香港特別行政區政府

創新及科技局

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INNOVATION AND
TECHNOLOGY BUREAU

THE GOVERNMENT OF THE HONG KONG
SPECIAL ADMINISTRATIVE REGION

20/F, West Wing, Central Government Offices,
2 Tim Mei Avenue, Tamar, Hong Kong

By email

15 March 2019

Mr Desmond LAM
Clerk to Panel on Commerce and Industry
Legislative Council Complex
1 Legislative Council Road
Central, Hong Kong

Dear Mr LAM,

Panel on Commerce and Industry
Meeting on 15 January 2019

Progress report on the Innovation and Technology Fund

At the meeting on 15 January 2019, the Panel requested the Government to provide supplementary information on the subject agenda. The Innovation and Technology Bureau's response is enclosed herewith for Members' reference.

Yours sincerely,

(Ricky CHONG)
for Secretary for Innovation and Technology

c.c. Commissioner for Innovation and Technology
(Attn.: Miss Kathy CHAN)

Panel on Commerce and Industry
Meeting on 15 January 2019
Administration's Response

Details of Funding Schemes under the Innovation and Technology Fund ("ITF")

As each of the funding schemes under the ITF has its specific nature, objective and target group(s), the ways and criteria to evaluate their effectiveness differ. For example, under the Technology Start-up Support Scheme for Universities ("TSSSU"), start-ups funded under the scheme are required to submit annual reports to the Innovation and Technology Commission ("ITC") with details on their business development, including commercialisation details of their research and development ("R&D") results, and information such as the number of patent applications filed and income, etc. The relevant universities are also required to report to ITC their observations and assessment on the performance of their start-ups every year (see paragraph 3(l) below). In addition, we would collect data on patents successfully acquired by enterprises which have received support under the Patent Application Grant ("PAG") to assess its effectiveness.

2. However, it is rather difficult to quantitatively measure the effectiveness of some ITF funding schemes. For instance, the Midstream Research Programme ("MRP") aims to fund midstream research projects undertaken by University Grants Committee ("UGC")-funded institutions. The research outcomes would take a longer time and require further downstream R&D work before they can be commercialised into products. In addition, the General Support Programme ("GSP") supports non-R&D projects, including conferences, exhibitions, seminars and youth activities, etc., that help upgrade local industries and promote an innovation and technology ("I&T") culture in Hong Kong. As the cultivation of an overall I&T culture in the community is a long-term and continuous endeavor which does not have objective assessment criteria, it is relatively difficult to assess the effectiveness of the scheme in concrete terms.

3. We have been working with funding recipients to explore ways to more effectively evaluate the effectiveness of different funding schemes. With a view to facilitating Members' understanding on the operation and effectiveness of the various funding schemes under the ITF, we set out below the number of applications received and approved as well as the amount of funding approved in respect of all funding schemes under the ITF since their launch, and the effectiveness of some of the funding schemes.

Supporting Research and Development

(a) Innovation and Technology Support Programme ("ITSP") was launched in 1999 to support R&D projects undertaken by R&D Centres, local universities and other public research institutions. As at end January 2019, 2 392 projects have been funded, with total funding of about $8.4 billion.

Since 2017, ITSP funded projects have so far generated 78 intellectual property ("IP") rights[1]. ITSP has funded many successful projects, such as the study of non-invasive prenatal diagnosis by Professor Dennis Lo from a local university, which led to the development of "non-invasive prenatal diagnostic technology". The technology has been widely adopted in over 90 countries, benefitting millions of pregnant women globally. Furthermore, the ITSP has funded the Hong Kong Research Institute of Textiles and Apparel ("HKRITA") to conduct R&D work on recycling of textile products. One of the R&D outcomes is the development of an automated system to recycle old clothes into recycled fibres. The technology won a gold medal at the 46th International Exhibition of Inventions of Geneva in 2018 and has been utilised by a local company to set up an automated production line in the Tai Po Industrial Estate to produce recycled fibres;

(b) Guangdong - Hong Kong Technology Cooperation Funding Scheme ("TCFS") was launched in 2004 to fund research projects involving Guangdong/Hong Kong cooperation. As at end January 2019, 265 projects have been funded, with total funding of about $863 million;

(c) University-Industry Collaboration Programme ("UICP") was launched in 1999 to provide dollar-for-dollar matching funding for R&D projects jointly undertaken by private companies and local universities. As at end January 2019, the UICP has funded 353 applications involving 251 enterprises, with total approved funding of about $435 million;

(d) Enterprise Support Scheme ("ESS") was launched in 2015 to provide dollar-for-dollar matching funding for private companies

[1] Since 2017, funded organisations have been invited to provide relevant information in the evaluation reports submitted after completion of the projects. As some organisations have yet to submit the evaluation reports, the information does not fully reflect the total number of IP rights generated by all funded projects.

to carry out R&D projects. As at end January 2019, the ESS has supported 100 applications involving total funding of about $327 million. The 89 enterprises which benefited from the scheme have contributed about $387 million;

(e) R&D Cash Rebate Scheme ("CRS") was launched in 2010 to provide cash rebates to private companies for their expenses in ITF R&D projects, or other R&D projects fully funded by these companies and undertaken by local universities and other designated public research institutions. As at end January 2019, the CRS has approved 2 148 applications with total funding of about $451 million, benefitting 1 227 private enterprises. It is estimated that the relevant R&D expenditure involved reaches about $1.38 billion.

