

Annual Report on Activities and Advancement of Knowledge Transfer

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1. Executive Summary: Knowledge Transfer & Entrepreneurship @ PolyU

This report summarises key Knowledge Transfer (KT) and Entrepreneurship activities and developments of The Hong Kong Polytechnic University (PolyU) for the year ending on 30 June 2020. FY2019/20 was an extraordinary year for PolyU, Hong Kong and the world at large, with both the society and economy seriously affected by COVID-19 pandemic. Drawing on its strengths in research innovations and ability to translate research into applications, PolyU had demonstrated its commitment to serving the community during these testing times, and also enlisted support from external stakeholders.

During the early stage of the outbreak of COVID-19, we responded promptly to the pressing and huge demand for personal protective equipment (PPE) by our professional expertise in designing protective face shields. We also got the support from local manufacturers for producing up to 30,000 face shields per day in March 2020. In addition, we had developed the world's most comprehensive automated multiplex diagnostic system for scanning respiratory infectious diseases including COVID-19. The system is currently deployed in two hospitals for the rapid diagnosis of COVID-19 pneumonia, while the technology will be commercialised for mass production and further frontline applications. More information can be found in section 3.

Despite the unprecedented challenges faced by the University, this year marked an important year of achievements for PolyU on KT and entrepreneurship development. Quantitatively, we had brought about a significant increase of 43% to \$428 million in income from collaborative research, contract research and consultancy projects in Hong Kong and Mainland China. Meanwhile, in its efforts towards long-term impactful KT through translating research into market application, the University had reinforced its research capabilities by undertaking more collaborative research with various industry partners. As a result, during the year, a number of joint university-industry research institutes had been and were to be established in both Hong Kong and Mainland China. More information can be found in section 2.4.

The University has established an institutional level committee – Knowledge Transfer Steering Committee (KTSC) – chaired by the University President to steer and formulate strategic moves to support KT and entrepreneurship development in a holistic manner. The establishment of the KTSC also signifies the strategic importance of KT and entrepreneurship at PolyU, with its aim to steer and spearhead the overall strategic KT and entrepreneurship developments to realise research impact, as well as the overarching principle to transfer the University's intellectual properties (IPs) to create societal impact.

In FY2019/20, the University also took the opportunity to review its KT-related policies and operation models, with a view to creating an environment conducive to and providing active support for KT endeavours which are underpinned by research and innovation and can create far-reaching impact on society.

- To build a holistic 'research to commercialisation pipeline': the University is planning to establish university-industry collaborative research institutes or innovation centres by leveraging the resources from the industry and the government to not only spearhead further collaborative research but also extend it to downstream application and commercialisation of the research outcomes for societal and industry impact.
- To enhance venturing support for academic- and student-led startups to commercialise their research technologies and innovations through more flexible licensing terms, incubation and funding support and mentorship in collaboration with industry and community partners
- To explore different measures to facilitate KT through IP licensing and assignment: while IP licensing is a prevailing form of KT, the University has formalised a mechanism for assignment of IP under a due process to benefit both the University and the assignee, particularly when the concerned IPs are at the later stage of their life cycle.

Sections 2 to 6 of this report provide a recap on our efforts and achievements in KT and Entrepreneurship with enhanced programmes / framework, supplemented by the relevant appendices including the related performance measures and the actual deployment of the KT Fund in FY2019/20.

2. Driving Research Excellence to foster Impactful Knowledge Transfer

We are dedicated to producing research that is designed to make a transformational impact on the world in which we live. A few noteworthy research achievements funded by UGC and industry in FY2019/20 are illustrated below:

2.1 PolyU Receives Largest Share of the Research Impact Fund for Two Years Running

PolyU was proud to have its research excellence recognised in the five research areas in data storage technology, space exploration, edge learning, glaucoma treatment and ultrasound imaging technology for assessing cardiovascular diseases led by the University, receiving almost HK\$33 million in funding from the Research Impact Fund of the Research Grants Council in the FY2019/20 round of funding. This accomplishment marked the second year in a row where PolyU obtained the largest amount of funding support among local universities in terms of the dollar amount and the total number of funded projects.

2.2 Innovative Smart-fire Project Secures Grant in Recent Round of Theme-Based Research Scheme



In the ninth round of the Research Grants Council's Themebased Research Scheme 2019/20, a smart fire project, entitled "SureFire: Smart Urban Resilience and Firefight", led by Professor Asif Sohail Usmani of the Department of Building Services Engineering was awarded a research grant of more than HK\$30 million. The project will gather an interdisciplinary team of local and international researchers, a government agency and several high-tech companies to conduct research on fire prediction, prevention and control, and emergency management. The team will also develop a smart firefighting system for use in densely populated urban environments.

2.3 Collaborative Research Engagements with Other Academic and Research Institutions

In April 2020, PolyU and Peng Cheng Laboratory (PCL) signed a collaborative agreement, aiming to jointly conduct research cooperation in the field of Big Data Analytics, Advanced Networks and IoT, AI and Robotics, Blockchains and Smart Health for the benefit of the national and social development.

PolyU also collaborated with Macau University of Science and Technology to develop a new AI system to assist in the rapid diagnosis of COVID-19 pneumonia, and the research was published in the prestigious international journal "Cell".



2.4 Establishing Research Institutes / Joint Laboratories with Collaborating Partners to Facilitate KT

In order to enhance collaborative relationships with industry associations, research institutions and professional bodies in a coordinated manner to promote and facilitate knowledge transfer, PolyU has been strategically partnering with appropriate bodies to establish joint research centres / institutes and joint laboratories to expedite the technology development and commercialisation in respective research domains (e.g. the strategic areas of aerospace & aviation, biotechnology, sustainability, new energy, AI and big data, nano-technology and other areas as appropriate). Newly set up in FY2019/20, the research institutes / laboratories will focus on the following specific research domains:

AI and Smart City

The PolyU-Shenzhen Technology and Innovation Research Institute (Futian) will leverage the opportunities offered by the Greater Bay Area (GBA) development and run research projects related to AI and smart city development, and will be supported by the Shenzhen-Hong Kong Science and Technology Innovation Cooperation Zone (Pilot Scheme).

Autonomous Vehicles

The joint Laboratory established by PolyU and an institute in Guangzhou will explore innovation in autonomous vehicles. Research from the Laboratory will not only foster the development of intelligent connected vehicles (ICVs) and autonomous driving in Guangzhou, but also across other major mainland cities.

Environmental and Energy

The following two laboratories have been formed with the Guangzhou Institute of Geochemistry (GIG) of the Chinese Academy of Sciences and Southern University of Science and Technology (SUSTech) respectively to tackle environmental and energy challenges:

- Guangdong-Hong Kong -Macao Joint Laboratory of Environmental Pollution Processes and Control
- Guangdong-Hong Kong-Macao Joint Laboratory for photonic-Thermal-Electrical Energy Materials and Devices

It is anticipated the aforementioned research institutes and joint laboratories will add impetus to the impactful research produced by PolyU.

3. Leveraging our Research Expertise to Combat COVID-19

During the second half of the fiscal year, we actively engaged in the fight against the COVID-19 pandemic. The Health and Medical Research Fund of the HKSAR government recently awarded a sum of HK\$59 million to 23 projects at local universities which combat COVID-19. Out of this total, PolyU received HK\$18 million for 8 projects, which represents over 30% in terms of both the monetary value and the number of projects funded. The University additionally received over HK\$21 million for 10 projects by the government's Innovation and Technology Fund for COVID-19 related research. The funded PolyU projects cover a diverse range of disciplines, including health technology, biomedical sciences, healthcare, rehabilitation and social sciences. The high level of government funding secured by PolyU is a testament to the University's strong research reputation. The University has further employed its own funds, as well as investment from industry, to fight the pandemic.

In addition to the funding milestones mentioned above, PolyU researchers developed a pioneering and costeffective diagnostic method, known as the 'rapid automated multiplex diagnostic system' in February 2020, which can detect COVID-19 with only one test in one hour. This fully-automated system provides ultra-sensitive detection of up to 40 infectious respiratory pathogens, including novel coronavirus, with no manual handling required at any time during the testing process. More information can be found in Case 1 of Appendix 2.



