

ITEM FOR FINANCE COMMITTEE

INNOVATION AND TECHNOLOGY FUND

HEAD 111 – INNOVATION AND TECHNOLOGY

Subhead 090 Midstream Research Programme for Universities (block vote)

Subhead 101 Innovation and Technology (block vote)

Subhead 112 Re-industrialisation Funding Scheme

HEAD 184 – TRANSFERS TO FUNDS

New Subhead “Payment to the Innovation and Technology Fund”

Members are invited to approve –

- (a) the creation of a new subhead Payment to the Innovation and Technology Fund under Head 184 Transfers to Funds and a supplementary provision of \$4.75 billion under the new subhead in 2021-22, to sustain the continuous operation of the existing funding schemes under the Innovation and Technology Fund and the research and development centres/laboratories as well as the introduction of new measures;
- (b) the transfer of all funds under Head 111 Innovation and Technology Subhead 090 Midstream Research Programme for Universities (block vote) and Subhead 112 Re-industrialisation Funding Scheme to Head 111 Innovation and Technology Subhead 101 Innovation and Technology (block vote) so as to enhance the flexibility in utilising the funds; and

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- (c) a supplementary provision of \$425 million under the new subhead “Payment to the Innovation and Technology Fund” under Head 184 Transfers to Funds so as to transfer the remaining balance of \$425 million under Head 135 Government Secretariat: Innovation and Technology Bureau Subhead 700 General Non-recurrent Item 801 Innovation and Technology Fund for Better Living to Head 111 Innovation and Technology Subhead 101 Innovation and Technology (block vote), so as to enhance the flexibility in utilising the funds.

PROBLEM

We need to inject \$4.75 billion into the Innovation and Technology Fund (ITF) in 2021-22 and 2022-23 to sustain the continuous operation of the existing funding schemes under the ITF and the research and development (R&D) centres/laboratories as well as the introduction of new measures, and need to improve the flexibility in utilising the funds under the ITF at the same time.

PROPOSAL

2. The Commissioner for Innovation and Technology, with the support of the Secretary for Innovation and Technology, proposes to –

- (a) inject \$4.75 billion into the ITF in 2021-22;
- (b) subsume the Midstream Research Programme for Universities (MRP) under the Innovation and Technology Support Programme (ITSP) and transfer all funds under Head 111 Innovation and Technology Subhead 090 Midstream Research Programme for Universities (block vote) to Head 111 Innovation and Technology Subhead 101 Innovation and Technology (block vote);
- (c) transfer all funds under Head 111 Innovation and Technology Subhead 112 Re-industrialisation Funding Scheme to Head 111 Innovation and Technology Subhead 101 Innovation and Technology (block vote), so as to enhance the flexibility in utilising the funds; and

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- (d) through corresponding injection into the ITF, transfer the remaining balance of \$425 million under Head 135 Government Secretariat: Innovation and Technology Bureau Subhead 700 General non-recurrent Item 801 Innovation and Technology Fund for Better Living to Head 111 Innovation and Technology Subhead 101 Innovation and Technology (block vote), so as to enhance the flexibility in utilising the funds.

The Government also invites Members to note the injection of \$4.75 billion into the ITF in 2022-23 will be reflected in the estimates of the same financial year.

JUSTIFICATION

Outcomes of the ITF

3. Supporting the development of innovation and technology (I&T) is a priority of the current-term Government. Our efforts in recent years have gradually achieved results. Hong Kong's gross expenditure on research and development (GERD) has continually been on the rise, from \$16.7 billion in 2014 to \$26.3 billion in 2019, representing an increase of 57%. The number of R&D personnel and the number of staff members of start-ups also recorded significant increase in recent years, from an average of about 75 R&D personnel per 10 000 labour force in 2014 to about 90 in 2019, with a total number of about 36 000 R&D personnel as of now. The number of staff members of start-ups also increased significantly from about 2 400 in 2014 to about 12 500 in 2019.

4. There are currently nine unicorns in Hong Kong and the number of start-ups also increased from about 1 070 in 2014 to about 3 360 in 2020, demonstrating the growing vibrancy of our I&T ecosystem. In terms of international ranking, Hong Kong is among the best, with its overall digital competitiveness ranked 5th in the world; as for the performance in technological infrastructure and the Global Innovation Index, Hong Kong is ranked 7th and 11th respectively.

5. The annual expenditure of the ITF increased by over seven times from over \$700 million in 2013-14 to over \$5.3 billion in 2020-21. At present, the ITF supports 17 funding schemes and provides funding for the work of 53 R&D centres/laboratories, in order to provide comprehensive support to local I&T force. Since its establishment in 1999, more than 19 800 projects have been funded by the ITF as at end-February 2021, involving a total commitment of around \$22.7 billion. As at end-February 2021, the uncommitted balance of the ITF was \$4.1 billion.

/Funding

Funding Schemes under the ITF

6. When established, the ITF had four funding schemes. Funding schemes under the ITF have increased into the present 17 funding schemes in response to the changes in Hong Kong's I&T ecology and developments (such as the growth of the I&T cooperation with the Mainland). Each funding scheme has its own objective, scope, and modus operandi, supporting five I&T areas, namely supporting R&D, facilitating technology adoption, nurturing I&T talent, supporting technology start-ups, and fostering an I&T culture. Information on the numbers of applications, the amounts of approved funding and the effectiveness of various funding schemes, etc., is set out below –

Supporting R&D

- (a) ITSP was introduced in 1999 to fund applied R&D projects undertaken by local R&D Centres¹, universities as well as other designated public research institutes². In the past four years³, a total of 717 projects were funded with an aggregate funding amount of over \$2.8 billion. These funded projects involve different technology areas, including biotechnology, Chinese medicines, electrical and electronics, environmental technology, information technology, manufacturing technology, materials science and nanotechnology. During the same period, the funded projects have generated over 300 intellectual property (IP) rights⁴.
- (b) Mainland-Hong Kong Joint Funding Scheme (MHKJFS) was introduced in 2019 to support and encourage universities and research institutes in Hong Kong and the Mainland to conduct collaborative R&D projects, with a view to enhancing R&D collaboration between

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¹ Namely the Hong Kong Applied Science and Technology Research Institute (ASTRI), Nano and Advanced Materials Institute (NAMI), Logistics and Supply Chain Multitech R&D Centre (LSCM), Hong Kong Research Institute of Textiles and Apparel (HKRITA), and Automotive Platforms and Application Systems R&D Centre (APAS).

² Including all local self-financing degree-awarding institutions registered under the Post-Secondary Colleges Ordinance (Cap. 320), the Hong Kong Productivity Council (HKPC), the Vocational Training Council (VTC), the Clothing Industry Training Authority and the Hong Kong Institute of Biotechnology (HKIB).

³ Unless otherwise specified, “in the past four years” in this paper refers to the period between April 2017 and end-February 2021.

⁴ Since 2017, funded organisations have been invited to provide relevant information about IP rights in the post-project evaluation forms submitted after completion of the projects. As some organisations have yet to submit the evaluation forms, the information has not fully reflected the total number of IP rights generated by all funded projects since 2017.

the two places⁵. In 2019, MHKJFS invited proposals under the themes of “Biotechnology” and “Artificial Intelligence” (AI) with a total of 113 applications received. In 2020, proposals were invited under the themes of “Biotechnology: Research on Prevention and Treatment of Neurological Diseases; Research on Prevention and Treatment of Cancer; and Research on Modernisation of Chinese Medicine” and “AI”, with a total of 84 applications received. As at end-February 2021, eight projects⁶ have completed the entire approval process and the approval process of another four projects are expected to be completed gradually by the first half of 2021.