(f) MRP was launched in 2016 to fund midstream research projects undertaken by UGC-funded institutions. As at end January 2019, the MRP has supported 24 applications involving total funding of about $117 million, of which 12 projects are collaboration projects across institutions. All projects are currently in progress;

Facilitating Technology Adoption

(g) Public Sector Trial Scheme ("PSTS") was launched in 2011 to support public sector bodies to try out new technologies or products developed in ITF projects and by incubatees/graduate tenants of the Hong Kong Science and Technology Parks Corporation ("HKSTPC") and Cyberport. As at end January 2019, 202 projects have been funded with total funding of about $334 million, benefitting over 280 public sector organisations, including non-government organisations providing elderly/welfare or rehabilitation services, hospitals, schools and government departments, etc.

Some successful examples include: (a) trial in elderly homes of a vest jacket embedded with a radio-frequency identification tracking system specially developed for elderly persons with brain degenerative illnesses to assist staff in taking better care of them[2]; (b) a specially developed high-performance uniform worn multiple times by the Hong Kong Rowing Team at the Asian

[2] Collaboration project between the Logistics and Supply Chain MultiTech R&D Centre ("LSCM"), HKRITA, Hong Kong Applied Science and Technology Research Institute and the Tung Wah Group of Hospitals.

Games and the Olympic Games[3]; (c) and the "Single E-lock Scheme"[4] adopted by the Hong Kong Customs and Excise Department. The scheme provides seamless customs clearance by adopting "Internet of Things" and electronic lock application technologies, which greatly reduces customs clearance time. The scheme will play an important role in promoting speedy customs clearance amongst customs jurisdictions in the Guangdong-Hong Kong-Macao Greater Bay Area;

(h) Technology Voucher Programme ("TVP") was launched in 2016 to subsidise local enterprises on a 2:1 basis to use technology solutions to improve productivity or upgrade/ transform their business processes. As at 10 March 2019, a total of 1 063 applications have been supported with a success rate of 95% and total funding of about $149 million.

98 funded enterprises which have completed relevant TVP projects have submitted evaluation reports to the ITC. 96% of them considered the projects effective in enhancing their competitiveness, and all funded enterprises opined that the ITC should continue to implement the TVP;

Nurturing Technology Talent

(i) Researcher Programme (formerly known as the Internship Programme) was launched in 2004 to fund ITF recipients and incubatees/I&T tenants of HKSTPC and Cyberport to hire local graduates as researchers, thereby nurturing more I&T talent. As at end January 2019, the programme has supported 3 815 researchers, involving total funding of some $900 million.

Around 70% of the researchers who have completed their engagement period indicated that they would continue their career or plan to pursue a career in I&T-related areas;

(j) Postdoctoral Hub was launched in August 2018 to fund ITF recipients and incubatees/I&T tenants of HKSTPC and Cyberport to recruit postdoctoral talent for R&D work. As at end January 2019, 360 applications have been approved (including 298 local graduates and 62 non-local graduates), with total funding of about $180 million;

[3] Collaboration project between HKRITA and the Hong Kong Sports Institute.
[4] Developed by LSCM.

(k) Re-industrialisation and Technology Training Programme ("RTTP") was launched in August 2018 to fund local enterprises on a 2:1 matching basis for their staff to receive technology training. As at end January 2019, 349 employees of local enterprises have been supported to receive technology training, involving total funding of about $2.35 million;

Supporting Technology Start-ups

(l) TSSSU was launched in 2014-15 to support university professors and students to start technology businesses and commercialise their R&D results. Up to 2018-19, six universities have received a total of 813 applications. 291 applications were approved, involving 188 start-ups with total funding of $114 million. The major performance indicators of TSSSU include the number of start-ups that have been presented with awards, the number of start-ups that have generated IP rights and the number of IP rights generated, the number of start-ups that have rolled out their products/services in the market, the number of start-ups that have received revenue and the amount of revenue received, the number of start-ups that have raised capital and the amount of funding raised, the number of start-ups admitted to incubation programmes and the number of jobs/training opportunities created. The outcomes of TSSSU (as at end 2018) are set out in Annex D to LC Paper No. CB(1)406/18-19(03). As at end 2018, three TSSSU-funded start-ups have closed down;

(m) Innovation and Technology Venture Fund ("ITVF") co-invests with venture capital ("VC") funds in local I&T start-ups at an investment ratio of about 1:2 with a view to attracting private sector to increase their investments in local I&T start-ups. We signed agreements with six VC funds selected as ITVF's co-investment partners in the third quarter of 2018. We have been receiving investment invitations and relevant proposals from these partners. We are now considering these investment proposals and would decide the soonest possible whether to invest after completing the relevant procedures;

Promoting an I&T Culture

(n) GSP was launched in 1999 to support non-R&D projects that help upgrade local industries and promote an I&T culture in Hong Kong. As at end January 2019, the GSP has supported 211 projects, involving total funding of about $310 million.