Another example is how the University responded to an urgent request by the Hospital Authority and Queen Elizabeth Hospital to produce face and eye shields for medical staff in Hong Kong, since this equipment was in critically short supply at the beginning of the outbreak. A team led by Professor H.C. Man, Dean of the Faculty of Engineering and Director of the University Research Facility in 3D Printing, immediately started work on designing the shields after the request was received. The team referred to studies (by PolyU's School of Design)

comparing the head sizes of Asians and Westerners to design face shields that would be a better fit for Chinese wearers. They then deployed state-of-the-art 3D printing technology to produce the first batch of the face shields,

which were prototypes. With support from local manufacturers, production lines subsequently began manufacturing around 30,000 face shields per day in March so that the urgent demand for PPE for Hong Kong's medical personnel could be satisfied.

PolyU has furthermore created other essential PPE to help fight COVID-19, including reusable face masks as well as the production of reusable isolation gowns that can sustain up to 30 washes and are ideal in environments such as residential care facilities.

4. Creating Impact for Industry and Society

4.1 Design, Supply and Installation of Structural Health Monitoring System for Cross Bay Link, Tseung Kwan O - Main Bridge and Associated Works

CCCC Highway Consultants Co., Ltd. engaged the Faculty of Construction and Environment to contribute their domain expertise in the design, development and implementation of an innovative Structural Health Monitoring System for the Cross Bay Link – Tseung Kwan O Bridge structure. Construction of the bridge is expected to



complete in 2022 and will boast a real-time online Structural Health Monitoring system with a total of over 700 sensors of 13 types for load and structural response monitoring spanning across the 1.8km bridge connecting the Tseung Kwan O – Lam Tin Tunnel at the west end and Wan Po Road near Area 86 of TKO at the east. This system will allow the bridge to be scientifically monitored and easily maintained and managed during its design life of 120 years and will provide quantitative and reliable data on the real-time picture of the condition of the bridge structure, observe its evolution and detect the appearance of degradations.

4.2 Impactful KT Solutions for the Railway Industry

Department of Civil and Environmental Engineering and the National Rail Transit Electrification and Automation Engineering Technology Research Centre (Hong Kong Branch) were engaged by Sanmen county government to build a smart transit transportation system and application platform. The platform will assist the local government to set up a professional team on securing R&D and commercialisation projects. In addition, the team will also set up the "Sanmen Rail Transit Innovation Centre" for providing innovative solution and support services, and organise local and international seminars and exchange activities to promote the commercialisation of smart transit transportation technologies.

4.3 Enhancing the Supports to Carers of Elderly Persons and of Persons with Disabilities in Hong Kong

The Labour and Welfare Bureau has launched many pilot and regularized services to support carers of elderly persons and of persons with disabilities. In order to enhance the support to carers, the Bureau engaged the Faculty of Health of Social Sciences to carry out a consultancy study to analyse the needs of carers, to find ways to help the carers maintain a balance between caregiving responsibilities and a life outside caregiving, and to make practical recommendations.

The study involves identifying the needs and service expectations from the perspectives of carers and stakeholders, as well as good carer policies and services outside Hong Kong. The findings will assist the Bureau to formulate a holistic carer-centred policy in Hong Kong. The study is expected to be completed in mid-2021.

5. Nurturing Entrepreneurs & Facilitating Impactful KT through Entrepreneurial Venturing

5.1 Developing a Holistic Entrepreneurship Support Framework

With entrepreneurship as one of the strategic focused areas of the University, PolyU has put together a holistic support framework to foster "Do Well Do Good" entrepreneurship development among faculty members, students and alumni to create social and community impact. Addressing both students and young graduates' entrepreneurship learning and practice on a broad basis, as well as deep dive academic venturing with PolyU research deliverables, the University offers different education, funding, incubation and acceleration programmes along each stage of their entrepreneurship journey.

5.2 Nurturing Future Entrepreneurs with Entrepreneurship Education and Seed Funding

PolyU has long incorporated entrepreneurship training into its all-round education model to help students excel in today's dynamic environment and make a difference to society. From credit-bearing courses to extra-curricular activities and entrepreneurship training programmes, young students aspiring to become entrepreneurs benefit from highly experiential and practical entrepreneurship education to complement its class room learning, like the Startup Internship and Immersion Programme involving Shenzhen University and other six overseas universities in the summer



of 2019. Despite the difficulties faced in FY2019/20 which caused postponement of some planned programmes, the University is actively planning for a more holistic entrepreneurship education framework for students, with a new minor programme in entrepreneurship and other credit / non-credit bearing programmes on the horizon.

PolyU also provides seed grants to support students' entrepreneurship practice and pursuit, including Student Entrepreneurial Proof-of-Concept (POC) Fund and PolyU Micro Fund. Adding new 6 student POC projects and 22 startups under Micro Fund programme in FY2019/20, the two schemes have already supported over 60 students' innovation projects and over 160 startups created by PolyU's students and alumni since the inception of the programmes in 2017 and 2011 respectively.

PolyU, with the support of the SIE Fund, also launched a social innovation funding programme – Good Seed for the 3-year period between 2015 to 2018. In FY2019/20, PolyU again secured SIE Fund support of \$9.6 million to run the Good Seed Programme for another 3.5 years, from 2020 to 2022. Branded as Good Seed 2.0, the programme signified a fresh start with the enhanced funding and other new supportive initiatives to not only PolyU's members, but also to students and alumni of other universities.

Despite the difficulties imposed by the social movement and then the COVID-19 in FY2019/20, the Good Seed 2.0 successfully started the first cohort in February 2020, which was joined by 335 young participants who generated 103 innovative ideas. After two rounds of adjudication, 8 teams were granted Good Seed funding of HKD200,000 to implement their social innovation projects with the support of PolyU, NGOs, design and industry mentors from our network.

With all the seed grants and funding programmes, PolyU has supported more than 300 startups, with around 70%¹ still actively operating. The startups also performed well, winning more than 200 international and regional awards, and secured further funding and investment supports of over \$430 million.

¹ Survival Rate is calculated as the percentage of active startups as of 30 June 2020 that were funded / supported with PolyU funding.

5.3 Creating Impactful Startups with Academic Venturing

(a) Supporting Technology Commercialisation through Startup Ventures



In addition to supporting students' entrepreneurial learning and pursuit, PolyU also puts strong strategic emphasis on promoting KT and commercialisation of research outcome through entrepreneurial venturing. The University has been reviewing and liberalising relevant policies and guidelines to create a much conducive environment to actively support academic to commercialise their research through startups. In FY2019/20, there were 9 startups created by research students / academics commercialising PolyU's research technologies, with some of them secured funding supports from the University through Tech Launchpad Fund (TLF). Two of these academic-led startups commercializing 'An Innovative Tank-

top with Biofeedback System for Adolescents with Early Scoliosis' and 'Ultrasound Image-guided Scanner for *in vivo* Liver Tissue Stiffness Analysis' have also been successfully admitted to the HKSTP Incu-bio programme.

In addition, we also launched a new pilot Startup Postdoc Programme in Shenzhen / GBA with the subsidies from Shenzhen Government. Aiming to support the continual R&D and downstream commercialisation of post doctorates' research technology, the Programme was launched in 2019 with 6 postdocs recruited. The two-year programme provides the admitted postdocs with monthly stipends and a comprehensive commercialisation and entrepreneurship support package, including dedicated industry mentorship, entrepreneurship learning programme (as detailed in section (b) below) and startup funding opportunity. Among the 6 postdocs, 2 of them have won the Internet+ Competition (Hong Kong) along with the other 3 teams to become the representatives from Hong Kong to compete in the competition at the national level.

(b) Navigating Commercialisation Pathway through Tailored Programme

The PolyU Lean Launchpad Programme (LLP), a 10week experiential learning programme launched in 2018 with supports from local industry partners and practitioners, provides much required opportunity for academics and researchers to conduct market validation on their research technology, helping them to shape the commercialisation pathway of their research. Up till the end of June 2020, a total of 24 teams covering fashion and wearable technology, health technology, smart city, AI and big data were admitted to the programme. Among the 24 teams, 8 of them have commercialised their innovations / technology through startups or licensing.