- (c) Guangdong - Hong Kong Technology Cooperation Funding Scheme (TCFS) was introduced in 2004 to fund applied R&D projects that include elements of cooperation between Guangdong and Hong Kong (i.e. projects involving collaboration between research institutes and/or enterprises in Guangdong/Shenzhen and Hong Kong) to enhance R&D collaboration between Hong Kong and Guangdong Province. In the past four years, a total of 58 projects were funded with a total funding amount of about \$90.78 million.
- (d) Partnership Research Programme (PRP) was launched in 2019 by consolidating the previous University-Industry Collaboration Programme and the collaborative stream of ITSP to fund collaborative R&D projects jointly conducted by R&D Centres, universities and other designated public research institutes with companies. As at end-February 2021, a total of 107 projects were funded with an aggregate funding amount of about \$227.28 million. A funded enterprise can own the IP rights of the project and commercialise the R&D outcomes if it sponsors half or more of the total project cost. PRP has attracted more than \$200 million sponsorship from the private market so far, illustrating the growing active participation of the industries in collaborative R&D projects.
- (e) Enterprise Support Scheme (ESS) was launched in 2015 to provide dollar-for-dollar matching funding of up to \$10 million for private companies to carry out in-house R&D projects. In the past four years,

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⁵ Applications received under MHKJFS will first be assessed by the Ministry of Science and Technology (MOST) and the Innovation and Technology Commission (ITC) separately. Only those supported by both sides will be processed.

⁶ MHKJFS was first launched and was affected by the epidemic. Moreover, the MOST and the ITC have to separately assess the applications and compare the assessment results and then discuss and finalise the list of applications to be supported. Eventually, the ITC would request the applicants concerned to revise their project proposals with reference to the assessment comments before commencing the formal approval procedures. Therefore, the approval procedures require relatively more time.

the ESS Assessment Panel has assessed 385 applications⁷, of which 134 have received support. Private companies and the ITF have contributed about \$445 million \$402 million respectively.

Among the ESS funded projects, the R&D work of 75 projects has been completed with 26 of them for over 24 months. We have made enquiries with the relevant companies earlier and received responses from 17 companies. 16 of them (17 projects involved) indicated that they had already commercialised the project deliverables with income generated. Among the 17 projects, nine received new private funding injection with the total amount exceeding \$115 million. The projects also created nearly 100 additional jobs, won 40 awards and involved 56 relevant patent applications.

- (f) R&D Cash Rebate Scheme (CRS) was introduced in 2010 to provide cash rebate for private companies' eligible expenditure in R&D projects funded by the ITF, and those funded entirely by themselves conducted in partnership with designated local public research institutes⁸. The level of cash rebate was 10% in 2010. It was subsequently increased to 30% in 2012 and to 40% in 2016. In the past four years, a total of about 600 companies were approved with cash rebate⁹, involving a total amount of over \$500 million. We estimated that during the same period the private sector invested more than \$1.3 billion in R&D projects.
- (g) MRP was launched in 2016 to support universities funded by the University Grants Committee (UGC) to conduct midstream researches. The theme for the first two rounds of MRP was "Elderly Health and Care" whereas that for the third round was "Health Technologies for Diagnosis". As at end-February 2021, a total of 44 projects involving about \$230 million have been funded, of which 30 are R&D projects involving collaboration among multiple research institutes or disciplines. The themes for the fourth round were "Drug Development" and "Green Engineering Technologies". Application was closed on 26 March 2021. A total of 71 applications have been received.

/Facilitating

⁷ Under the Scheme, the amount of approved funding and number of approved projects in 2020-21 amount to about 2.3 times and three times those of 2015-16 respectively.

⁸ Including R&D Centres established by the Government, HKPC, VTC and HKIB.

⁹ Under CRS, the amount of approved funding and number of approved projects in 2020-21 amount to about 2.5 times and about 1.3 times those of 2015-16 respectively.

Facilitating Technology Adoption

- (h) Public Sector Trial Scheme (PSTS) was introduced in 2011 to support public sector organisations to try out new technologies or products developed from ITF-funded R&D projects and by incubatees/graduate tenants of the Hong Kong Science and Technology Parks Corporation (HKSTPC) and the Cyberport. To assist more local technology companies in realising and commercialising their R&D outcomes and encourage public organisations to utilise more local R&D outcomes, we have extended the funding scope of the PSTS to cover all technology companies conducting R&D activities in Hong Kong since March 2020 to support them to produce prototypes or samples of their R&D outcomes and/or conduct trials in the public sector for improving their products. The maximum funding amount for each project is \$1 million.

In the past four years, PSTS funded 205 projects¹⁰ involving a total funding amount of about \$424 million, benefiting over 130 different organisations to conduct over 280 trials.

- (i) Technology Voucher Programme (TVP) was launched in 2016 on a pilot basis, with an aim of subsidising eligible local enterprises and organisations on a matching basis in using technological services and solutions to improve productivity, or upgrade or transform their business processes. Subsequently, TVP has been incorporated into the ITF as a regular funding scheme, and a number of enhancements have been introduced.

With effect from 1 April 2020, TVP has been further enhanced, with the Government funding ratio raised from two-thirds to three-quarters. The cumulative funding ceiling for each applicant were increased from \$400,000 to \$600,000, and the maximum number of projects were increased from four projects six projects.

As at end-February 2021, a total of 9 562 applications have been received under TVP (excluding applications which were subsequently withdrawn or unable to be processed due to ineligibility or missing supporting documents.) Of the 3 854 applications assessed, 3 623 were approved involving a total funding amount of

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¹⁰ Under PSTS, the amount of approved funding and number of approved projects in 2020-21 amount to about 2.6 times and about 3.2 times those of 2015-16 respectively. The funding amount and number of approved applications for 2020-21 include those under the special call for projects for the prevention and control of Novel Coronavirus Disease 2019 (COVID-19).

about \$562 million, representing a success rate of about 94%. We estimated that the private sector entities and organisations contributed \$367 million matching funds during the same period, which indicates their efforts in upgrading and revamping their business processes through digital transformation¹¹.

According to the evaluation reports submitted by nearly 800 beneficiary enterprises/organisations that have already completed their projects, 97% of them were of the view that the projects were conducive to enhancing their competitiveness (the remaining 3% indicated that the projects were implemented mainly to enhance efficiency or save cost). Almost all of them indicated that the ITC should continue to implement TVP.

- (j) Re-industrialisation Funding Scheme (RFS) was launched in 2020 to subsidise manufacturers, on a 1 (Government):2 (company) matching basis, to set up new smart production lines in Hong Kong. The funding ceiling is one-third of the total project cost or \$15 million, whichever is lower. As at end-March 2021, the Secretariat has received a total of 13 applications. The RFS Vetting Committee has vetted 11 applications, and agreed in principle to support nine of them, which involve industries such as biotechnology, food processing, construction, printing, medical device and nanofiber materials. It is estimated that private companies will contribute about \$110 million and the ITF around \$55 million. ITC will continue to promote RFS by organising briefings in collaboration with chambers of commerce and industry associations.

