KNOWLEDGE TRANSFER

ANNUAL REPORT
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The Hong Kong University of
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Clear Water Bay, Kowloon, Hong Kong

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EXECUTIVE SUMMARY

The beginning of the 2019–2022 Triennium is challenging. In the midst of social incidents in Hong Kong and the COVID-19 pandemic, the Hong Kong University of Science and Technology (HKUST) continues to fulfill its mission to nurture and strengthen an innovative culture and entrepreneurial spirit to impact the society, with the vision of advancing innovation and entrepreneurship in Hong Kong, the Greater Bay Area (GBA) and beyond.

Sweeping across continents and claiming over 1 million lives to date, the COVID-19 pandemic represents the greatest threat to public health in a century. The HKUST community has wasted no time developing and undertaking innovative technologies and initiatives to fight the pandemic on all fronts, including the development and implementation of a smart fever detection screening system, the adoption of an automated geo-fencing technology used to establish an application "Stay Home Safe" to monitor the compliance of quarantine regulation by the Hong Kong Government, the deployment of autonomous vehicles designed to reduce human contact, and a novel long-lasting antimicrobial formula that can kill up to 99.9% of highly infectious viruses, all of which demonstrate vividly how HKUST translates research into practical applications.

In addition to technological inventions, HKUST continued to step up its efforts to transfer knowledge from the University to the general public despite the coronavirus pandemic. Over 2019–20, 500 knowledge transfer-related public lectures, workshops, seminars, public engagement activities, and 39 performances and exhibitions of creative works were organized. Despite having to organize some of the events virtually, the total number of attendees got an 81% increase compared with the previous year, which is a strong indication that HKUST shared its knowledge with a much wider audience base.

Unprecedented crises have posed severe challenges to different sectors in Hong Kong, among them local businesses have been hit hard particularly. To help the business sector overcome difficulties, HKUST has reinforced its existing gap funding and incubation programs, expanding the funding scope and introducing new entrepreneurial initiatives to support and encourage the growth of start-ups during these tough times. Such efforts included the launch of a HK$50 million HKUST Entrepreneurship Fund (E-Fund) to support the development of early-stage start-ups; the provision of a HK$5 million Bridge Gap Fund (BGF) to support technology commercialization; the allocation of total funding of over HK$1.2 million by the Dream Builder Funds (DBF) to over 60 student projects; and initiation of the TECHnopreneurSHIP (Tech-Ship) Program, the first of its kind in Hong Kong, to encourage matching between faculty and entrepreneurs. The number of HKUST active start-ups and spin-offs, supported by the entrepreneurship programs under Clear Water Bay (CWB) campus and Mainland platforms, reached 229, a 14% increase compared to the past year, of which 20% leveraged HKUST technologies.

Cultivating high-value Intellectual Property (IP) such as the antiviral coating technology in safeguarding public health, HKUST's IP income has got a 24% increase in 2019–2020 compared to last year, demonstrating the high value of the University's IP and its significant contribution to social impact. Seven joint institutes/centers were established to strengthen knowledge transfer (KT) processes, talent development, and research innovation, of which three units have approved a total of 21 translational projects, comprising funding of more than HK$46 million in the reporting year.

Along with the notable achievements in IP, the total income from contract research, consultancy and testing services, including projects initiated by HKUST's Mainland platforms, reached HK$106.7 million, amounting to a 17% increase compared to last year despite the hardship in 2019–2020. A HK$550.9 million was received for funding 132 collaborative research projects jointly conducted by local, Mainland China or overseas collaborators to strengthen KT infrastructure.

Beyond Hong Kong, the newly renovated Guangdong-Hong Kong-Macao International Youth Entrepreneurship Hub in Nansha, together with the Blue Bay and Blue Bay X (BBX) Incubators in Shenzhen, the HKUST Foshan Center for Technology Transfer and Commercialization in Foshan, have been serving as platforms to showcase HKUST's

entrepreneurship activities in the Greater Bay Area (GBA). Currently, HKUST Mainland Platforms support a total of 93 start-up and spin-off companies.

In line with the new Strategic Plan of the University, we will continue to incorporate innovation and entrepreneurship in our collective spirit. KT has always been a core part of HKUST's mission, read on to understand all the KT-related activities and achievements of HKUST over the year of 2019–2020.

INTRODUCTION

The HKUST Strategic Plan prescribes a three-pronged approach, comprising Education, Research (Basic and Applied) and Translational Activities (KT/Societal Contributions) to the University's five Strategic Areas in (1) Data Science, (2) Sustainability, (3) Public Policy, (4) Autonomous Systems and Robotics, and (5) Design Thinking and Entrepreneurship. KT has been a consistent element embedded within HKUST's mission and vision.