5.4 Building Entrepreneurial Community within and beyond Campus



Despite the odds faced in FY2019/20, the University has completed the Phase 2 expansion and development of InnoHub (Hong Kong) in this fiscal year. It now boasts expanded infrastructures like work spaces, open and exhibition areas, etc, as well as education and incubation support. The InnoHub will become an important nurturing ground and entrepreneurial community for the next generation of entrepreneurs and startups, supported by both PolyU and industry partners. Until end June 2020, a total of 116 PolyU supported startups and student project teams have benefited from the InnoHub's supports.

The University's continuous effort to expand regional outreach and partnership generated positive results with some startups expanded to other markets in Greater China and ASEAN countries. Under the collaborations with Shenzhen University (SZU) in creating the Greater Bay Area International Institute for Innovations (GBA I3), the University concluded a 7-week Startup Internship and Immersion Programme (SIIP) in July 2019, which was participated by more than 70 students from PolyU, SZU and other six overseas institutions.





To engage entrepreneurial community within and outside PolyU campus, an annual flagship event - Entrepreneurship Parade 2019, has been organized in November 2019. Attended by more than 100 guests including Dr David Chung JP, the Under Secretary for Innovation and Technology of HKSAR Government as the guest of honour, 3 successful PolyU startup co-founders shared their entrepreneurial journey to the attending guests, who were also impressed by the new innovative products and technology showcased by the PolyU support startups.

6. Promoting KT and Entrepreneurship

6.1 Holistic KT and Entrepreneurship Marketing

To connect the broadest prospective audiences for maximum reach and influence, we have adopted a crosschannel and cross-platform marketing approach to publicise PolyU's innovations for optimal effect. Consistent messages on PolyU's works and achievements in KT and Entrepreneurship are communicated in an integrated manner.

(a) Innovation Awards

To raise the significance and awareness for PolyU innovations that bring excellent value and benefit to society, we leverage distinguished innovation awards as a strategic marketing tool. In this context, awardwinning research teams are encouraged to participate in communication events, trade shows and other community exchange events with coordinated cross-channel promotion. This integrated approach stimulates interactions between PolyU and industry, expediting the KT and commercialization processes, and attracting research funding.



In FY2019/20, PolyU competed in 3 invention expos, namely Asia International Innovative Invention Award, the 2nd Asia Exhibition of Inventions Hong Kong and the 71st International Trade Fair for Ideas, Inventions & New Products (iENA). PolyU won 7 prizes in total with the 5 submitted projects, earning acclaim at local, regional and international levels.

(b) Publicity, Publications and Social Media

PolyU also promotes KT and Entrepreneurship through the traditional channels of press events, publications and the dynamic social media. Last year, PolyU held two press conferences to publicise its automated multiplex diagnostic system that can detect up to 40 infectious respiratory pathogens and its collaboration with Macau University of Science and Technology (MUST) to advance the diagnosis of COVID-19 pneumonia in February and June 2020 respectively. On top of monthly e-newsletters featuring the PolyU's technologies and forward-thinking Poly-preneurs, the brochure "Easing Your Way to Business Innovation" on the 4



major modes of KT adopted by PolyU with detailed explanation of the benefits brought to partners by these modes and success cases was published. To entice collaboration and commercialisation, copies of the brochure were sent to industry partners, trade associations and different communities. A quarterly magazine, "Excel x Impact", was also launched to showcase PolyU's achievements, people and latest developments that make impacts to society. In the GBA, a couple of 3-week digital marketing campaigns were conducted to promote KT and partnership with PolyU, while selected articles on KT and Entrepreneurship were regularly distributed to the vast reader bases in the region via Weibo and WeChat.

(c) Webinars

While physical events were suspended or cancelled mostly due to measures against social gathering under COVID-19 pandemic, web-based events were gaining momentum and rapidly became the dominant platform for information dissemination, communication and exchange. No longer tied to a single physical venue in Hong Kong, these online events bring the benefit of extended participation by audiences from different parts of the world.



In the year under review, PolyU staged a number of webinars to foster knowledge transfer and facilitate exchange between academia, industry and the government. At the "Smart Water Technologies" webinar, our expert in leakage diagnosis and strategic water management demonstrated PolyU's non-destructive diagnostic technologies while the guest speaker from Water Supplies Department enlightened the audience on the challenging task of water loss management from the government's perspective, attracting participants from related industries and government bodies in Hong Kong, Macau, the Chinese mainland, Singapore, Malaysia and the US. Two series of pandemic-related webinars

under the themes "Transforming Business, Adapting to Change" and "e-Dialogue: Positive Thinking" were organized by CEO Club. Totalling 7 episodes, the 2 series covered a wide range of industries, such as property management, public utilities, hygiene, catering, retail and manufacturing. PolyU's academics also shared their expertise and insights with the audience and presented their research outcomes in these webinars.

(d) Tradeshows and Exhibitions

Exhibitions are an indispensable channel for demonstrating PolyU's KT and R&D expertise. Off campus, we join strategically relevant tradeshows and exhibitions, where our researchers can interact with tradespeople and industrialists. In FY2019/20, PolyU participated in 11 such shows in Hong Kong, Shenzhen, Suzhou, Islamabad in Palestine and Nuremberg in Germany, reaching out to 620,000 people in targeted segments in the world. Six other local and international events that we had signed up for were either postponed or cancelled due to social unrests or COVID-19 pandemic.

6.2 Engaging Partners and Communities for KT Impact

PolyU constantly reaches out to different communities in a proactive manner, maintaining and developing communication channels and partnership networks to drive KT and Entrepreneurship development, with specific focus on forging synergy among different communities for integrated communication.

(a) Strategic Partnership with EMSD

PolyU signed a Memorandum of Co-operation (MOC) with the Electrical and Mechanical Services Department (EMSD), HKSAR in 2019 and established a long-term strategic partnership to facilitate the exchange of knowledge, expertise and experience for promoting the adoption and development of innovation and technology.



Under this partnership, PolyU helps to promote the use of E&M InnoPortal, co-organise events with EMSD and publicise the achievements of the collaboration. For example, PolyU's green technologies were exhibited and presented to government officials at the Green I&T Day in August; and PolyU's mechanical engineering projects are being displayed in EMSD's E&M InnoZone for long-term exhibition.

In FY2019/20, PolyU also carried out 15 projects with EMSD in the technology areas such as geographic information technology, battery recycling, energy saving technology and technologies for combating COVID-19 pandemic.

(b) Partnership with Industry Communities

To penetrate key industrial sectors, PolyU strategically works with trade and industry associations to foster longterm partnerships on both sector-specific applications and cross-disciplinary collaborations. We are actively reaching out to collaborate with industry associations, but many planned activities were suspended due to social unrests and the pandemic.

Meanwhile, we continued to collaborate with industry associations to broaden our readership base through sharing of PolyU's technology capabilities and achievements in trade association publications. Over 20 articles were widely shared by 10 associations on their various channels. Our partners include the Federation of Hong Kong Industries, Hong Kong Apparel Society and The Hong Kong Metals Manufacturers Association, which have been active in furthering their agenda regarding innovation and reindustrialisation with enabling technologies.

Regular thematic activities are organized with the CEO Club, Poly-preneurs, startups, as well as PolyU and industrial communities to induce cross-over networking and interests in our technology and university-industry partnering programmes. The sharing sessions, luncheon meetings, networking gatherings and guided tours provide an excellent platform for business matching and university-industry collaboration. For example, in a special sharing session, participants from various communities including industry, entrepreneurs and PolyU exchanged their views on latest developments in property technology (PropTech) with the founder cum president of the Institute of Next Barcelona as well as senior management from Sino Group.

7. Closing Remarks and The Way Forward

For PolyU, FY2019/20 was an unconventional year full of unprecedented challenges. The impact of the social unrest and then the outbreak of the COVID-19 pandemic in Hong Kong and across the globe has however, united the PolyU community to overcome the difficulties and challenges. Under the leadership of the new President and Council Chairman, we aim to build upon our proud history in the past 80+ years to further drive world-class research and translate research excellence into meaningful applications to create societal impact and benefits.