Nurturing I&T Talents

- (k) Research Talent Hub (RTH)¹² was introduced in 2020 to provide funding support for eligible companies or organisations¹³ to engage up to four graduates in Science, Technology, Engineering and Mathematics (STEM)-related disciplines from a local university or a well-recognised non-local institution¹⁴ to conduct R&D work. It

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¹¹ Under TVP, the amount of approved funding and number of approved projects in 2020-21 amount to about six times and about five times those of 2017-18 respectively.

¹² Merging the Researcher Programme (RP) launched in 2004 and Postdoctoral Hub (PH) launched in 2018.

¹³ All technology companies conducting R&D activities in Hong Kong, including incubatees and I&T tenants of the HKSTPC and the Hong Kong Cyberport Management Company Limited, as well as organisations and companies undertaking R&D projects funded by ITF, are eligible to apply.

¹⁴ “Well-recognised non-local institution” refers to one of the top 100 institutions for STEM-related subjects in the latest Quacquarelli Symonds World University Rankings, the Academic Ranking of World Universities and the Times Higher Education World University Rankings.

provides maximum monthly allowances of \$18,000, \$21,000 or \$32,000 for each research talent with a bachelor's, master's or doctoral degree respectively. The maximum engagement period for each research talent is generally 36 months.

In order to allow more flexibility for employers to engage R&D talents, the eligibility for RTH has been extended since March 2021, allowing employers to engage graduates with a bachelor's or master's degree of well-recognised non-local institutions, but all participants must be Hong Kong permanent residents or persons permitted to work in Hong Kong by the Immigration Department.

In the past four years, RTH (including the previous RP and PH) approved about 4 500 applications for research talent¹⁵, including over 1 500 postdoctoral research talents with a total funding amount of about \$2 billion. According to the 507 questionnaires collected by ITC in 2020, more than 95% of the relevant research talents expressed interest in pursuing a career in scientific research in the future; about 63% indicated that they had secured a job in R&D-related areas, while 26% expressed that they were still searching for jobs or had decided to further their studies.

- (l) Re-industrialisation and Technology Training Programme (RTTP) was introduced in 2018 to fund local enterprises on a 2(Government):1(enterprise) matching basis for their staff to receive training in advanced technologies, especially those related to "Industry 4.0". RTTP is administered by the VTC and overseen by VTC's Innovation and Technology Training Board which determines the types of technology training that can be funded. As at end-February 2021, RTTP has approved 1 116 applications for registering public courses and funding of over \$29 million for 3 740 trainees to receive over 4 640 trainings in advanced technologies.
- (m) STEM Internship Scheme was launched in 2020 as a pilot scheme to subsidise undergraduates and post-graduates taking STEM related programmes in local universities¹⁶ to enrol in short-term internships, with a view to encouraging STEM students to gain I&T-related work experience during their studies and to fostering their interest early in

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¹⁵ Under RTH, the amount of approved funding and number of approved projects in 2020-21 amount to about seven times and about 3.5 times those of 2015-16 respectively.

¹⁶ The seven universities participating the Scheme are the University of Hong Kong, the Chinese University of Hong Kong, City University of Hong Kong, the Hong Kong University of Science and Technology, Hong Kong Baptist University, Education University of Hong Kong and the Hong Kong Polytechnic University

pursuing a career in I&T after graduation, so as to enlarge the local I&T talent pool (see paragraphs 26 to 27 below). In 2020, more than 1 600 students and over 1 000 companies/organisations participated in the Scheme, with expenditure of about \$37 million.

Supporting Technology Start-ups

- (n) Technology Start-up Support Scheme for Universities (TSSSU) was launched in 2014 to support professors and students of local universities¹⁷ to start technology businesses and commercialise their R&D results. Starting from 2019-20, the maximum annual funding per university under TSSSU has doubled from \$4 million to \$8 million, and the maximum amount of financial assistance for each start-up has increased from \$1.2 million to \$1.5 million per year. In the past four years, the ITF has provided a total of about \$143 million to 200 start-ups.

Funded start-ups have to submit an annual report on the development of their businesses to ITC via their associated universities. During 2017-18 to 2019-20, out of the 156 funded start-ups, 36 won international awards, 83 generated a total of more than 550 IP rights from their R&D results, 98 rolled out a total of about 200 products or services in the market, and 80 generated business revenue. In addition, 123 start-ups have successfully received capital injections. The total investment was nearly \$400 million, of which over \$250 million (around 64%) was private investment.

- (o) Innovation and Technology Venture Fund (ITVF) was launched in 2017. It aims to encourage venture capital (VC) funds to invest in local I&T start-ups so as to create a more vibrant I&T ecosystem in Hong Kong. In the third quarter of 2018, ITC entered into co-investment agreements with six VC funds to co-invest in local I&T start-ups at a matching investment ratio of approximately 1 (Government):2 (co-investment partners (CPs)).

In early 2020, ITC invited a new round of applications for becoming co-investment partners. After the selection process, ITC has initially selected three VC funds as CPs and entered into agreements with three of them in December 2020 with a view to investing in more local I&T start-ups.

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¹⁷ The six universities are the University of Hong Kong, the Chinese University of Hong Kong, City University of Hong Kong, the Hong Kong University of Science and Technology, Hong Kong Baptist University and the Hong Kong Polytechnic University.

As at February 2021, the Government, through ITVF, invested more than \$100 million in 19 local I&T start-ups with businesses covering supply chain management, e-commerce, financial technology, biotechnology and AI, etc., attracting private investment of over \$500 million.

Promoting I&T Culture

- (p) General Support Programme (GSP) was introduced in 1999 to support non-R&D projects that help upgrade local industries and promote I&T culture in Hong Kong. In the past four years, GSP funded 100 projects with a total funding amount of about \$185 million. Examples of funded events in 2020 include the “Gerontech and Innovation Expo cum Summit” (with attendance of over 23 000), the “Hong Kong Student Science Project Competition” (with about 530 secondary school students participating), the “Hong Kong University Student Innovation and Entrepreneurship Competition” (with about 515 university students participating), and the “Innovation and Technology Scholarship” (with awards given to 25 university students). These activities help foster knowledge and interest in I&T amongst the general public, especially youngsters. GSP also supports projects which promote the development of smart city in Hong Kong, such as organising smart city pavilions and thematic seminars to introduce smart city technology and its application, as well as providing platforms for exchanges among the local industries.
- (q) Patent Application Grant (PAG) was launched in 1998 to provide funding support for first-time patent applicants. In the past four years, a total of 582 applications were approved with a total funding amount of about \$150 million. Over 443 applicants have been granted patents during the same period.

7. Since its introduction twenty one years ago, the ITF has made significant contributions to the local I&T development by nurturing numerous R&D talents and start-ups, delivering commercialised R&D results, as well as attracting private investment of over \$4 billion. These are elements essential in a vibrant I&T ecosystem, laying a solid foundation for Hong Kong’s development into an international I&T hub as supported under the 14th Five-Year Plan. At the same time, the ITF brings about benefits to the daily life of the general public (especially during the COVID-19 pandemic), as well as the commercial and industrial sectors. Examples of signature projects under the ITF are set out at Enclosure 1.