Examples of funded projects include the "Hong Kong Student Science Project Competition" (over 1 000 secondary school students took part in the competition in 2018), the "Innovation and Technology Scholarship Award Scheme" (25 university students were awarded in 2018), the "Chuang Qing Chun" China College Students' Entrepreneurship Competition (Hong Kong Region) (about 500 university students took part in the competition in 2018), and the "InnoCarnival", which attracted 200,000 visitors in 2018. These events could help develop knowledge and interest in I&T amongst the general public, especially youngsters;

(o) PAG was launched in 1998 to provide funding support for first-time patent applicants to apply for a patent. As at end January 2019, the PAG has supported 2 202 applications, involving total funding of about $419 million. 746 applicants had successfully acquired patents.

4. Other than the TSSSU, for those funding schemes that target private enterprises, we do not have information on whether any funded enterprises have closed down after completing the relevant projects.

The R&D work of State Key Laboratories ("SKLs") and Hong Kong Branches of Chinese National Engineering Research Centres ("CNERCs")

5. Brief descriptions of the R&D work of the 16 SKLs are listed below:

SKL (Hosting Organisation)	Description
SKL of Emerging Infectious Diseases (The University of Hong Kong ("HKU"))	The research focus of the SKL of Emerging Infectious Diseases is on emerging infectious diseases including avian, other animal and human viruses such as influenza virus, coronaviruses and other viruses. Studies on novel emerging antimicrobial resistance in bacteria isolated from animals and human are also conducted. R&D projects currently undertaken by the Laboratory include "Molecular Basis for Interspecies Transmission and Pathogenesis of Middle East Respiratory Syndrome Coronavirus", "Prevention and Research of Emerging Infectious Viral Diseases" and "Research on the viral emerging infectious diseases and the control and prevention measures". Examples of products/services developed from its R&D findings include DelNS1 live attenuated vaccines for influenza viruses, and antigenic and genetic characteristics of zoonotic influenza viruses and development of candidate vaccine viruses for pandemic preparedness and consultation services provided to World Health Organisation twice a year.

SKL (Hosting Organisation)	Description
SKL of Brain and Cognitive Sciences (HKU)	The SKL of Brain and Cognitive Sciences aims to provide a national platform for cutting-edge research in unraveling the neural underpinnings of brain functions. The Laboratory focuses on empirical and translational research in brain sciences. Through a multidisciplinary approach, the complex relationships between neurobiological and psychosocial factors underpinning cognitive and affective processes would gradually be unraveled. Substantive impact has been made toward translational research goals for the betterment of mental wellness at large. Examples of its research include: using animal models to understand the cellular as well as the molecular mechanisms of how light therapy may ameliorate the symptoms of depression; unraveling the neurobiological underpinnings of neuroplasticity in humans; mapping the neural network for affective processing; and developing novel techniques based on machine learning and closed-loop neuroimaging to reprogramme fear circuits in the human brain for the treatment of phobia and understanding how trauma memories may be consolidated and modulated during sleep. The Laboratory aims to combine multiple sources of information in order to work out a coherent framework for promotion of brain and mental health, making use of the latest tools of "big data" and "machine learning" sciences.

SKL (Hosting Organisation)	Description
SKL of Translational Oncology (The Chinese University of Hong Kong ("CUHK"))	The SKL of Translational Oncology conducts intensive research investigating the molecular genetics, signalling pathways, clinical diagnostics and novel therapeutic developments of cancers common to the region, in particular nasopharyngeal cancer, liver cancer and lung cancer. R&D projects currently undertaken by the Laboratory include "Cancer Genomics using Next Generation Sequencing", "Novel therapies for Lung cancer and Nasopharyngeal carcinoma" and "MOST Special Project: Asian Cancers – from Bench to Bedside". An example of the services developed from its R&D results is the liquid biopsy test for EGFR mutations for lung cancer. Members of the Laboratory have also commercialised IP portfolio for cancer screening using circulating DNA.
SKL of Terahertz and Millimeter Waves (City University of Hong Kong ("CityU"))	The SKL of Terahertz and Millimeter Waves is committed to the advancement and applications of millimeter wave and terahertz technologies. Its key research areas include antenna design, RFIC design and fast computational technique. R&D projects currently undertaken by the Laboratory include "Transmitarrays for 5G and Beyond", "A Compact System for Terahertz Spectroscopy and Imaging" and "Biomimetic three dimensional ("3D") Microsystem to Study Tumour Survival and Drug Responses". The Laboratory has participated in the development of the "Rapid test technology and commercialisation of nano-sensor for detection of chemical contaminants in seafood", which can rapidly detect contaminants in food within half an hour with concentrations of less than 0.2ppm.