Riding further on the support from public and private sectors on deep technology, we will spearhead more academic-led startup ventures, enabling commercialisation through academic venturing. We will also carry out a review of the university's IP policies and models to enable a more flexible and liberal environment to foster commercialisation of the University's IP portfolio. In addition, we are strengthening our entrepreneurship education offering with a holistic approach and framework, from formal credit-bearing courses to extra-curricular learning opportunities, to inspire our students' innovative and entrepreneurial mindset and to enrich their skills and knowledge for their future entrepreneurial journey. To this end, PolyU is planning to launch a new minor programme in innovation and entrepreneurship as one of the major cornerstones in our entrepreneurship education.

The global socio-economic environment presents both challenges and opportunities to higher education institutions. Leveraging the national policy and priorities for the GBA development, PolyU will forge ahead with the planned initiatives, including the establishment of more university-industry research institutes and innovation platforms, and advancement of KT and entrepreneurship initiatives for impact to contribute to the innovation, technology and entrepreneurship development entrepreneurship of Hong Kong, the GBA and the nation.

Miranda Lou Executive Vice President

Appendix 1: Performance Measure – KPIs & Additional Measures

(a) Key KT Performance Indicators

A summary of the key performance indicators for various KT areas are presented in the table below, with figures expressed in HK\$'000:

Performance Indicators	2018/19 Actual	2019/20 Actual	2020/21 Target	
Patenting & Lice	Patenting & Licensing			
No. of patents filed	130	129	110	
No. of patents granted Note 1	50	79	70	
Accumulative no. of licenses granted	126	134	149	
Income generated from IPR Note 2,3	\$6,642	\$2,641	\$4,000	
Expenditure involved in generating income from IPR	\$6,383	\$7,934	\$8,000	
Consultancy, Collaborative / Contract Re	search & Spin-off	/ Joint Ventures		
No. of collaborative research, income generated and total contract value Note 4	365 \$154,244 \$654,096	420 \$234,620 \$761,121	450 \$251,400 \$814,400	
No. of contract research, income generated and total contract value Note 5	331 \$73,901 \$397,963	326 \$118,656 \$461,440	350 \$127,400 \$495,600	
No. of consultancy projects and income generated Note 6	842 \$71,165	705 \$75,033	670 \$78,800	
No. of economically active spin-off companies Notes 7	29	236	270	
Net income generated (or net loss arising) from spin-off companies Notes 8	\$595	\$657	\$700	
Other Knowledge Transfer / I	Dissemination Activ	vities		
No. of equipment and facility service agreements and income	440 \$3,690	178 \$3,535	200 \$3,970	
No. of student contact hours for business or CPD needs Notes 9,10	1,082,404	1,373,767	1,400,000	
Income received from CPD courses Note 10	\$290,860	\$254,646	\$260,000	
No. of public lectures / symposiums / exhibitions and speeches to community	647	303	400	
No. of performances and exhibitions of creative work by staff or students	100	33	50	
No. of staff engaged as members of external advisory bodies	378	389	400	

(b) Additional Performance Measurements

Performance Indicators	2018/19 Actual	2019/20 Actual	2020/21 Target
Marketing ۵	& Outreaching		
 Outreach to industry ^{Note 11} No. of Exhibitions / Conference and Forum attended ^{Note 12} No. of people ^{Note 13} reached ('000) 	40 1,680	53 644	40 600
No. of innovations / technologies being promoted / marketed	152	107	100
Innovation and Entrepreneurial Activities Enabling KT			
Accumulative no. of startups supported Note 14	288	332	382
Accumulative no. of academic involving startups Note 15	7	11	18
Accumulative no. of PolyU innovations / technologies / knowledge transferred through startups by students / alumni / staff Note 16	49	60	75
 No. of Entrepreneurship Fund applications Note 17 No. of students, alumni and staff involved Note 18 No. of new startups / entrepreneurial projects funded Note 19 	216 404 30	231 554 44	250 600 50

Notes:

- 1. A detailed list of patents granted is presented in Appendix 5.
- 2. The reported figure includes license income of \$594,594 in FY2018/19 and \$657,434 in FY2019/20 generated from PolyU supported startups which licensed PolyU's IPs. This license income was also included in the "Net income generated (or net loss arising) from spin-off companies" (refer to Note 8 below).
- 3. A drop in the licensing income in FY2019/20 was due to (1) implementation of a new measure to relatively lower upfront licensee fee so as to encourage academic-backed startups with PolyU technologies; (2) negative impact brought by the social movement and COVID-19 in FY2019/20.
- 4. Collaborative research income reported is on cash-receipt basis from on-going projects in FY2019/20, with an aggregate project value of \$761.1 million. As some of the internally funded projects also involved third parties as collaborators for KT purpose, the number of those projects was counted here but not the income nor project value.
- 5. Contract research projects are those involving third parties from public, private and NGO sectors. The income reported is on cash-receipt basis from on-going projects in FY2019/20, with an aggregate value of \$461.4 million.
- 6. The reported figure for FY2019/20 includes \$15.2 million income from corporate and executive development training related consultancies and \$59.8 million income from consultancy and advisory services, such as investigation, advisory on business, management, social, technical or policy related issue(s), as well as product, technology, materials or process enhancements. Volume of projects is expected to be scaled down to focus on strategic projects with societal / industry impact.
- 7. Compared to the figure reported in past years until FY2018/19, the reported figure for FY2019/20 included the number of all active startups that were either funded by PolyU funding programmes (including PolyU Micro Fund, China Entrepreneurship Fund, Tech Incubation Fund, Tech Launchpad Fund, Good Seed Programme), or obtained license from PolyU to commercialise the University's IPs. Subsidiaries set up as operating vehicles for specific functional purposes, e.g. PTeC, Hotel ICON and PolyU Base in Shenzhen are not included.
- 8. The reported figures represents the license income of \$594,594 in FY2018/19 and \$657,434 in FY2019/20 generated from PolyU supported startups which licensed PolyU's IPs. This license income was also included in the "Income generated from IPR" (refer to Note 2 above).
- 9. The student contact hours are defined to be the number of enrolments multiplied by the number of contact/course hours.

- 10. The CPD courses are now defined to include award-bearing and credit-bearing programmes (both in and outside Hong Kong) for learners already in work who are undertaking the course for purposes of professional development / upskilling / workforce development, in addition to short term non-credit-bearing training programmes.
- 11. The reported figures cover events organized / attended by the Institute for Entrepreneurship and Innovation and Technology Development Office.
- 12. The target reflects only major public exhibitions, symposia and competitions in both Hong Kong, mainland and overseas, excluding seminars, workshops and featured media reporting for specific technologies, commercialization and startups endeavours.
- 13. Includes both people from industry and the general public.
- 14. The reported figure includes all funded startups from Micro Fund, China Entrepreneurship Fund (CEF) Schemes, TIF, TLF and Good Seed programmes. The figure for FY2018/19 was restated to include the number of awardees under 2018 cohort 2 of Good Seed programme.
- 15. The reported figure includes all academic-led startups with licenses from PolyU for commercializing the University's IPs
- 16. The reported figure includes all PolyU supported startups founded by students, alumni or academic staff licensed PolyU's IPs and/or commercializing PolyU's innovations (e.g. students' final year projects)
- 17. The reported figure includes all applications under Micro Fund, China Entrepreneurship Fund (CEF) Schemes, TIF, TLF and Good Seed schemes.
- 18. It also includes non-PolyU participants from the Good Seed Programme.
- 19. The actual number of funded startups in FY2018/19 was 38. Among them 8 were existing startups seeking for further funding from PolyU's other funding schemes. As such, the total number of new startups supported was 30.

Appendix 2: Impact Case History

Case 1 - Rapid Automated Multiplex Diagnostic System for Testing Infectious Respiratory Diseases

1) Summary of the Impact

Infectious diseases represent an important portion of global public health concerns, in particular with regard to the global outbreak of novel coronavirus (SARS-CoV-2). The challenge of frontline diagnosis in hospitals, clinics and ports is that infectious diseases could exhibit similar symptoms or can be asymptomatic.