Encl. 1

/R&D

R&D Centres, Technology Transfer Offices of Universities (TTOs) and Laboratories

8. In addition to funding schemes, the ITF funds, in full or in part, the operating expenditure of R&D Centres, TTOs and laboratories to enable them to carry out more R&D work and technology transfer, or commercialise their R&D outcomes. The entities supported include –

Encl. 2

- (a) the 16 State Key Laboratories (SKLs) set up in Hong Kong (the list is at Enclosure 2);
- (b) the six Hong Kong Branches of the Chinese National Engineering Research Centres (CNERCs) (the list is at Enclosure 2);
- (c) the research centres/laboratories in the InnoHK research clusters;
- (d) four R&D Centres (i.e. NAMI, LSCM, HKRITA, and APAS)¹⁸; and
- (e) the TTOs of seven universities¹⁹.

SKLs and Hong Kong Branches of the CNERCs

9. The SKL Scheme is one of the major national science and technology development schemes managed by the MOST. High-quality research teams and good research equipment are prerequisites for becoming SKLs. Meanwhile, research institutions approved by MOST as CNERCs serve as major impetus in providing engineering research and consultancy support to the industries. They need to possess strong R&D capabilities and enjoy leading positions in their areas of expertise both in the Mainland and internationally. Examples of the R&D results of the current 16 SKLs in Hong Kong and the six Hong Kong Branches of CNERCs in Hong Kong are set out at Enclosure 2.

10. Since 2011-12, ITC has been providing annual funding to SKLs in Hong Kong and the Hong Kong Branches of CNERCs as a source of funding in addition to funding approved by the UGC as well as various local and Mainland institutions, to enable them to strengthen their research capability, build up the necessary infrastructural support and map out a longer term development plan. The maximum annual funding for each laboratory/centre is \$10 million, and the funding scope covers manpower, equipment, consumables and services incurred for the purpose of conducting R&D work.

/ *“InnoHK”*

¹⁸ The operating expenditure of ASTRI is funded from Government’s annual recurrent subvention.

¹⁹ The seven universities are the University of Hong Kong, the Chinese University of Hong Kong, City University of Hong Kong, the Hong Kong University of Science and Technology, the Hong Kong Baptist University, the Education University of Hong Kong and the Hong Kong Polytechnic University.

“InnoHK” Research Clusters

11. We are pressing ahead with the establishment of the *InnoHK* Research Clusters in the Hong Kong Science Park. The first two research clusters are “*Health@InnoHK*” focusing on healthcare technologies and “*AIR@InnoHK*” focusing on AI and robotics technologies. The *InnoHK* Research Clusters have received over 60 proposals from local universities and many world-renowned universities and research institutes. After rigorous selection and assessment process, the R&D centres of the two Research Clusters are actively recruiting graduate students and scientific researchers. Although the work progress of some R&D centres has been affected by the epidemic, the first batch of around 20 admitted R&D centres have completed the renovation of their laboratories and are commencing operation progressively. The remaining R&D centres will commence operation later this year.

R&D Centres

12. At present, the Government has five R&D Centres to drive and coordinate applied R&D in relevant areas. The R&D Centres work closely with the industries to encourage local private enterprises to invest in R&D so as to facilitate the commercialisation of R&D results and technology transfer. The R&D Centres also actively participate in PSTS to promote the use of local technology products and services by public sector organisations. Over the years, the R&D Centres have nurtured a group of scientific research talent, and their innovative inventions have won international awards. We will regularly brief the Legislative Council (LegCo) Panel on Commerce and Industry (C&I Panel) on the progress report of the R&D Centres.

TTOs

13. ITC has been providing extra funding through the ITF to TTOs of seven universities, in addition to UGC, to enhance their technology transfer capabilities, and supporting the development of innovative ideas and R&D results of universities’ scientific research talent into new products or services. The funding support has facilitated the patent and licensing activities in TTOs, enabled TTOs to organise various activities for promoting entrepreneurship and proactively connect with industry players, investors, public and private incubators/accelerators, as well as the local, Mainland and overseas R&D communities, and provided pertinent assistance to technology start-ups incubated by the universities. The universities have procured more professional services and engaged more professionals of related areas to optimise their application and management of patents, expanding their networks in the industry, and implementing business plans, etc. The number of patents granted to the universities receiving the funding support have increased from 319 in 2014-15 to 640 in 2019-20. Meanwhile, the number of patent licensing

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agreements have increased from 333 to 557. In addition, TTOs have delivered 2 686 technology transfer-related public lectures, symposium and exhibitions, etc., and organised/attended 447 promotional, marketing and business development activities, etc.

Benefits brought by the ITF to I&T Development

14. ITC has all along monitored the implementation of various ITF funding schemes and the work progress of funded organisations/projects to ensure the proper use of public money. To examine the impact of individual funding schemes under the ITF, ITC has recently commissioned an independent consultant to carry out a study of five schemes under the ITF, namely ESS, ITSP, TCFS, RP and GSP. The consultant has engaged over 800 ITF stakeholders through interviews, focus group discussions and surveys.

15. According to the consultancy report, the ITF has made significant contributions in advancing I&T development, facilitating commercialisation of R&D outcomes, creating economic impact and nurturing R&D talents. Details of the outcomes of ESS, ITSP and TCFS in the above areas are tabulated below –

Completed and On-going Projects	ESS	ITSP	TCFS
<i>Benefits of commercialisation of outcomes</i>			
Percentage of projects with commercialisation income*	53%	33%	18%
Cumulative commercialisation income*	HK\$378 million	HK\$3,742 million	HK\$248 million
Percentage of projects with patents granted	44%	31%	56%
Percentage of projects with start-up/spin-off company established	29%	15%	21%
<i>Fostering knowledge/technology transfer and sharing</i>			
Percentage of projects published in academic/professional publications	17%	39%	59%
Percentage of projects granted science and technology/industry awards	34%	29%	34%
Number of knowledge sharing activities organised	1 392 activities	22 885 activities	3 180 activities
Percentage of project coordinators who indicated if not for ITF funding, the project could not have been conducted	96%	90%	87%

* ITSP and TCFS projects are mainly seed and platform projects that belong to relatively upstream (exploratory in nature) and midstream R&D, which has not reached the commercialisation phase yet.

16. These schemes have engaged a cumulative total of 25 238 R&D talents and the results are encouraging. Some of the completed projects were also able to attract further investment from private market funds (including angel investors and VC funds), which demonstrates that relevant schemes were able to foster co-investment of public and private sectors in R&D, thereby increasing Hong Kong's overall gross expenditure on R&D. Separately, TCFS has established a sound foundation for Guangdong-Hong Kong and Shenzhen-Hong Kong R&D collaboration. As TCFS proceeds, the interest from both sides to collaborate on R&D projects grows, which helps foster cross-border exchange and collaborative development.