SKL (Hosting Organisation)	Description
SKL of Agrobiotechnology (CUHK)	The SKL of Agrobiotechnology is positioned primarily in basic science research of agrobiotechnology. Applied basic science studies are conducted on selected strategic areas of very strong basic science foundation with a vision to safeguard food security and contribute to the development of climate-smart agriculture for China and the world. Research focuses and achievements of the Laboratory include: (1) Identification of important genes through new generation genomics technology. The Laboratory is a frontier in the global legume research arena, and 15 patents relating to gene identifications have so far been granted. Through collaboration with Gansu Academy of Agricultural Sciences, three cutting edge drought tolerant soybean cultivars were developed through molecular markers technology. The cultivars passed the provincial test and were available for farmer's use; (2) Studies on plant cell biology A 3D electron microscopy system and a platform with whole-cell tomography at nanometer resolution for plant organelle biogenesis studies were established; (3) Research on drought tolerance and methods to improve water use efficiency Apart from studying the underlying mechanism for drought tolerant, the Laboratory promoted the use of a water saving irrigation system which is widely adopted for local cultivation in Northwestern China through setting up testing stations and farmers' schools; and (4) Development of new technology platforms on genomics, epigenomics, proteomics, and animal growth etc.

SKL (Hosting Organisation)	Description
SKL of Ultra-precision Machining Technology (The Hong Kong Polytechnic University ("PolyU"))	The objective of the SKL of Ultra-precision Machining Technology is to undertake research on ultraprecision machining technologies and precision surface metrology so as to enhance the capability of Hong Kong and Mainland China in the design, fabrication and measurement of advanced optics and critical precision components. R&D projects currently undertaken by the Laboratory include "An encoded-light-based autostereoscopic metrology system for in-situ measurement of 3D structured surfaces", "Research and development of process and equipment for supporting ultra-precision polishing of superhard materials" and "Development of ultra-precision equipment". Examples of products/services developed from its R&D results are 3D television in 4K Ultra High-Definition readily viewable without special glasses (in collaboration with a Hong Kong company), precision fresnel optics for passive infra-red sensors (in collaboration with a company in United States of America) and technical support for the design and precision manufacture of freeform optics for Virtual Reality ("VR") displays for a company in Mainland. Moreover, the 3D in-situ measurement technology was licensed to a high-tech start-up in Hong Kong Science Park, successfully appliedto a number of companies in Guangdong province.

SKL (Hosting Organisation)	Description
SKL of Molecular Neuroscience (The Hong Kong University of Science and Technology ("HKUST"))	The SKL of Molecular Neuroscience are are committed to research in neuroscience. Its current research areas include: (i) to investigate the molecular control and structural basis of neurodevelopment; (ii) to understand the mechanisms underlying neurodegenerative disorders and neural regeneration; and (iii) neurotechnologies and drug discovery. R&D projects currently undertaken by the Laboratory include "Pathophysiology and discoveries for Alzheimer's disease and related neurodegenerative diseases", "traditional Chinese medicine-based drug discovery for cognitive impairment", "Genetic risk factors for Alzheimer's disease in the Chinese population" and "Stem cell strategy for nervous system disorders". Examples of products/ services developed from its R&D results include: licensed the technologies titled "Methods and Compositions for Treating Neurodegenerative and Neuroinflammatory Conditions" and "Human Monoclonal Antibodies Against EphA4 and Their Use" to a company for the development of disease treatments, and collaborated with another company on a new formulation, its preparation method and application for depression relief.

SKL (Hosting Organisation)	Description
SKL of Marine Pollution (CityU)	The SKL of Marine Pollution, leveraging on its multidisciplinary edge, thoroughly identifys the environmental threats caused by toxic contaminants, hypoxia, biotoxins and pathological bacteria as well as ecosystem safety, conducts high-impact basic research in marine pollution, facilitates the development of new marine technology ventures in China, and solves complicated environmental problems over large temporal and spatial scales. R&D projects currently undertaken by the Laboratory include "The Application of Multiple Bioindicators on Marine Pollution Monitoring", "Species Identification and Data Analysis of Epibenthic Communities in Hong Kong Marine Waters" and "Study on Juvenile Fish Diversity and Resources at Marine Parks and Marine Reserve in Hong Kong". The Laboratory also provides service for species identification by DNA test as well as consultancy services for monitoring marine water quality and coral health at Port Shelter when the Sai Kung Sewage Treatment Plant was destructed by Typhoon Mangkhut.