Professor Terence Lau, Interim Associate Vice President (Innovation and Technology Development) and Adjunct Professor at the Department of Applied Biology and Chemical Technology together with other team members developed the world's most comprehensive automated multiplex diagnostic system which includes a fully automated machine and a multiplex full-screening panel for point-of-care genetic testing (POCT) of up to 40 infectious respiratory pathogens including the COVID-19 virus. The System adopts patent-pending microfluidic and biochemical technologies that achieve ultra-sensitive detection and simultaneous differentiation of various pathogens with extremely high specificity. It is user-friendly which could relieve the challenge of frontline diagnostics in hospitals, clinics and ports with early and accurate detection of pathogens for effective and efficient disease control and management, and prevent spreading of contagious pathogens.

The project was initially funded by the industry and now supported by the Government for public sector trial. More large-scale pilot production and mass production and optimizations are underway. The team has also received valuable support from a local biotechnology company, Avalon Biomedical Management Ltd.



Prof. Terence Lau demonstrated the use of the automated diagnostic system

In one single test within an hour, the System can identify 30 to 40 pathogens including SARS-CoV-2 (virus causing COVID-19)

2) Underpinning Research

After numerous infectious disease outbreaks such as Spanish flu H1N1 (1918), Asian flu H2N2 (1957), Hong Kong flu (1968), Avian flu H5N1 (1997), SARS-CoV (2003), Swine Flu H1N1 (2009), MERS-CoV (2012), Avian Flu H7N9 (2013), today the global community is again combating a novel coronavirus, and as of today there is still immense need for a cost effective and accurate POCT diagnostic system suitable for large scale adoption.

The research team for this project is led by PolyU Professor Terence Lau Lok-ting and supported by HKU Professor Yuen Kwok-yung. Through collaborative efforts, the team has spent the past four years to develop the System.

In one single test and within approximately one hour, the System can identify **30 to 40 pathogens** including seasonal influenza viruses, such as influenza A subtypes H1, H2 and H3, avian influenza viruses H5, H7 and H9, human respiratory syncytial virus, severe acute respiratory syndrome coronavirus (SARS-CoV), Middle East respiratory syndrome coronavirus (MERS-CoV) and SARS-CoV-2. Leveraging the current polymerase chain reaction (PCR) technology, the system is fully automated from sample nucleic acid extraction and amplification, to signal detection and analysis. The System adopts patent-pending microfluidic and biochemical technologies that achieve ultra-sensitive detection (down to 5 gene copies) and simultaneous differentiation of various pathogens with extremely high specificity. It is also user-friendly, with manual handling not being required throughout the testing process.

In the past year, the team has optimized the System and conducted trials on different clinical samples. In the midst of the SARS-CoV-2 outbreak, the team has also conducted tests on clinical samples using the system. It is a highly versatile technology platform which can be extended to other needs as well.







與現有技術比較 Comparing to Existing Technologies Cepheid. BIO SFIRE | FilmArray **Our System** 測試病源數量 DETECTION OF PATHOGENS 40(可增多 / or more) 22 6 低 - 西方國家 / 低 - 西方國家 / 地緣相關度 LOCAL SIGNIFICANCE 高 / High Low - Western Countries Low - Western Countries 驗測時間 TESTING LEAD-TIME 約一小時 / Around 1 Hour 約一小時 / Around 1 Hour < 一/小時 / < 1 Hour 價格 COSTING 低 / Low 高 / High 非常高 / Very High 樣本處理 SAMPLE HANDLING 直接 / One-Step 多程序 / Multi-Process 直接 / Direct 靈敏度 SENSITIVITY 高 / High 高 / High 高 / High 定性及定量 / 定性及定量 / 分析方法 定性 / Qualitative ANALYSIS METHOD Qualitative & Quantitative Qualitative & Quantitative

臨床樣本試驗 Testing with Clinical Sample 2019新型冠狀病毒 2019-nCoV

- Chip Cartridge : spotted with a panel of targets
- m Covy Ngene, Right gene, Fluk, Flu B, H1, H3, H5, SARS, MERS, RSV, HKU1, OC43, 229E, NL63, GADPH (control), qPCR (control), SUC1 (control) Sample : Patient sample from Prof Yuen •
- . Control : GADPH, qPCR control, SUC1 (RT control).

3) References to Research

Selected publications relating to PolyU's research and development on the diagnostic system are listed as follows:

Tsui NBY, Cheng G, Chung T, Lam CWK, Anita Yee A, Peter K. C. Chung PKC, Kwan TK, Ko E, He D, Wong WT, Johnson Y. N. Lau JYN, **Lau LT***, Fok M*. (2018) Population-Wide Genetic Risk Prediction of Complex Diseases: A Pilot Feasibility Study in Macau Population for Prevision Public Healthcare Planning. Scientific Reports, 2018 Jan; 8(1853).

Lau LT "Molecular Testing for Food Allergens", Food Allergens Testing: Molecular, Immunochemical and Chromatographic Techniques, edited by G Siragakis and D Kizis, Wiley- Blackwell, 2014, p29 - 45.

Details of Key Research Grants

Pilot Production and Clinical Evaluation on Automated Multiplex Diagnostic System for COVID-19 (PI: Professor Terence Lau) Public Sector Trial Scheme, Innovation and Technology Fund. Project Period: May 1, 2020 – April 30, 2021.

Patent

Tsang YL, Chu LH, Lau JYN, Lau LT. 2020. POINT-OF-CARE MICROFLUIDIC IN VITRO DIAGNOSTIC SYSTEM US Provisional Application Number 62/972119

Lau LT and Chung T 2020. Stepping oligo approach in Polymerase Chain Reaction (PCR). US Provisional Application Number 63/001594

4) Impact and Benefits

Humankind's modern day battles against epidemics remain a major challenge and it is vital that we keep learning from the past and equipping ourselves with the best technologies available. For instance, COVID-19 is taking its toll on the world, affecting more than 200 countries and regions. In the face of a surge in cases and other uncertainties, rapid diagnosis and identification of high-risk patients for early intervention is crucial for controlling the pandemic. The research team is continuing on the technology advancement and development to ensure the system's robustness and cost-effectiveness, and to collaborate with relevant parties on clinical trials, regulatory approvals, and frontline applications of this POCT System.

In the future, applications of the System could potentially be extended as a platform technology for use in cancer and drug screening, food safety testing, environmental testing, genomics, agricultural use, plus other medical use, in addition to the diagnosis of other infectious diseases such as meningitis, blood- borne disease, gastrointestinal disease, mosquito-borne disease, and sepsis. Adaptations could be made according to the geographical region where the System is applied.

Up to present, the System was deployed in two hospitals for the rapid diagnosis of COVID-19 pneumonia. The technology will be commercialised for mass production and further frontline applications.

