the rack from toppling. This system reduces labour costs and increases the utilisation of the space of the warehouse by eliminating the corridor area for pickers to access individual racks. This technology has been adopted by the local mini-storage industry.</p>

<b>Project / Technology</b>	<b>Status / Progress</b>
<p><b>8. Electronic form framework system for Landslide Prevention and Mitigation (LPMit) Works</b></p> 	<p>LSCM has developed a workflow management and electronic form framework system for landslide prevention and mitigation projects, using blockchain and peer-to-peer storage network technology to monitor work processes.</p> <p>This technology is particularly suitable for application in civil engineering projects where the work processes of multiple construction units need to be monitored. The system can replace the existing handwritten forms and provide a more reliable and traceable workflow record.</p> <p>The Centre is testing the system with the Civil Engineering and Development Department.</p>
<p><b>9. Using computer vision and machine learning to improve the quality management process at construction sites</b></p> 	<p>LSCM and a local university have jointly developed a technology using computer vision and machine learning to automate the existing quality management process which relies heavily on manual operation and records. The technology will analyse images of site activities captured real-time by surveillance cameras and utilise machine intelligence to determine if there are any quality deviations and/or defects.</p> <p>The application has been successfully trialled in a number of construction sites and was awarded a Gold Medal at the International Exhibition of Inventions of Geneva in 2021.</p>

**Annex E**

**Nano and Advanced Materials Institute (“NAMI”)  
Highlight of Operation in 2019-20 and 2020-21**

**I. New Research and Development (“R&D”) Projects and Industry Contribution (in \$million)**

	<u>2018-19</u>			<u>2019-20</u>			<u>2020-21</u>		
	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution	No. of New Projects	Project Cost	Industry Contribution
Platform <sup>1</sup>	4	27.6	4.5	6	53.2	14.4	12	81.5	15.8
Collaborative <sup>2</sup>	26	90.6	43.6	22	68.0	32.4	14	50.5	22.8
Seed <sup>3</sup>	11	30.7	n/a	11	30.7	n/a	6	16.8	n/a
<b>Total:</b>	<b>41</b>	<b>148.9</b>	<b>48.1</b>	<b>39</b>	<b>151.9</b>	<b>46.8</b>	<b>32</b>	<b>148.8</b>	<b>38.6</b>
Public Sector Trial Scheme	2	2.4	n/a	4	6.1	n/a	10	23.3	n/a

**II. Operating Expenditure (in \$million)**

	2018-19	2019-20	2020-21
Staffing	39.6	42.3	43.0
Accommodation	9.4	11.4	13.0
Equipment	6.8	7.5	6.0
Others	17.8	17.5	17.8
<b>Total :</b>	<b>73.6</b>	<b>78.7</b>	<b>79.8</b>

<sup>1</sup> Platform projects require industry contribution of at least 10% of the total project cost.

<sup>2</sup> Collaborative projects require industry contribution of 30-50% of the total project cost.

<sup>3</sup> Seed projects are projects which are more forward-looking and exploratory in nature. No industry contribution is required.



### III. Industry Income (in \$million)



	2018-19	2019-20	2020-21
Industry Contribution	48.1	46.8	38.6
Licensing/Royalty	2.9	3.1	2.8
Contract Services	12.8	8.0	12.8
Others	2.2	1.2	2.2
Total :	65.4	57.4	55.4
Project Cost :	118.1	121.2	132.0
Level of Industry Income :	55%	47%	42%

### IV. Other Performance Indicators

	2018-19	2019-20	2020-21
Number of Organisations Benefitting from the Public Sector Trial Scheme	19	9	34
Number of Interns Engaged	6	14	31
Number of Patents Filed	65(27)	68(26)	85(19)




*Note : Figures in brackets denote the numbers of patents granted.*

**Progress of Selected Projects on R&D, Commercialisation and Use of R&D Outcomes in the Public Sector in 2019-2020 and 2020-2021**