SKL (Hosting Organisation)	Description
SKL of Research on Bioactivities and Clinical Applications of Medicinal Plants (CUHK)	The objective of the SKL of Research on Bioactivities and Clinical Applications of Medicinal Plants is to promote modernisation of traditional Chinese medicines through the application of biotechnologies. In order to achieve wider acceptance, the Laboratory endeavours to provide scientific proof of efficacy and safety of selected herbs to supplement the needs of clinical medical sciences. The Laboratory specifically focuses on the areas of cancer, cardiovascular health, health supplements development, DNA identification and barcoding, and viral infection etc. The Laboratory has also been collaborating with the Botanical Research Centre of Yunnan on various new drugs development. Research work being undertaken include the treatment of bone metastasis using a four herbs formula (in collaboration with other specialists), effects of Chinese herbal medicines on recovery of soft tissue injury, and effects of herbal extracts on multidrug resistance of bacteria (in collaboration with a French national research institute). Products developed by the Laboratory include anti-inflammatory herbal patch, prostate suppression supplement, anti-osteoporosis supplement, wound healing supplement, supplement to soothe menopausal symptoms, bone health supplement, and anti-allergic herbal supplement etc.

SKL (Hosting Organisation)	Description
SKL of Liver Research (HKU)	The SKL of Liver Research undertakes frontier multidisciplinary basic and translational research on liver diseases, including those developed from Hepatitis B virus ("HBV") infection. The Laboratory engages in basic laboratory research with a view to devising better diagnoses and treatment for HBV infection, cirrhosis and liver cancer. The long-term objective is to reduce the incidence and mortality of Hepatitis and liver diseases in Hong Kong. R&D projects currently undertaken by the Laboratory include "innovative study of hepatocarcinogenesis", "understanding cancer stemness in liver cancer - from regulation to translational applications", and "new strategies guiding treatment of chronic hepatitis B". Examples of products/services developed from its R&D results include "Compositions and Methods for Prognosis and Therapy of Liver Cancer", "Use of Annexin A3 as a Diagnostic and Prognostic Biomarker and Therapeutic Target for Treating Hepatocellular Carcinoma" and "Hepatitis B Variants with Reduced Sensitivity to Therapeutic Compounds, Their Detection and Uses Thereof".

SKL (Hosting Organisation)	Description
SKL of Synthetic Chemistry (HKU)	The SKL of Synthetic Chemistry focuses on creating or identifying novel chemical entities, devising and developing environmentally friendly methods for Green Chemistry; and conducting researches on bioactive organic compounds for drug development as well as luminescent and functional molecules for solving energy problems. R&D projects currently undertaken by the Laboratory include "Practical iron-catalysed C–N and C–O bond formation reactions", "Development of inexpensive luminescent metal complexes with earth-abundant metals", "Anti-cancer gold and platinum medicines and chemical biology of natural products from tradition Chinese medicines" and "Development of novel antibiotics against multidrug resistance". Examples of proprietary products/services developed from its R&D results include a series of tetradentate platinum-based green OLED emitters, a series of visible colour Platinum-OLED emitters ranging from blue to red light zone, and a series of non-porphyrin type tetradentate Platinum(II) emitters.

SKL (Hosting Organisation)	Description
SKL of Chemical Biology and Drug Discovery (PolyU)	The research of the SKL of Chemical Biology and Drug Discovery focuses on research subjects such as organic synthesis, catalysis, chemical biology and related diagnostics. There are three major research objectives: (1) to synthesise and develop novel compounds, natural products and biological compounds as drug candidates; (2) to conduct research and develop new pharmaceuticals and health products; and (3) to explore and develop new molecular techniques for development of drug and medical health products. R&D projects currently undertaken by the Laboratory include "the development of anti-cancer technology for difficult cancer types", "development of inhibitors targeting the resistance mechanisms of clinical superbugs", "rational design of inhibitors targeting bacterial transcription", and "development of autophagy modulators to inhibit lung cancer cell proliferation". Several drug candidates developed by the Laboratory have been licensed to a number of international pharmaceutical companies for clinical and preclinical trial studies.

SKL (Hosting Organisation)	Description
SKL of Environmental and Biological Analysis (Hong Kong Baptist University ("HKBU"))	The SKL of Environmental and Biological Analysis establishes a bioanalytical platform focusing on proteomics, metabolomics, biosensing and bio-imaging through the intersection and penetration of biological sciences, environmental sciences and materials sciences. By focusing on the national needs and frontiers of health research related to POPs, the Laboratory proposes new principles for the analysis and testing of POPs in the environment and organisms, develops new methods and techniques for analysis and testing, and creates new testing instruments or devices. R&D projects currently undertaken by the Laboratory include "mass spectrometry and metabolomics study on atmospheric fine particles induced respiratory diseases in Taiyuan and Guangzhou", "analysis of lipid oxidation chemical markers in frying old oil and its metabolism based on mass spectrometry", and "damages from Peroxidative Perfluorooctane Sulfonic Acid (PFOS) on vascular endothelial cell function through carbonylation of protein signaling in diabetic state". Examples of products/services developed from its R&D results include method for identifying fried oil, derivatisation reagent and its preparation method and application, as well as device for detecting lead in the water.