5) References to the Corroboration of Impact and Benefits

Media Coverage

Date	Media	Торіс	URL
Feb 11, 2020	TVB news	理大儀器為呼吸道疾病患者快速測試約一小 時有結果	https://rb.gy/716064
Feb 11, 2020	RTHK	理工大學成功研發出一個呼吸道傳染病快速 測試系統,可用作即時基因檢測。	https://rb.gy/fyzcwt
Feb 11, 2020	Now TV	理大研發出快速測試系統檢測新型冠狀病毒	https://rb.gy/0iwgtq
Feb 11, 2020	South China Morning Post	Researchers from Hong Kong's PolyU develop diagnostic system to identify up to 40 types of bacteria or viruses causing respiratory infections	https://rb.gy/ckshjm
Feb 11, 2020	The Standard	New PolyU disease test widens scope	https://rb.gy/7tvyoy
Feb 11, 2020	Hong Kong Economic Journal	理大研快速測呼吸道傳染病毒 包括新肺炎	https://rb.gy/uuualy
Feb 11, 2020	Wenweipo	港理大研發快速自動診斷新冠肺炎系統一小 時內驗出病毒	https://rb.gy/gqktny
Feb 11, 2020	Hong Kong Economic Times	理大研發系統 1 小時測新冠病毒 可分辨 40 種病原體 盼半年內港應用	https://rb.gy/qsvesg
Feb 11, 2020	Headline Daily	理大成功研發快速測試系統1小時內驗出新 冠肺炎	https://rb.gy/0utzxm
Feb 11, 2020	Yahoo news	理大成功研發快速測試系統 1 小時檢測 30- 40 種病毒包括新型肺炎	https://rb.gy/vbuejm
Feb 12, 2020	China Daily	New PolyU system can detect virus in an hour	https://rb.gy/ujeai6
Feb 12, 2020	Chinanewscom	New PolyU system can detect virus in an hour	https://rb.gy/7rlzwu
Feb 14, 2020	Bioworld	Researchers develop diagnostic system that detects up to 40 infectious respiratory pathogens in one test	https://rb.gy/c8xlew
Feb 14, 2020	Unwire.com	理大研發武漢肺炎快速診斷儀	https://rb.gy/ge5bls
Feb 22, 2020	RTHK31	醫生與你 同行抗疫	https://rb.gy/skpuxd
Feb 28, 2020	Hong Kong Economic Journal Startup beat	理大自動檢測 一小時知結果	https://rb.gy/mfbx44
Mar 11, 2020	News Break	PolyU develops the world's most comprehensive automated multiplex diagnostic system for detecting infectious respiratory pathogens in a single test	https://rb.gy/mlr4dz
Mar 17, 2020	RTHK Podcast One	深圳生物科技發展	https://rb.gy/mbxwqb
May 31, 2020	TVB Finance Magazine	新冠肺炎疫情確實對廣大經濟帶來重大打擊, 但同時造就一系列科技業得以加快發展,醫療 科技就是其一。	https://rb.gy/xexadf
Jul 18, 2020	TVB News Magazine	全民檢測	https://rb.gy/ov34kl
Sep 25, 2020	China Daily	Inno-tech the way forward	https://rb.gy/ygqsoj

Case 2 - Peptide-Based Data Storage for China's Next-generation Manned Spacecraft

1) Summary

Humankind is generating digital data in an exponentially increasing manner. The same trend is observed in space mission, where huge amount of digital data relating to planetary phenomena is generated and recorded. In this area, the commonly used memory storage devices reveal great limitations in terms of data storage capacity and shelf life of the stored data.

To overcome this problem, a team of researchers from PolyU, led by Associate Professor Zhongping Yao and Professor Francis Chung Ming Lau, have developed a novel technology that uses peptides to store digital data. This technology has the potential to store data in a very compact physical space and hence in a high density manner. Furthermore, the data should be retrievable even after thousands of years. With this technology, a collaboration having an aim to optimising data storage for space exploration was carried out with the China Aerospace Science and Technology Corporation. In particular, data-encoded peptides were sent to space in China's next-generation manned spacecraft launched by the new Long March-5B rocket. The spacecraft and the peptides returned to Earth after 3 days. Subsequently, the peptides were analysed and all the stored data were retrieved correctly, confirming the robustness of peptides as a storage media in space missions.

The project was funded by Research Impact Fund (RIF), and in collaboration with the China Aerospace Science and Technology Corporation.

The data-encoded peptides that returned from space

Retrieval of data stored in the peptides, by sequencing the peptides using tandem mass spectrometry

The research team led by Dr Yao Zhong-ping (middle) and Prof. Francis Lau (2nd from left), with some researchers Dr Albert Ng (left), and (from right) Dr Tam Wai-man and Dr So Pui-kin.

2) Underpinning Research

Humankind is generating digital data at an exponential rate. These data are typically stored using electronic, magnetic or optical devices, which require relatively large physical spaces and cannot last for decades. To solve these two problems, new data storage methods are needed.

The research team led by PolyU Associate Professor Zhongping Yao and Professor Francis Chung Ming Lau has developed a new method that uses peptides to store data. This technology has the potential to store data in a very high density manner. Moreover, the data should be retrievable after many thousands of years if the peptides are stored in cold and dry conditions. This team spent four years developing the method and protocol for peptide data storage, and demonstrated the feasibility of the method by successfully storing and retrieving a text file and a music file with 40 and 511 peptides, respectively.

Since last year, the team has been collaborating with the China Aerospace Science and Technology Corporation in exploring the use of peptides to store digital data in space mission. The peptides storing the text file and the music file in previous experiments were carried by a spacecraft launched on 5th May 2020 and then exposed to the extreme radiation in space environment for 3 days. After returning to Earth, the peptides were analyzed and their stored data were retrieved perfectly, showing the robustness of peptides as a storage media even exposed to space radiations.

Further experiments will be performed in the near future. More peptides storing a larger amount of data are expected to be sent into space. Peptide designs and data-encoding methods will be continually improved with the ultimate aim of achieving the highest storage density and stability.

Overview of the process of storing and retrieving data into and from peptides

3) References to Research

Details of Key Research Grant:

"Data Storage and Retrieval using Peptides and Tandem Mass Spectrometry Sequencing", Research Impact Fund (Reference No. R5013-19). PC: Zhongping Yao, Co-PIs: Francis C. M. Lau, Henry H. M. Lam, Jiang Xia. Project period: 15th April, 2020 – 14th April, 2025

Patent:

Yao, Z.P., Ng, C.C.A., Lau, C.M. & Tam, W.M. US Provisional Patent Application No. 62/657,026 (Filed on 13 April 2018); PCT Application No. PCT/CN2018/119349 (Filed on 6 December 2018); US Non-Provisional Patent Application No.16/224,957 (Filed on 19 December 2018).

4) Impact and Benefits

The development of peptide data storage will produce a new media and method for data storage which could be much denser and more durable than current media, and may have benefits over other developing storage media. Having a data storage media with much higher storage density and longer durability has the potential to radically transform the data storage industry and the way we manage data. The organizations involving in data storage and retrieval, particularly those that generate big data and that need to archive data for a very long time are tremendously benefitted. Space agencies would be greatly benefitted, as massive amounts of data must be stored and managed in a confined area for long durations.

Currently, the cost per MB of peptide data storage is still much higher than conventional media, and the reading and writing speed is still too low for everyday usage. However, the technologies of peptide synthesis and peptide sequencing have been rapidly advancing, and the cost involved has been lowering exponentially in the last decade. Following this trend, in the near future, the cost may become low enough that commercialization of peptide data storage is possible, and it may be possible to store big data, such as the data generated in space missions, in vials of peptides.

5) References to the Corroboration of Impact and Benefits

Media Coverage:

香港中國通訊社,"港理大研發新一代數據存儲技術 將透過載人飛船進行太空試驗, 20-5-2020. URL: <u>http://www.hkcna.hk/content/2020/0520/827204.shtml</u>

星島日報,"理大研發新一代數據儲存技術",21-05-2020.

URL: https://std.stheadline.com/daily/article/2216073/%E6%97%A5%E5%A0%B1-%E6%95%99%E8%82%B2%E7%90%86%E5%A4%A7%E7%A0%94%E7%99%BC%E6%96%B0%E4% B8%80%E4%BB%A3%E6%95%B8%E6%93%9A%E5%84%B2%E5%AD%98%E6%8A%80%E8%A1% 93

Portal To The Universe, "Hong Kong PolyU Explores Use of Peptides in Data Storage for China's Next-Gen Human Spacecraft", 22-5-2020. URL: http://www.portaltotheuniverse.org/blogs/posts/view/728989/

京港學術交流中心,"理大研發新一代數據存儲技術透過國家新一代載人飛船進行太空試驗",26-5-2020.