17. The consultant has interviewed project coordinators of RP and GSP, with results as follows –

Schemes	Interview results
RP	<ul style="list-style-type: none"> • 84% of project coordinators indicated that RP assisted them in recruiting an adequate number of R&D talents • Of the researchers recruited under RP, 83% continued to develop in the I&T sector, among which 41% remained in the same organisation
GSP	<ul style="list-style-type: none"> • 93% of funded organisations indicated that ITF funding was indispensable • 92% of funded organisations indicated that GSP was effective in enhancing public knowledge and interest in I&T and building an I&T culture • 84% of the funded organisations intended to continue organising non-R&D projects that would foster I&T development

18. According to survey findings, the most important positive impact brought about by the ITF within and beyond the organisations of project coordinators of the five funding schemes are set out in the table below –

Funding Schemes	Most important positive impact within the organisation	Most important positive impact beyond the organisation
ESS	Development of new/improved products or services	Project results can contribute to advancements in technology and innovation areas
ITSP	Knowledge accumulation on specific innovation/technology/research area	Project results can contribute to advancements in technology and innovation areas

Funding Schemes	Most important positive impact within the organisation	Most important positive impact beyond the organisation
TCFS	Increased research capacity and additional R&D projects	Foster collaboration with Mainland institutes and organisations
RP	Increased research capacity and reputation of the organisation	Nurture more R&D talents
GSP	Increased recognition and prestige	Enhance public awareness of I&T and build an I&T culture in the community

The relevant analysis and surveys have fully demonstrated that the ITF has been effective in various aspects, especially in promoting R&D and the application of R&D outcomes.

PROPOSED ARRANGEMENTS

Funding Injection into the ITF

19. The expenditure of the ITF has increased substantially in recent years with the launch of various new funding schemes and enhancement measures. It is estimated that the expenditure of the ITF will reach approximately \$5.3 billion and \$5.1 billion in 2020-21 and 2021-22 respectively and can only be utilised up to the fourth quarter of 2021. Therefore, we propose to inject a total of \$9.5 billion into the ITF in two years, to sustain the continuous operation of the existing funding schemes and the R&D centres/laboratories as well as the introduction of new measures. After obtaining the approval of the LegCo Finance Committee (FC), the Government will inject \$4.75 billion into the ITF in this financial year, and another \$4.75 billion will be injected into the ITF in 2022-23, and will be reflected in the expenditure estimates in the same year.

Implementing New Initiatives and Enhancement Measures

20. In addition to maintaining the continuous operation of the existing funding schemes/support programmes under the ITF, we will also continue to prudently utilise the ITF to match the pace of social and economic development, and try our best to provide support in different areas so as to inject impetus into the future development of the local I&T ecosystem. We will continue to review the operation of the ITF from time to time to improve efficiency and flexibility. In the coming year, we plan to implement the following new initiatives and enhancement measures.

/New

*New Initiatives*Subsuming MRP under ITSP

21. At present, both ITSP and MRP provide funding support to R&D projects in various technology areas. The former is a funding scheme under Subhead 101 Innovation and Technology (block vote) with an aim of supporting upstream/midstream/downstream R&D projects conducted by local R&D Centres, universities and other designated local public research institutes. The latter, under Subhead 090 Midstream Research Programme for Universities (block vote) under the ITF, supports theme-based midstream R&D projects conducted by UGC-funded universities (with the interest income generated from the dedicated provision of \$2 billion of capital). To improve the flexibility in utilising the funding, we propose to subsume MRP under ITSP, and all funds under Subhead 090 Midstream Research Programme for Universities (block vote) under the ITF will be correspondingly transferred to Subhead 101 Innovation and Technology (block vote) under the ITF.

Incorporating the funds of RFS and the Innovation and Technology Fund for Better Living (FBL) into the ITF Block Vote

22. The FC approved in May 2020 an injection of \$2 billion into the ITF to create a dedicated Subhead 112 Re-industrialisation Funding Scheme with a \$2 billion commitment for the implementation of RFS to subsidise manufacturers to set up new smart production lines in Hong Kong on a 1 (Government): 2 (company) matching basis. In June 2016, the FC approved the creation of an item with a commitment of \$500 million under Head 135 Government Secretariat: Innovation and Technology Bureau Subhead 700 General Non-current for the establishment of the FBL to support I&T projects that aim to make the daily life of the public more convenient, more comfortable and safer, or to address the needs of specific groups. FBL was launched in 2017. In the past four years, FBL funded 35 projects involving a funding amount of about \$120 million. The remaining commitment is about \$380 million. So far, a total of about \$75 million has been disbursed and the remaining balance of the FBL is about \$425 million.

23. Having reviewed in detail the modus operandi and spending patterns of the two schemes, we propose to merge the two schemes above with Subhead 101 Innovation and Technology (block vote) under the ITF. In particular, all funds under the dedicated Subhead 112 Re-industrialisation Funding Scheme under the ITF as well as Head 135 Government Secretariat: Innovation and Technology Bureau Subhead 700 General Non-recurrent Item 801 Innovation and Technology Fund for Better Living will be transferred to Subhead 101 Innovation and Technology (block vote) under the ITF. After the merging, the funding

/arrangements

arrangements of the two schemes will be consistent with other funding schemes currently under the ITF. This arrangement will increase the flexibility of utilising the ITF funds, better meet market needs and smoothen the long-term operation of the two schemes.

Enhancement Measures

Engaging HKPC as Implementation Partner of TVP

24. TVP is very popular with the local business sector, and the number of applications received has been increasing substantially and persistently. Excluding applications which were subsequently withdrawn or were unable to be processed due to ineligibility or missing supporting documents, the numbers of applications in the past few years are as follows –

Year	Number of Applications
2016 (November to December)	15
2017	577
2018	703
2019	1 574
2020	5 795
2021 (as at end-February 2021)	898

25. To expedite the processing of applications received, after considering the operation of TVP and making reference to the operational experiences of other funding schemes²⁰, ITC decides to engage HKPC as the implementation partner²¹ of TVP, and make use of its human resources and professional experience to shorten the processing time, thereby improving efficiency.

Regularise STEM Internship Scheme

26. Last year, the Government earmarked \$40 million under the ITF to launch the STEM Internship Scheme on a pilot basis to provide a monthly allowance of \$10,500 to undergraduates and post-graduates taking STEM related programmes in local universities to enrol in short-term I&T-related internships.

/The

²⁰ At present, RTTP and PAG under the ITF also adopt similar arrangements, i.e. appointing VTC and HKPC as secretariat and implementation agent respectively.

²¹ Administrative costs involved in the implementation of TVP by HKPC will mainly be covered by the ITF. HKPC, as implementation partner of TVP, will also bear part of the administrative costs including office expenses and salaries of some of the staff.

The seven participating universities commented that the Scheme had encouraged employers to create more I&T-related internship places, offering students the opportunity to apply their STEM knowledge in the workplace and understand the I&T work environment and culture early. According to the findings of the surveys conducted by participating universities, upon completion of their internship, most of the students (94%) gained a better understanding of the I&T field, and 88% of students would consider pursuing a career in I&T in the future. A vast majority of the participating employers (99%) were satisfied with the interns' performance and 96% of the employers planned to join the scheme again. In view of the universities' and the business sector's overwhelming response and high regard for the scheme, the Financial Secretary announced in the 2021-22 Budget that the STEM Internship Scheme would be regularised.

27. The regularised scheme generally adopts the arrangements in the pilot phase, with its expenditure subsumed under the ITF. On eligibility, having liaised with the universities, we have included more STEM-related programmes in the list of eligible programmes of the scheme.

Expanding the Funding Scope of RTH

28. The Chief Executive announced in the 2020 Policy Address that the Government would launch a Global STEM Professorship Scheme²² to attract more world-renowned scholars to engage in I&T-related teaching and research activities in Hong Kong. The Innovation and Technology Bureau is working with the Education Bureau to formulate the details of the scheme. We will provide around \$500 million under RTH of the ITF for scholars to recruit up to four researchers to assist them in carrying out R&D work for three years. The level of monthly subsidy will be on a par with that of RTH, with a current funding level of a maximum of \$32,000 per month for doctoral degree holders.