SKL (Hosting Organisation)	Description
SKL of Pharmaceutical Biotechnology (HKU)	The SKL of Pharmaceutical Biotechnology aims to conduct basic and treatment-related research on diabetes and cardiovascular complications caused by obesity. R&D projects currently undertaken by the Laboratory include the "mechanobiology of obesity", "adiponectin antagonises dietary obesity-induced metabolic dysfunction via modulation of gut microbiota", and "fatty acid binding protein-4 as a mediator of autoimmune diabetes: from molecular mechanism to clinical significance". Examples of products/services developed from its R&D results include Adiponectin Immunoturbidimetric Assay, which has been approved by China Food and Drug Administration ("CFDA") and obtained CE marking for population-based screening and precision diagnosis of diabetes; and anti-lipocalin-2 antibody for treatment of diabetic cardiomyopathy, for development of monoclonal antibody-based bio-drugs, which has been licensed to a pharmaceutical company.
SKL of Digestive Disease (CUHK)	The SKL of Digestive Disease carries out basic, translational and clinical research on the gastrointestinal cancer, peptic ulcer bleeding, chronic liver disease and inflammatory bowel disease commonly found among the Chinese people. R&D projects currently undertaken by the Laboratory include "biomarkers for non-invasive diagnosis of colorectal cancer", "novel biomarkers for non-invasive diagnosis of gastric cancer" and "serum biomarkers for non-invasive diagnosis of fatty liver disease". Examples of products/services developed from its R&D results include miR-92a for diagnosing Colorectal cancer and RNF180 DNA for diagnosing gastric cancer, both of which have been approved by CFDA.

SKL (Hosting Organisation)	Description
SKL of Advanced Displays and Optoelectronic Technologies (HKUST)	The SKL of Advanced Displays and Optoelectronic Technologies conducts both basic and applied research on displays technology. Five main research areas are oxide thin film transistors (TFT) array technology; third generation organic LED (OLED) devices; liquid crystal display (LCD) devices; video signal processing and Integrated Circuit ("IC") design; and frontier technologies relating to flexible and high-resolution silicon LED, as well as nano optoelectronic display. R&D projects currently undertaken by the Laboratory include "optimisation of reverse mode Polymer Network Liquid Crystal smart window", "coatable polariser", and "development of reverse mode smart window on flexible substrate". Products/services developed from its R&D results include smart label system.

6. Brief descriptions of the R&D work of the six CNERCs are listed below:

CNERC (Hosting Organisation)	Description
Hong Kong Branch of the National ASIC System Engineering Research Center (Hong Kong Applied Science and Technology Research Institute)	The Hong Kong Branch of National Engineering Research Center for Application Specific Integrated Circuit System focuses on microelectronics and IC and systems. It conducts research, facilitates technology transfer and nurtures talent in respect of the three areas, namely mixed signal systems IC, advanced digital systems and packaging. R&D projects currently undertaken by the Branch include "Intelligent Video Accelerator", "Immersive 3D Video Accelerator" and "Hardware Acceleration for VR Video Streaming". Examples of products/services developed from its R&D results include hardware accelerator for professional 3D conversion, visually enhanced ultra high definition, and advanced powerline communications.
Hong Kong Branch of National Engineering Research Center for Steel Construction (PolyU)	The Hong Kong Branch of National Engineering Research Center for Steel Construction aims to promote the socio-economic development in China and Hong Kong through applied research on and technological advancement in the engineering of steel construction and sustainable development of infrastructure. R&D projects currently undertaken by the Branch include "atmospheric corrosivity of exposed structural steelwork", "corrosion mechanisms and prevention of high performance steel in reinforced concrete structures", and "effective high strength steel construction for sustainable infrastructure development in Hong Kong". Examples of products/services developed from its R&D results include the publication of the "Technical Guide on Selection of Equivalent Steel Materials to European Steel Materials Specifications" and the "Professional Guide on Design of Buildings and Structures in Low to Moderate Seismicity Regions".

CNERC (Hosting Organisation)	Description
Hong Kong Branch of National Rail Transit Electrification and Automation Engineering Technology Research Center (PolyU)	The Hong Kong Branch of National Rail Transit Electrification and Automation Engineering Technology Research Center is dedicated to establishing a world-class smart rail technology research centre in Hong Kong. It focuses on developing advanced high speed rail technologies to enhance the safety, reliability and comfort of China's high speed rail. R&D projects currently undertaken by the Branch include Train Axles Crack Detection Enabled by the Utilisation of Guided Waves, the Effects of the Application of Ultrasonic Guided Waves in the Structural Health Monitoring of High-Speed Railways and Fiber Optic Current Sensor for Electrified High-Speed Railway Traction Power Supply System. Examples of products/services developed from its R&D results include on-board real-time condition monitoring systems of the components in high-speed trains, Metro trains and Maglev trains vehicle; online trackside wheel condition monitoring system for trains; and online railway tunnel deformation monitoring system.
Hong Kong Branch of National Precious Metals Material Engineering Research Center (CityU)	The Hong Kong Branch of National Precious Metals Material Engineering Research Center focuses on innovative research on advanced precious metal materials and their processing technology. R&D projects currently undertaken by the Branch include "Noble Metal-based Nanoporous Powders and Wires with Controlled Topological Nanostructures Via Convenient Electrochemical Techniques", "the study of 24/23K nanogold with superior hardness", and "development of High Strength and High Ductility Micro-alloyed Gold by Inducing Gradient Nanostructures". Examples of products/services developed from its R&D results include patented "Microalloyed Gold" and the supercapacitor which is being commercialised in collaboration with the industry partners.