URL: https://www.bhkaec.org.hk/a/112515-cht

ExcelxImpact (PolyU), "Big Data in a tiny package", 6-2020, Issue 1. URL: <u>https://www.polyu.edu.hk/publications/excelximpact/issue/202006/research-innovation/big-data-in-a-tiny-package</u>

Appendix 3: Technology Marketing and Networking Activities

(a) Highlights of Special Events

Date	Event	Photos
Aug 2019	Cross-over networking activity Three Poly-preneurs presented their products during a networking event connecting several communities including CEO Club, Poly- preneurs, startups and industry associations.	
Sep 2019	Poly-preneurs [®] Guided Visit to Sino InnoLab and Talk on Innovation & PropTech During this visit, the founder cum president of the Institute of Next Barcelona and senior management of Sino Group gave a sharing on innovations and PropTech.	
Sep 2019	Poly-preneurs [®] Sharing Series Seminar: 授幼兒管教錦囊 締造愉快成長歲月 In this event, 2 Poly-preneurs shared with the audience their practical experiences in running early childhood education business and exchanged expert knowledge with a professor from the Department of Applied Social Sciences.	Cartered and a set of a set

Date	Event	Photos
Oct - Nov 2019	Eco Expo 2019 PolyU exhibited a collection of its green technologies and its endeavours in bringing about a clean and sustainable environment.	
Oct - Nov 2019	The 71st International Trade Fair for Ideas, Inventions & New Products, Germany At this annual international event, PolyU garnered 4 awards with its 3 inventions in the areas of atmospheric acidic ultrafine particle measurement, light field-based object detection and distance measurement, as well as advanced indoor positioning.	<image/>
Nov 2019	China Hi-Tech Fair 2019 Our booth at the fair exhibited the expertise, professional services and research outputs of PolyU Shenzhen Base and its research facilities, with special focus on food safety and traditional Chinese medicine.	
Apr 2020	Strategic cooperation signing ceremony PolyU and Peng Cheng Laboratory (PCL) signed a collaborative agreement, aiming to jointly conduct research cooperation in the field of Big Data Analytics, Advanced Networks and IoT, AI and Robotics, Blockchains and Smart Health for the benefit of the national and social development.	

Date	Event	Photos
May 2020	CEO Club 化疫為機 以變應變 Webinar Series:防疫轉「營」	 ♦ VE CEO ♦ VE CEO ♦ VE CEO ♦ VE CEO ♦ VE E CEO ♦ VE CEO ♦ VE CEO ♦ VE CEO ♦ VE CEO ♦ VE CEO ♦ VE CEO ♦
	In this seminar, a professor specialised in nanofibre technologies from PolyU's Department of Mechanical Engineering introduced his novel invention for air and water purification and disinfection to the audience online.	E CEO ↔ I/E ↓E CEO ↔ I/E
May 2020	Smart Water Technologies: Leakage Diagnosis and Strategic Management The webinar promoted PolyU's expertise in the domain of water leakage diagnosis, and the Assistant Director from Water Supplies Department also shared about Government's challenges in water management and how PolyU's technologies helped solve the problems over the years.	Smart Water Technologie Biognosis & Strategie Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bible Bi

(b) Major Exhibitions and Tradeshows Participated

	Exhibitions / Tradeshows Participated	Location	Disciplines / Items Promoted
1.	Asia International Innovative Invention Award and Exhibition 2019	Hong Kong, PRC	Anti-counterfeiting technology
2.	Green I&T Day	Hong Kong, PRC	Green technologies
3.	Food Expo 2019	Hong Kong, PRC	Food safety technologies, food testing, etc.
4.	Innovfest Suzhou 2019	Suzhou, PRC	HVAC, healthcare, etc.
5.	Hong Kong Electronics Fair Autumn Edition 2019	Hong Kong, PRC	Electronics
6.	Eco Expo 2019	Hong Kong, PRC	Green technologies and researches
7.	71 st International Trade Fair for Ideas, Inventions & New Products	Nuremberg, Germany	Indoor positioning technology, air quality measurement system, and imaging technology
8.	China Hi-Tech Fair 2019	Shenzhen, RPC	Life sciences, healthcare, machining, etc.
9.	中巴高等教育展	Islamabad, Palestine	Healthcare and railway technologies
10.	2019 DMP Greater Bay Area Industrial Expo	Shenzhen, PRC	Power management, ultra-precision machining, anti-counterfeiting technology
11.	2 nd Asia Exhibition of Inventions Hong Kong	Hong Kong, PRC	HVAC

Appendix 4: PolyU InnoHub / Entrepreneurship Activities

In FY2019/20, there were 20 activities organised by PolyU InnoHub or jointly with local and regional partners and collaborators²:

Event	Date	Partnering Organization(s)
 RISE x PolyU University Fireside Chat: Journey of Paddy Cosgrave: Birth of the World's Largest Tech Event 	4 Jul 2019	RISE
 InnoHub Tour (浙江科技學院學生赴港交 流團) 	29 Jul 2019	-
3. Singapore Airlines AppChallenge Roadshow @Hong Kong: Driving Open Innovation	7 Aug 2019	Singapore Airlines
4. 2020 年度理大科技領航基金計畫(TLF) 深圳宣講會	29 Aug 2019	-
5. PolyU Orientation Info Day 2019	30 Aug 2019	-
6. 「理大深圳創業團隊&怡和集團」創新創 業交流會	5 Sep 2019	-
7. PolyU InnoHub x Entrepreneur First: Birth of The Future Tech Entrepreneur	24 Sep 2019	Entrepreneur First
8. PolyU InnoHub x HKAI Lab AI Technology and Opportunities in Hong Kong	25 Sep 2019	HKAI Lab
9. MEMSI 2020 - PolyU infosession	30 Sep 2019	MIT Innovation Node
10. Cyberport Recruitment Talk - Cultivating Innovators on Entrepreneurship and in Greater Bay Area	10 Oct 2019	Cyberport
11. PolyU InnoHub@Shenzhen 2019 創業團隊 交流會	31 Oct 2019	-
12. PolyU Entrepreneurship Parade 2019	5 Nov 2019	-
13. 「創投實驗室 Thursday Lab」第二期	12 Dec 2019	-
14. Hong Kong Techathon 2020 - Pre-mixer	14 Dec 2019	-
 15.「有"理"有我」PolyU InnoHub@Shenzhen 創業社群活動暨 PolyU Startup Booster 理 大科創研發支援服務簡介 	9 Jan 2021	-
16. Hong Kong Techathon 2020	10-12 Jan 2020	HKSTP, UST, HKU, CUHK, CityU, HKBU, LingU
17. CUPP 2020 - Briefing Session	6 Apr 2020	Cyberport
18. Challenges and Opportunities for Graduates Under the Epidemic	23 Apr 2020	PolyU Entrepreneurship Society
19. HKT x PolyU InnoHub - How to leverage Anti-Epidemic Fund for more business	15 May 2020	НКТ
20. 第十二屆深創賽深港澳高校預選賽理大首 場預熱活動「理大科技創新博士創賽交流 專場」	28 May 2020	第十二届深创赛深港澳高校预 选赛

 $^{^2}$ Excluding training programmes, local and regional outreaching events / activities like: HKTDC Electronics Fair (Autumn Edition), 2019 Meet Taipei and 2019 高交會創客展

Appendix 5: List of Patents Granted in FY2019/20

1.	一種力學行為可變的電磁分流阻尼器系統	China
2.	一種永磁電機	China
3.	一種可收納袖子的運動文胸	China
4.	一種機械式流體實驗水槽快速開門裝置	China
5.	一種多冗餘度機械臂系統的協同控制方法與裝置	China
6.	一種應力記憶高分子材料及智慧壓力裝置	China
7.	一種吊鉤高度檢測方法裝置	China
8.	一種吲哚骨架的膦配體及其製備方法和應用	China
9.	一種苯並咪唑-吲哚骨架的膦配體及其製備方法和應用	China
10.	一種基於鐳射退火工藝的發光紡織面料製備方法	China
11.	一種遙感影像變化區域檢測方法及裝置	China
12.	一種遙感影像變化檢測方法、裝置及終端	China
13.	一種融合多特徵的面向對象變化檢測方法	China
14.	一種傅裡葉鎖模雷射器	China
15.	三萜類化合物的應用和治療帕金森藥物	China
16.	手性三價金絡合物及其製備方法和應用	China
17.	無線網路的通道接入方法及裝置	China
18.	可折疊式水中多功能康復訓練裝置	China
19.	外骨骼踝關節機器裝置	China
20.	全短纖維複合結構紗的加工方法與設備	China
21.	抗菌化合物及其在紡織工業中的應用	China
22.	自復位黏滯複合阻尼器	China
23.	發光針織物和發光裝置	China
24.	地理國情監測資料的質量控制方法、裝置和終端設備	China
25.	高催化活性的基因改造梭菌屬神經毒素	China
26.	異戊烯基二氫黃酮類化合物在防治骨疾病領域的應用	China
27.	控制電路和高頻斷路器	China
28.	握姿人手圖像識別系統及其識別方法	China
29.	混聯拋光機床	China
30.	超聲輔助鐳射焊接異種材料	China
31.	單色經多色緯機織物的表面顯色和織造方法	China
32.	顧及資料不確定性的關聯規則顯著性檢驗方法及裝置	China
33.	磁場調製式混合勵磁電機	China
34.	蟾毒靈膠束納米製劑極其製備方法	China
35.	SAR影像變化檢測方法及裝置	China
36.	- 37. 圖像編碼方法及裝置	China
		Hong Kong
38.	Body-Sensing Tank Top with Biofeedback System for Patients	Hong Kong
	will Scollosis 具有用於忠脊性側凸的忠者的生物反饋系統的關意表。	
20	印脰战冈心 2D Indeer Modelling Method System and Davies based or	United States of America
37.	Point Cloud Data	United States Of America