EXPECTED BENEFITS

29. We anticipate that the injection of funding into the ITF and the implementation of the above new initiatives and enhancement measures will reap the following benefits –

- (a) provide sustained and comprehensive support for applied R&D activities in Hong Kong;
- (b) continue to raise the level of GERD;

/(c)

²² The Government briefed the LegCo C&I Panel on the Global STEM Professorship Scheme on 26 January 2021.

- (c) encourage R&D collaboration and exchanges between universities/public research institutes and private companies, and amongst the local, Mainland and overseas research communities;
- (d) support the upgrading and development of various industries in Hong Kong through I&T activities so as to meet the changing international, Mainland and domestic business environment;
- (e) encourage more private companies to participate in ITF-funded projects or invest in R&D projects, non-R&D projects and technology start-up activities;
- (f) encourage technological application by the industries, facilitate the adoption of local R&D outcomes by public sector organisations, improve the quality of life of citizens;
- (g) create more I&T jobs and internship opportunities to nurture and attract more I&T talents;
- (h) organise I&T activities for all to foster a vibrant I&T culture;
- (i) support the local “re-industrialisation” progress;
- (j) encourage and attract more internationally renowned universities and R&D institutions to collaborate with local scientific research institutes; and
- (k) further improve Hong Kong’s I&T ecology and help build Hong Kong into an international I&T centre.

MONITORING AND REVIEW MECHANISM

30. ITC has already put in place a robust control mechanism, and regularly reviews the operation of the various funding schemes to ensure that the funding is properly disbursed and used. We will also introduce enhancement measures in a timely manner to meet the development and needs of the society. In brief, all applications are vetted by professional panels (which generally include the industries and independent members) according to the assessment framework of the relevant funding scheme. Each scheme has its own guidelines on, among other things, the usage of ITF funding, procurement arrangements, reporting and auditing requirements, disbursement of grants and return of residual funds, etc. All such requirements, alongside key information of approved projects, are available at the ITF’s website²³ for public reference.

/31.

²³ <https://www.itf.gov.hk/en/project-search/index.html>

31. ITC conducts progress meetings/site visits with the project teams to verify the project progress and usage of funds as set out in the project reports. Funds will be disbursed only if the project is able to meet pre-set milestones. In case of non-compliance with the funding guidelines or where project progress is unsatisfactory, we may withhold the disbursement of funds. ITC will continue to enforce the control mechanism, review and make necessary enhancements as appropriate.

FINANCIAL IMPLICATIONS

32. We estimate that injecting a total of \$9.5 billion into the ITF and the implementation of new initiatives (see paragraphs 21 to 23 above) will sustain the operation of the ITF up to the first quarter of 2024²⁴. According to the latest forecast, the estimated expenditure under the ITF is as follows –

Financial Year	\$ million
2020-21	5,331
2021-22	5,062
2022-23	6,267
Total	16,660

PUBLIC CONSULTATION

33. We reported to the LegCo C&I Panel on the latest development of the ITF on 20 April 2021, and consulted the C&I Panel on the proposals for injecting \$9.5 billion into the ITF and the implementation of new measures. The C&I Panel supported the funding proposals.

BACKGROUND

34. The ITF was established by a Resolution passed by the LegCo on 30 June 1999 as a statutory fund under section 29 of the Public Finance Ordinance (Cap. 2) and is administered by ITC. The FC approved an injection of \$5 billion

/for

²⁴ The actual cash flow of the ITF may vary depending on the number and amount of funding applications approved under different schemes, and any new schemes that may be launched in the future.

for the establishment of the ITF in July of the same year. Subsequent injections of \$5 billion and \$10 billion into the ITF were approved in February 2015 and July 2018 respectively to sustain the continuous operation of the various funding schemes under the ITF²⁵. The ITF has all along financed projects that contribute to I&T upgrading in our manufacturing and service industries, in order to facilitate the long-term development of Hong Kong.

Innovation and Technology Bureau
Innovation and Technology Commission
May 2021

²⁵ The FC has also approved the following injections into the ITF to provide dedicated funds for the implementation of relevant schemes –

- (a) In June 2016, \$2 billion was injected to fund projects under MRP with the investment income generated;
- (b) In July 2016, \$2 billion was injected to fund the ITVF;
- (c) In July 2018, \$10 billion was injected to fund the establishment of the *InnoHK* research clusters in Hong Kong; and
- (d) In May 2020, \$2 billion was injected to provide financial assistance in the RFS.

Some signature examples of the Innovation and Technology Fund (ITF)

Anti-epidemic

- (a) Adopting its nanofiber technology, the Nano and Advanced Materials Institute has developed the world's first nanofiber N99 facemask – NASK, in collaboration with a manufacturer with the funding support of the Innovation and Technology Support Programme (ITSP). NASK is manufactured in Hong Kong and is compliant with the EN149 standard of the European Union. It is a super breathable facemask with bacteria killing property, and is effective in removing most of the airborne contaminants. NASK has also been adopted by the Hospital Authority since March 2020 to mitigate the global shortage of surgical respirators.
- (b) The Government has developed the “StayHomeSafe” system and electronic wristband in the early stage of the epidemic to support the mandatory home quarantine measure implemented in early February 2020. The system makes use of a Bluetooth Low Energy electronic wristband and a monitoring solution developed by the Logistics and Supply Chain Multitech research and development (R&D) Centre with funding support by ITSP, coupled with the “StayHomeSafe” mobile app developed by a local technology start-up that adopts geo-fencing technology to detect electronic signals around the dwelling places of persons under quarantine. Using artificial intelligence (AI), it analyses changes in various signal strength to effectively monitor whether persons under quarantine are staying at their designated premises;
- (c) In early 2020, the Novel Coronavirus Disease 2019 (COVID-19) started to spread rapidly, and there was an acute shortage of disposable masks in the market. We utilised the R&D results of Hong Kong Research Institute of Textiles and Apparel (HKRITA) which was funded by ITSP to produce CuMask+™ to help the community fight the epidemic. Two of the layers of CuMask+™ are made with small quantities of copper, capable of immobilising bacteria, common viruses, and other harmful substances. It reaches the American Society for Testing and Materials F2100 Level 1 standard, and could be reused for 60 times. It is a more environment-friendly choice. From May 2020 to end-February 2021, the Government has distributed around 10.48 million CuMask+™ via different channels for Hong Kong residents' use;

/(d)