CNERC (Hosting Organisation)	Description
Hong Kong Branch of National Engineering Research Center for Tissue Restoration & Reconstruction (HKUST)	The Hong Kong Branch of National Engineering Research Center for Tissue Restoration & Reconstruction focuses on the development of new luminescent materials and their high efficiency applications in biomedical sensors and chemical probes, which bring benefits to various fields, including detection, imaging, quarantine, inspection, diagnosis, environmental protection and homeland security. R&D projects currently undertaken by the Branch include "development of new Aggregation-Induced Emission ("AIE") luminogen-based chiral materials for efficient circularly-polarised organic light-emitting diodes", "nanostructured materials with AIE properties for bioimaging and theranostics", and "development of new AIE systems and exploration of their biomedical applications". Examples of products and services developed from its R&D results include fluorescent powders for latent fingerprint visualisation, rapid diagnosis method for HPV detection and early pregnancy test papers.

CNERC (Hosting Organisation)	Description
Hong Kong Branch of Chinese National Engineering Research Center for Control & Treatment of Heavy Metal Pollution (HKUST)	The Hong Kong Branch of Chinese National Engineering Research Center for Control & Treatment of Heavy Metal Pollution, through conducting research on innovative water pollution control technologies continuously, seeks to address the demand for clean water supply in coastal areas and municipal/industrial wastewater treatment. The major research areas include resources recovery from wastewater, energy-saving sewage treatment and optimisation of urban water systems etc. to promote scientific research, technological innovation, and translation of scientific research outcomes. R&D projects currently undertaken by the Branch include "Retrofitting works for the existing Sulfate Reduction Autotrophic Denitrification and Nitrification Integrated ("SANI") Process at Shatin Sewage Treatment Works", "Scale-up trial of a novel low-cost and energy-efficient self-forming dynamic membrane bioreactor", "Sulfur cycle-based enhanced biological phosphorous removal process", "Sulfur cycle-based brine water and excess sludge minimisation in leachate treatment", "Total municipal organic waste management by integrating food waste disposal and sewage treatment", and "Innovative multiple-stage biofilms technology for polluted water purification". Examples of the services developed from its R&D results include a large scale trial of SANI process in treating sewage in Hong Kong, and SANI Pilot Tests under Shatin Sewage Treatment Works Caverns Relocation Project.

Outcome of Work of Technology Transfer Offices of Designated Universities

7. Starting from 2013-14, the Government has been supporting, through the ITF, the Technology Transfer Offices ("TTOs") of six universities[5] with extra funding[6] to enhance their technology transfer capabilities. Key performance indicators as well as examples of the outcome of work relating to technology transfer and realisation of research and development results of each TTO from 2013-14 to 2017-18 are as follows –

	2013-14	2014-15	2015-16	2016-17	2017-18
The University of Hong Kong					
No. of patents filed	94	157	129	144	132
No. of patents granted	24	50	60	64	67
No. of patents licenced	66	75	86	102	114
No. of economically active spin-off companies	2	2	11	15	20
Example	- Invented by the Department of Electrical and Electronic Engineering of HKU, Vector Flow Imaging is an innovative technology to visualise and analyse blood flow in arteries and vessels. This patented technology can facilitate clinical detection of abnormal vascular conditions and is being used by a world-leading medical equipment manufacturer in its latest ultrasound imaging systems. - The AIDS Institute of HKU invented a vaccine for prevention and treatment HIV infection. The vaccine is patented and licensed to a company in the industry for further development. The company has completed the pilot-scale production of the vaccine and plans to start the pre-clinical trials. - HKU researchers invented a novel LED driver to tackle the problems caused by power converters in LED street lighting projects.				

[5] The six universities are HKU, CUHK, CityU, HKUST, HKBU and PolyU.

[6] The TTOs also have other funding sources such as grants from the UGC, etc.

	The novel driver has a very long lifetime of over 10 years. Its power conversion efficiency reaches 93%, and over 80% of its components are recyclable. Products utilising this technology have been launched to the market.

	2013-14	2014-15	2015-16	2016-17	2017-18
The Chinese University of Hong Kong					
No. of patents filed	166	125	165	223	327
No. of patents granted	136	58	83	132	185
No. of patents licenced	61	57	67	90	78
No. of economically active spin-off companies	17	16	15	13	13
Example	- Several professors at CUHK invented a non-invasive early cancer diagnostic technology, which involves molecular diagnosis, high-intensity DNA sequencing, and state-of-the-art Computer Science and Data Science. The technology can detect fatal diseases and cancer at their earliest stages when curative treatments are most viable. - The Interactive Weight-bearing Exercise Platform developed by a team at the Department of Orthopaedics and Traumatology of CUHK can reduce the risk of bone fracture after fall for those people suffering from osteoporosis. Products utilising the technology is available in local and overseas markets. - A research team at the School of Pharmacy of CUHK developed a new material for nanoparticle contrast agent with low cost and high safety. The new material can provide a safer and more cost effective method for the early diagnosis of Alzheimer's Disease. The patented technology has been licensed to a local company for marketing.				