40 54. A Three-dimensional (3D) Ultrasound Imaging System for	European Procedure
assessing scoliosis	(Patents)
	Belgium
	Czech Republic
	Germany
	Spain
	France
	United Kingdom
	Croatia
	Italy
	Netherlands
	Poland
	Portugal
	Romania
	Serbia (ex-Serbia &
	Montenegro)
	Sweden
55. An Improved Method for Preparing Aqueous MnO ₂ Ink and Capacitive Energy Storage Devices Comprising MnO ₂	United States of America
56. Biofeedback System with Body Mapping Clothing for Patients with Adolescent Idiopathic Scoliosis	United States of America
56. Client-Server Architecture for Multicore Computer System to Realize Single-Core-Equivalent View	United States of America
57. Exoskeleton ankle robot	United States of America
58 Hydrocarbon-Stapled Polypeptides for Enhancement of	United States of America
Endosome-Lysosomal Degradation	
59. Inductive Power Transfer Using Diverted Magnetic Field	United States of America
60. Interactive Exoskeleton Robotic Knee System	United States of America
61. Magnetic-Aided Electrospark Deposition	United States of America
62 65. Methods and Catalysts for Green Biodiesel Production from	Germany
Unrefined Low Grade Feedstock	European Procedure (Patents)
	France
66. Method Of Laser Joining Of Dissimilar Materials With Ultrasonic Aid	United States of America
67. Photocatalyst	United States of America
68. Preparation Of Nanostructured Titanium	United States of America
69. Preparation of Nanostructured Titanium at Cryogenic Temperatures for Medical Implant Applications	United States of America
70. Prodrug of Green Tea Epigallocatechin-3-Gallate (Pro-EGCG) for Use in the Treatment of Endometriosis	United States of America
71. Reversible wavelength channels for optical communication networks	United States of America
72 79. Temperature-compensated fibre optic strain gauge	Germany
	European Procedure
	(Patents)
	Spain
	France
	United Kingdom
	Italy
	Netherlands
	Turkey

Appendix 6: Highlighted Cases of Funded Startups

MEGA Automation

STEFG-PolyU China Entrepreneurship Fund 2018 Awardee

Background:

The management team and founders of MEGA are Hong Kong experts specialising in research and building controls. Building an Internet of Things (IoT) network with self-developed intelligent hardware, system and algorithms, the company provides a cloud platform for operation control, data monitoring & analysis and various value-added services for the big data of smart cities. The cloud platform is able to automatically regulate and optimise the operation of building's equipment and achieve the goals of energy saving and emission reduction.

MEGA's products and solutions have been applied to office buildings of a number of listed companies in Hong Kong, including Swire Properties, Henderson Land, CLP Power, etc.

Current Stage:

MEGA is actively expanding to China market and engaging with different mainland real estate developers. Recently, MEGA had completed the projects with the IDG Sports Accelerator in Shenzhen Bay and Gung Ho Space in Zhongshan.

Awards:

- TechConnect 2017 Global Innovation Award
- HKTDC & Angel Investment Foundation Hong Kong Value Creation for Technology Pitching Competition 2019 – Champion
- The Second Asia Exhibition of Inventions Hong Kong 2019 - Gold Medal

Blue Pin

Micro Fund 2018/19 Awardee, Lean Launchpad Programme 2018/19 Supported Startup and Tech Launchpad Fund 2019/20 Awardee

Background:

BluePin is a startup formed by a group of Hong Kong expertise, offering an effective indoor positioning system for different venues such as exhibition halls, shopping malls and commercial buildings. Compared with the existing solutions in the market, BluePin provides end-to-end effective solution to the customers with high cost efficiency and satisfactory user experience.

BluePin's solutions have been used in HKPCA & IPC Show in Shenzhen, InnoCentre and PolyU campus with positive customer feedbacks.

Current Stage:

Blue Pin has expanded the business by developing the positioning system for valuable tools and equipment. The new system has been installed in PolyU Industrial Centre and EMSD Headquarter recently.

Awards:

- Hong Kong X Foundation FYP+ Supporting Scheme 2018-19 – Top 3 Winners
- The 71st International Trade Fair for Ideas, Inventions & New Products (iENA 2019) Gold Medal

Hercz Rehabilitation Technology Limited Tech Launchpad Fund 2019/20 Awardee

Background:

Hercz develops medical devices and Scar Care products for the customers with hypertrophic Scar, Keloid and surgical scar problems. One of its well-known consumer products, the Smart Scar Care Pad is an invention of Professor Cecilia Li from Department of Rehabilitation Sciences, PolyU. The Smart Scar Care Pad can reduce pigmentation and vascularity, and improve hydration and elasticity of burn and trauma scars.

Besides, Hercz has supported research & development projects on apparel for patients with mastectomy, 3D printed face masks for burn survivors and pressure straps for management of children hand burns.

Current Stage:

Since its incorporation in 2018, Hercz has raised HKD1 million of further investment, apart from the funding support from the PolyU Tech Launchpad Fund 2019-20. Hercz has expended partnership distribution network from Hong Kong and Macau to Australia, New Zealand, Singapore and Malaysia.

Awards:

- 45th International Exhibition of Inventions of Geneva, Switzerland, Innovation Award 2017 – Gold Medal
- National Council of Rector, Romania Mar 2017 Innovation Award

Appendix 7: Awards won by PolyU Supported Startups

Startups / Startup Founders	Awards
ASA Innovation & Technology Limited	China Centre for Promotion of SME Development and Office of the Government Chief Information Officer - Merit Awards
(Tech Incubation Fund 2017-18 and Tech Launchpad Fund 2018-19 &	Dongguan Municipal People's Government - 最具市場潛力大獎
2019-20)	Hong Kong Exporters' Association - Hong Kong Smart Design Awards 2020 - Gold Award, Judge Award and Technology Award
Blue Pin Consulting (HK) Limited (Micro Fund 2019 & Tech	International Trade Fair for Ideas, Inventions & New Products (iENA) - Gold Award
Launchpad Fund 2019-20)	Hong Kong X Foundation FYP+ Supporting Scheme 2018-19 – Top 3 Winners
Building Integration Perfection Limited	2nd Asia Exhibition of Inventions Hong Kong (AEI) Gold Award
(Micro Fund 2012 and STEFG-PolyU China Entrepreneurship Fund 2018)	
NoMatterWhat Technologies Limited (Micro Fund 2018 and Tech Launchpad Fund 2019-20)	HKTDC Value Creation for Technology Pitching Competition – Merit Award
Pokeguide Limited	500 Startups - Kobe Accelerator
Launchpad Fund 2017-18 &	Accenture and Tokyo Government - Tech Business Camp Tokyo 2019
2019-20)	Devpost - COVID-19 Global Hackathon 2020 - Winner
Wendy Law Design Studio (Micro Fund 2019)	PolyU ITC - Techstyle for Social Good International Competition - Hong Kong Best Design Award
傲飛創新科技(深圳)有限公司	China Academy of Art - Design Intelligence Award (DIA)
(STEFG-PolyU China Entrepreneurship Fund 2016 and	China Hi-Tech Fair 2019 - Best Product Award
Tech Launchpad 2019-20)	DIA - DIA 中國設計智造獎 -佳作獎
	Shanghai Promotion Center for City of Fashion - 2019 Upstyle Award
	Shenzhen Baoan Industrial and Information Technology Bureau - Shenzhen innovation design competition – Gold Award