- (d) ITSP has funded a multi-level antimicrobial polymer coating developed by a local university. This kind of coating is applicable to different surfaces including metals, wood, glass, plastics as well as fabrics and textiles. It has an effective period of up to 90 days and could help enhance personal and public hygiene and safety. The R&D outcomes have been transformed into innovative products to address the urgent needs of the community during the epidemic;
- (e) The Hong Kong Productivity Council (HKPC) developed the “kNOw Touch” contactless elevator panel which activates elevators over-the-air to reduce the risk of virus spreading. The prototype of the “kNOw Touch” is funded by the special call for projects under Public Sector Trial Scheme (PSTS) for the prevention and control of the COVID-19 epidemic, and organisations participating in the trial include the Electrical and Mechanical Services Department (EMSD) and the Airport Authority Hong Kong, covering sites including the West Wing of the Central Government Offices, Block 2 and Block 3 of Housing Authority Headquarters and the Lung Cheung Office Block, Cheung Sha Wan Government Offices, West Kowloon Health Centre, Tai Po Hui Market and Cooked Food Centre and EMSD Headquarters. Apart from the sites in the trial, HKPC has, in collaboration with elevator contractors, installed the “kNOw Touch” system at around 50 sites including private housing estates, commercial buildings and shopping centres, etc. The installation of the system at the Legislative Council Complex has already been completed. Besides, the Housing Authority and the Housing Society plan to install the system for about 200 elevators in its housing estates through companies licensed by HKPC;
- (f) A COVID-19 testing reagent developed by a local company has been trialled in the University of Hong Kong through the funding support of the special call for projects under PSTS. This type of testing reagent can produce testing results within a short period of time and can assist medical institutions and testing laboratories to conduct rapid testing of COVID-19;

Livelihood

- (g) With the funding support of ITSP, HKRITA has developed asymmetric footwear according to biomechanical characteristics, using materials with good abrasion resistance and mechanical properties to match the requirements of fencing sports. The project has been awarded the silver award at the 45th International Exhibition of Invention of Geneva. In addition, athletes from the Hong Kong fencing team were equipped with the fencing shoes developed from the project to attend international competitions, including Rio Summer Olympic in 2016, and Hong Kong Asian Championships in 2017. In 2020, the project outcome has been licensed to a private enterprise for commercialisation;

/(h)

- (h) With the funding support of ITSP, a local university has developed a novel “T1rho” imaging technology which provides artifacts-free “T1rho” imaging at the presence of magnetic field inhomogeneity. Clinical studies reported that “T1rho” is a valuable biomarker for diagnosis of a variety of diseases. However, at present, no MRI vendors in the market, including General Electric, Philips, and Siemens, provides commercial product of “T1rho”. The main reason is that the current T1rho technology is not stable enough to meet the standard clinical application requirement because the “T1rho” quantification is highly sensitive to magnetic field inhomogeneity. This novel technology can help overcome these obstacles and assist medical staff in medical diagnosis even at the presence of magnetic inhomogeneity. A “T1rho” prototype has been set up in the Prince of Wales Hospital for trial. Moreover, a start-up has been set up to commercialise this technology;
- (i) With the funding support of ITSP, a local university and the Massachusetts Institute of Technology have jointly developed AI and machine learning technologies in 2020 that can improve existing e-learning platforms. It does not only provide a variety of learning analysis and tutoring tools, but also recommends diversified learning paths to learners. The technologies have been applied to an online learning platform, allowing parents to understand their children’s learning progress in various areas, so as to formulate more accurate learning plans;
- (j) With the funding support of Guangdong-Hong Kong Technology Cooperation Funding Scheme (TCFS), a local university developed a special formula of medical silicone gel to be incorporated in pressure therapy for scar management. The silicone gel insert could provide optimal pressure on the scars and exert moisturising effects. The silicone gel developed has been shown to be durable, chemically and biologically inert and attachable on other surfaces such as fabrics. A pilot test on the prototypes with both normal skin and scars of volunteers has been conducted to test the pressure range, medical inertness and clinical effects. Clinical trials on patients from the Mainland and Hong Kong with different types of scars (i.e. surgical/burn/skin trauma) have also been carried out to show the clinical effectiveness of the product. This innovation won the Grand Award and a Gold Medal at the 45th International Exhibition of Inventions of Geneva, Switzerland in 2017. The relevant product has already been licensed to a company for commercialisation and is now being sold in Hong Kong;
- (k) With the funding support of TCFS, a local university has developed a quartz-enhanced photoacoustic spectroscopic system in 2018, which could be applied to urea breath test for detection of Helicobacter pylori infection, as well as other air pollution monitoring. This system is of lower cost, portable size and can quickly generate testing results (i.e. 0.1 second). Patent of the developed technology has been filed in the United States, and it is planned to be disseminated to the medical and public health sector in the next decade;

- (l) With the funding support of Midstream Research Programme for Universities (MRP), a local university has developed an unobtrusive health-monitoring system combining multimodality sensing and machine learning technologies to achieve early detection of cardiovascular diseases and prevention of dementia, thereby relieving the medical burden and expenses of the society. Existing commercially available health monitoring devices cannot perform long-duration and high accuracy monitoring of vital signs for the elderly. This project will address such performance limitation by integrating novel sensor designs and the generation and processing of signals. The core technologies of this project were successfully transferred to wearable devices in 2020 and the system is now under clinical validation;
- (m) With the funding support of MRP, a local university has developed a Virtual Therapist software system that utilises machine learning, data analytics, signal processing and AI algorithms to detect signs of negative mental emotional conditions, such as depression, anxiety and dementia in elderly patients. This university has already set up a start-up which dedicates to commercialise the relevant AI technologies. In the future, the company has a high chance in utilising the relevant R&D outcomes to carry out downstream research or product development activities;
- (n) Funding was provided by PSTS under ITF to a local university to conduct a trial by developing a genome database system for the Clinical Genetic Service of the Department of Health (DH-CGS). Over 1 000 samples were imported into the database with clinical information. The databases and machine learning module are used for diagnosis and research by DH-CGS. This project has enhanced the capability of DH-CGS in diagnosing genetic diseases and rare-disease-causing mutations. DH expressed that the project team had developed an effective population genomic database for storing and utilising the genomic data. All the clinical and laboratory staff are satisfied with the project deliverables, in terms of the functionalities and performance;
- (o) Funding was provided by PSTS under the ITF to a local university to develop a system using electromyography-driven neuromuscular electrical stimulation for stroke patients for rehabilitation of the whole upper limb. The system not only can provide assistance to the elbow and wrist joints by electric motors, but also can enhance the neuroplasticity during recovery by inducing additional muscular practice at the elbow, wrist and hand/fingers through electrical stimulation. The system will encourage a user to continuously generate electromyography to maximize the involvement of voluntary efforts during training. The proposed system will be portable, light-weighted and easy-to-use in hospital or at home. The project outcomes won a Gold Medal and Special Merit Award at the 43rd International

Exhibition of Inventions of Geneva in 2015. Two China patents on the innovative design of the portable and wearable training system have been granted. The preliminary results showed that the novel electrical stimulation training can better accelerate the recovery of patients' upper-limb functioning comparing with conventional training. Project deliverables have been successfully licensed to two companies for commercialisation;

Industrial and Commercial

- (p) With the funding support of TCFS, a local university has developed the core technology to improve the carbon nanotube based pulse energy and power of the ultrafast pulse mode-locked lasers, which could be used for micro-processing of high precision transparency materials, e.g. sapphire, etc., so as to enhance the manufacturing capability of high-end electronic products. Two patents of the developed technologies have been filed by the university. The project team is seeking further collaboration with the industrial partner;
- (q) With the funding support of the Partnership Research Programme, a local university has developed a "Smart Geotechnical Monitoring System" in collaboration with a local enterprise through an R&D project. The system can provide comprehensive monitoring in construction projects to keep track of movements of ground conditions, existing adjacent structures, and other possible impacts which may arise as a result of the works. The project outcome has been adopted by the project's industry partner for local engineering projects;
- (r) With the funding support of the Re-industrialisation Funding Scheme (RFS), a local food processing enterprise will set up a food processing smart production line for a central kitchen. Using traditional cooking processes with smart technologies such as Industrial Internet of Things and data analysis, the smart production line could enhance production efficiency to tackle limited production capacity, and enhance quality control and food safety so as to explore new market development and enhance its competitiveness in the market;
- (s) With the funding support of RFS, a local technology company will set up a smart electrospinning production line for nanofiber filter material. Traditional needle-type electrospinning production line faces a number of problems like easy needle clogging which requires manual replacement of needles, no real-time monitoring system and limited collectable data, etc. The smart production line to be set up could enhance production efficiency and quality, as well as create smart production related jobs to nurture local talent with knowledge in the area;