Project / Technology	Status / Progress
<p><b>1. Printed Battery with High Power Output</b></p> 	<p>NAMI has developed a flexible and thin printed battery with advanced materials which supplies a high current and sufficient power output to drive long-range internet-of-things (“IoT”) devices.</p> <p>This technology has won several international awards, including Gold Award of “Edison Awards”, “R&amp;D 100 Awards”; “CES Innovation Award” and the Gold Medal with Jury’s Commendation at the International Exhibition of Inventions of Geneva.</p>
<p><b>2. Long Lasting Battery for Extreme Temperature IoT Trackers Devices</b></p> 	<p>NAMI has developed a series of long lasting and safe batteries for IoT devices with doubled battery life under a wide operation temperature from -40 °C to 85 °C, expanding the application of the IoT devices to diverse geographical regions. The battery has been launched to the market in the use of T-BOX for vehicle IoT and solar-powered tracker.</p> <p>This technology has won several international awards, including Silver Award of “Edison Awards”, “CES Innovation Award” and Gold Medal with Jury’s Commendation at the International Exhibition of Inventions of Geneva.</p>

Project / Technology	Status / Progress
<p><b>3. Built-in biocide-free plastic materials suitable for injection molding process</b></p> 	<p>Without the use of leachable biocides, NAMI has developed an innovative approach for making plastics materials repellent to germ, compatible to traditional manufacturing process like injection molding, and with applications in many different areas, from food containers to medical products.</p> <p>Several germ-repellent plastics resins are now available for sale in the market. The technology has been adopted to develop products such as germ-repellent breathing tubes, germ-repellent bathroom fixtures, drinking bottles as well as germ-repellent varnish for children books and food paper boxes.</p>
<p><b>4. Collapse-Free Backfill Material for Pavement by Nano-Foam Technology</b></p> 	<p>NAMI has developed a self-leveling, free-flowing, soil-like backfill material. Unlike conventional soil-based backfilling requiring layer-by-layer soil compaction, the flowable fill material can continuously be pumped into the trench, enhancing productivity and pavement quality.</p> <p>With the support of Highways Department as one of the supporting organisation, the collapse-free backfill material has been applied in Central Kowloon Route - Kai Tak East project, as well as the landslip prevention and mitigation trial carried out by the Geotechnical Engineering Office of the Civil Engineering and Development Department.</p>

Project / Technology	Status / Progress
<p><b>5. Nano Bubble Technology</b></p> 	<p>NAMI has successfully developed an ozone nano bubble generator which can effectively oxidize the bacteria and viruses in water, destroying its outer structure and inactivating 99% of common bacteria including Escherichia Coli and Legionella. The system is on trial in the flushing system of several public toilets, including Tonkin Street public toilet managed by the Food and Environmental Hygiene Department, reducing 90% of the amount of bacteria in the flushing water, preventing the formation of biofilm on the surface of the toilet as well as reducing 50% of the odor caused by the excrement.</p>
<p><b>6. Durable Antibacterial and Antiviral Coating</b></p> 	<p>NAMI has developed a durable antibacterial and antiviral coating that can be applied on various surfaces such as plastics, metals, ceramics, glass and wood. The technology can also be applied on personal protective equipment soft surfaces such as clothing fibers, or used as disinfectant, providing a prolonged disinfection performance.</p> <p>Under the COVID-19 pandemic, the technology has been licensed to several companies for multiple uses, including provision of antibacterial and antiviral spraying services for places/facilities in Hong Kong and Mainland, as well as on facemasks and hand sanitizers.</p>

<b>Project / Technology</b>	<b>Status / Progress</b>
<p><b>7. Self-cleaning Antibacterial Vitreous Enamel Panel</b></p> 	<p>NAMI has developed self-cleaning antimicrobial vitreous enamel panel with enhanced level of resistance to microbes, mold and bacteria to ensure a cleaner and safer environment. The antibacterial panels will be adopted at the facilities under the Architectural Services Department and the Electrical and Mechanical Services Department (“EMSD”), including the Legislative Council Complex, Tin Shui Wai Temporary Market and the EMSD Headquarters.</p>
<p><b>8. NAMI eMuscle on “Doll Hair” Filament</b></p> 	<p>NAMI has developed eMuscle by employing shape memory polymers with molecular design to achieve tunable shape recovery/fixation temperature. The materials have been used to develop innovative “doll hair” of a new toy doll series by an industry sponsor. The product has been launched in May 2020.</p>
<p><b>9. High Performance Impact Protection Industrial Safety Glove</b></p> 	<p>NAMI has developed innovative impact protection material which is used to produce high performance industrial glove with higher impact protection, better resistance to high temperature and greater comfort than conventional gloves made with thermoplastic rubber. The product has been launched to the market.</p>