	2013-14	2014-15	2015-16	2016-17	2017-18
City University of Hong Kong					
No. of patents filed	116	76	85	113	94
No. of patents granted	22	32	44	57	58
No. of patents licenced	44	47	39	40	43
No. of economically active spin-off companies	7	6	4	7	9
Example	- Currently, chargers for smart mobile devices of different brands are not compatible with each other. The patented wireless charging technology invented by CityU enables different mobile devices to be charged simultaneously on a charging plate, which is more convenient, efficient and environmentally friendly. The technology is one of the key components in Qi, the global wireless charging standard. - A team at the School of Energy and Environment of CityU invented a bioconversion technology, which can be used in the recycling of mixed textile waste into value-added products, such as synthetic fibre and bioplastics. The technology helps address waste problem, and create a sustainable and circular economy. - A professor at the Department of Electronic Engineering of CityU invented a diagnostic system that can conduct a real-time estimation of the state and health of batteries. The system allows operators to monitor batteries remotely and conduct replacement exercise at an optimal time before incident occurs. The patented technology has been licenced to a power technology company.				

	2013-14	2014-15	2015-16	2016-17	2017-18
The Hong Kong University of Science and Technology					
No. of patents filed	195	198	157	205	244
No. of patents granted	80	93	162	134	143
No. of patents licenced	41	54	64	100	107
No. of economically active spin-off companies	35	47	60	94	184
Example	- A team at HKUST invented an air purification system. Adopting a multi-level antimicrobial filter covered with microcapsule emulsion, the system can remove up to 99.999% of airborne bacteria and viruses. The anti-adhesion coating on the filter can reduce the chance of microorganism growth and biofilm formation. Household purifier system adopting the technology is already available in the market. - Invented by a team at the Department of Industrial Engineering and Decision Analytics of HKUST, the patented audio processing technology is capable of separating target signals (such as speech) from background noise. An HKUST spin-off company has commercialised the technologies into products (including hearing test app, hearing aid app and standalone hearing aid devices) which are currently undergoing user testing and trial manufacturing. - A team at the Department of Physics of HKUST invented a light sheet microscope for biomedical imaging which is of high resolution, high speed and low photo toxicity. The technology allows researchers to analyse cell mutation more accurately and effectively. The spin-off company established by the team has rolled out related products in the Asia-Pacific Region.				

	2013-14	2014-15	2015-16	2016-17	2017-18
Hong Kong Baptist University					
No. of patents filed	47	51	63	84	61
No. of patents granted	6	13	41	30	38
No. of patents licenced	1	14	16	38	43
No. of economically active spin-off companies	3	3	3	3	3
Example	- A professor at HKBU invented a fast and accurate patented technology for non-invasive detection of early prostate cancer. The patent rights have been transferred to an HKBU spin-off company, which has received investment from a listed pharmaceutical company in Hong Kong and has established presence in a healthcare technology park in the Greater Bay Area. - A research team with members from the School of Chinese Medicine of HKBU and the Faculty of Medicine of CUHK have developed a new formula for the treatment of irritable bowel syndrome. The formula has been patented and licensed to a Hong Kong listed pharmaceutical company. Clinical trial tests are being conducted in the Mainland and Hong Kong. The new drug will be offered as a new treatment option for patients. - An HKBU professor has developed a new personal care product containing Chinese herbal ingredients. The patented technology has been licensed to a HKBU spin-off company, which has rolled out skin care products in Hong Kong.				

	2013-14	2014-15	2015-16	2016-17	2017-18
The Hong Kong Polytechnic University					
No. of patents filed	67	88	79	91	131
No. of patents granted	46	73	54	43	52
No. of patents licenced	76	89	110	129	138
No. of economically active spin-off companies	1	1	17	24	24
Example	- PolyU has invented a novel design of anti-heat stress uniform which includes a polo-shirt and trousers. The uniform is made from a new generation of moisture-absorbent textiles containing nanomaterials, which can effectively reduce the physiological strain and body heat storage of construction workers working outdoor under the heat of the sun. PolyU has licenced the technology to organisations in Hong Kong and other regions. - A research team at PolyU invented a new anti-cancer drug with much lesser side effects. The new drug can starve cancer cells to death whilst leaving normal cells unharmed. It is patented and licensed to an international biotechnology company for clinical trial and commercialisation. - PolyU, in collaboration with an optics company, has invented novel spectacle lens, which provide clear vision and help retard myopia progression simultaneously. A clinical study showed that the lens slowed down myopia progression of children by 60%. The technology is patented and the relevant lenses have been rolled out in the market worldwide.				

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