/(t)

- (t) With funding support by RFS, a local biotechnology company will set up a smart production line to produce biochips for diagnostic rapid testing. Through smart technologies like real-time data and robotic systems, the whole production process will be completed in the clean room environment thereby increasing the production capacity and at the same time reducing product contamination risk and preventing work injury of staff due to prolonged working hours. The planned smart production line can enhance production efficiency and quality, and hence can increase production capability of the biochips to meet the market demand;
- (u) With the funding support of the R&D Cash Rebate Scheme (CRS), a local manufacturer of intelligent security systems commissioned HKPC to research and develop smart production lines. The smart production lines, which can assemble high precision parts, effectively increase the production success rate. Through the support of intelligent automation equipment and digital technology, not only is the production capacity greatly enhanced but also its space requirement is substantially reduced;
- (v) Moreover, with the funding support of CRS, a local company, with producing plastic products in the Mainland being its core business, commissioned HKPC to develop and establish an intelligent production line for manufacturing optical adaptive lenses in Hong Kong, successfully developed its high value-added product lines and supply chains. Leveraging this, the company is able to open the Mainland and European markets with its “Made in Hong Kong” products. The intelligent production line, consisting of six machines and about 30 metres long, occupies only about 3,000 square feet and requires only two people to operate with a maximum production capacity of 100 lenses per hour.

**State Key Laboratories (SKLs) in Hong Kong
and Hong Kong Branches of
Chinese National Engineering Research Centres (CNERCs)
and Examples of Research Results in Recent Years**

I. SKLs in Hong Kong

	Hosting Organisation	Name of SKL	Head	Year of Approval
1.	The University of Hong Kong	SKL of Emerging Infectious Diseases	Prof GUAN Yi Prof YUEN Kwok-yung	2005
2.	The University of Hong Kong	SKL of Brain and Cognitive Sciences	Prof Tatia LEE Mei-chun	2005
3.	The Chinese University of Hong Kong	SKL of Translational Oncology	Prof Dennis LO	2006
4.	City University of Hong Kong	SKL of Terahertz and Millimeter Waves	Prof CHAN Chi-hou	2008
5.	The Chinese University of Hong Kong	SKL of Agrobiotechnology	Prof Hon-Ming LAM	2008
6.	The Hong Kong Polytechnic University	SKL of Ultra-precision Machining Technology	Prof Benny CHEUNG	2009
7.	The Hong Kong University of Science and Technology	SKL of Molecular Neuroscience	Prof Nancy IP Yuk-yu	2009
8.	City University of Hong Kong	SKL of Marine Pollution	Prof Kenneth Mei Yee LEUNG	2009
9.	The Chinese University of Hong Kong	SKL of Research on Bioactivities and Clinical Applications of Medicinal Plants	Prof LEUNG Ping-chung	2009
10.	The University of Hong Kong	SKL of Liver Research	Prof Irene O.L. NG	2010
11.	The University of Hong Kong	SKL of Synthetic Chemistry	Prof CHE Chi-ming	2010

	Hosting Organisation	Name of SKL	Head	Year of Approval
12.	The Hong Kong Polytechnic University	SKL of Chemical Biology and Drug Discovery	Prof WONG Kwok-yin	2010
13.	Hong Kong Baptist University	SKL of Environmental and Biological Analysis	Prof CAI Zongwei	2013
14.	The University of Hong Kong	SKL of Pharmaceutical Biotechnology	Prof XU Aimin	2013
15.	The Chinese University of Hong Kong	SKL of Digestive Disease	Prof YU Jun	2013
16.	The Hong Kong University of Science and Technology	SKL of Advanced Displays and Optoelectronics Technologies	Prof Ching Wan TANG	2013

II. Hong Kong Branches of CNERCs

	Hosting Organisation	Name of Hong Kong Branch of CNERC	Head	Year of Approval
1.	Hong Kong Applied Science and Technology Research Institute	Hong Kong Branch of the National ASIC System Engineering Research Center	Dr Martin SZETO	2012
2.	The Hong Kong Polytechnic University	Hong Kong Branch of National Engineering Research Center for Steel Construction	Prof K F CHUNG	2015
3.	The Hong Kong Polytechnic University	Hong Kong Branch of National Rail Transit Electrification and Automation Engineering Technology Research Center	Prof Yi Qing NI	2015

	Hosting Organisation	Name of Hong Kong Branch of CNERC	Head	Year of Approval
4.	City University of Hong Kong	Hong Kong Branch of National Precious Metals Material Engineering Research Center	Prof LU Jian	2015
5.	The Hong Kong University of Science and Technology	Hong Kong Branch of National Engineering Research Center for Tissue Restoration and Reconstruction	Prof Ben Zhong TANG	2015
6.	The Hong Kong University of Science and Technology	Hong Kong Branch of CNERC for Control and Treatment of Heavy Metal Pollution	Prof CHEN Guang Hao	2015

III. Examples of Research Results in Recent Years

- (a) Discovery of new genes that suppress and facilitate colorectal cancer, as well as those that suppress and facilitate stomach cancer. It is envisaged that the research results could be applied to the screening, examination and prognostic analysis of cancers, as well as used as potential therapeutic targets;
- (b) Completion of an entire system assessment on attenuated influenza viral vector vaccines, demonstrating that the influenza vaccine of such system has a more comprehensive cross-protective effect and can achieve long-term immunity. The vaccine has been developed into the relevant influenza viral vector COVID-19 vaccine after the outbreak of COVID-19;
- (c) Analysis of the impact of commonly used larvicidal oil (LO) on marine life through seawater sampling in Hong Kong and ecotoxicological testing, with a view to optimising the usage of LO locally, facilitating the exploration of other effective means to control mosquito larvae, and minimising pollution to the marine environment;

/(d)

- (d) Development of a curvature-adaptive multi-jet freeform polishing technology that can overcome the low efficiency problem of traditional waterjet polishing technologies. The new technology can be used for polishing various freeform surfaces, such as the complex 3D-printed surfaces, turbine blades, optical molds, and surfaces of microscale structure;
- (e) Development of a low-power Narrowband Internet of Things (IoT) System-on-Chip that integrates radio frequency power amplifiers and power management units to achieve wide-area IoT connections. The technology is licensed to famous multinational companies, is deployed in the end-products by several global customers, and creates a competitive advantage for local integrated circuit design companies and IoT solution providers; and
- (f) Four-generation iteration of a low-cost, energy efficient, innovative dynamic membrane bioreactor was conducted. The low-cost, portable membrane module can be easily assembled and operated in practical works. The technology can be applied for wastewater treatment and post-treatment.