The beginning of the 2019–2022 Triennium has brought about unprecedented challenges. In the midst of social incidents in Hong Kong and the COVID-19 pandemic worldwide, HKUST has continued to fulfill our mission to enrich and expand our culture of innovation and entrepreneurship to benefit the society at large. Our strategic objective of becoming a powerhouse for innovation and entrepreneurship has remained steadfast.

IMPACT CASES ON HKUST'S CONCERTED EFFORTS IN FIGHTING THE COVID-19 CRISIS

HKUST LEADS GLOBAL EFFORTS TO TACKLE COVID-19

Sweeping across continents and claiming over 1 million lives by the end of September 2020, the COVID-19 pandemic represents the greatest public health threat for over a century. HKUST responded quickly and effectively to address the global COVID-19 crisis. Faculty members from various disciplines have been working tirelessly with the industry and government to deliver innovative solutions across the full spectrum of COVID-19 response — prevention, mitigation and treatment. HKUST's efforts to fight against COVID-19 is available at https://youtu.be/pryuhi6mBBA and https://publications.ust.hk/Fight_COVID-19.

The Public Affairs Office (PAO) of HKUST makes a video to illustrate HKUST's effort to fight against COIVD-19.

HKUST's effort in fighting the COVID-19 are highlighted below.

A SMART FEVER SCREENING SOLUTION

Detecting inbound travelers with fever, a key symptom of infectious diseases such as SARS and COVID-19, is one of the most important screening methods. Rising to this challenge, HKUST researchers led by Professor Richard SO from the Department of Industrial Engineering and Decision Analytics have developed a novel Smart Fever Screening System (SFSS) to help prevent those suspected of carrying the virus from entering Hong Kong by checking visitors' body temperature.

Prof. Richard SO (first left) and his research team members develop a new AI-based Smart Fever Screening System.

By the end of January 2020, soon after the COVID-19 outbreak, 16 SFSS devices have been deployed at major boundary control points including the Hong Kong International Airport, other public service facilities, and the HKUST campus. While the system does not store personal

data amid concerns about privacy infringement, it can be installed in hospitals, elderly care homes and schools to keep vulnerable people safe. HKUST is proud of the fact that SFSS is safeguarding public health in a more efficient manner. Originated as an Innovation and Technology Fund (ITF) Project sponsored by Thales Group, later being supported by the Bridge Gap Fund (BGF) and technopreneurial support by the Technology Transfer Center (TTC) team, this project is an excellent exemplar of KT from experience in crowd monitoring and decision analytics.

A NOVEL SOLUTION FOR QUARANTINE COMPLIANCE

Quarantine is an essential public health strategy for containing the spread of infectious diseases. It helps ensure people who may have been exposed to a virus not infecting each other. With most of Hong Kong's COVID-19 infections confirmed to be imported, the Government quickly imposed a mandatory two-week quarantine on people entering the city from overseas. People who are self-isolating are required to report their real-time locations via WhatsApp or WeChat regularly.

Developed from HKUST technology, StayHomeSave is used to monitor people under home quarantine since March 2020.

An HKUST technology, Geo-fencing, was nurtured by a team of researchers and engineers led by Professor Gary CHAN from the Department of Computer Science and Engineering (CSE), who also served as Director of Entrepreneurship Center (EC) during the period, is to address the difficulty of monitoring the people under compulsory home quarantine.

Seeking to reduce costs and improve user experience, Professor Chan and his team innovated and redesigned a smart technology called "Signature Home" that uses unique location data such as signal variations to create geo-fences — virtual boundaries for real geographical areas. By connecting to WiFi, cellular and Bluetooth signals emitted from a house or a quarantine center, "signature" can be detected accurately to show whether a user has left the designated dwelling place.

In 2016, this core technology was licensed to Compathnion Technology Ltd. (Compathnion), an HKUST technology start-up led by Professor Chan, to be redeployed as a new mobile app called StayHomeSafe. Paired with an electronic wristband, the app can accurately detect and keep track of users' locations. It was adopted by the Hong Kong Government in mid-March to reduce resources for monitoring those under compulsory quarantine. Since March 2020, the app has helped the Government monitor hundreds of thousands of people under home quarantine and is known to other countries. Funded under the Technology Start-up Support Scheme for Universities (TSSSU), Compathnion continues to access markets through various exhibitions and networking activities supported by HKUST.

AUTONOMOUS VEHICLES SERVE THE COMMUNITY DURING COVID-19 OUTBREAK

Delivering essential supplies to people who are in quarantine or risky environment is a critical issue under the COVID-19 pandemic. The autonomous car is an important and promising way to address this issue.

Professor Ming LIU invents the first autonomous car in Hong Kong.

In 2017, the first autonomous car in Hong Kong was invented by Professor Ming LIU, Associate Professor of the Department of Electronic and Computer Engineering (ECE) and CSE, and Director of the Intelligent Autonomous Driving Center. Building upon this success, Shenzhen Unity-Drive Innovation Technology Co., Ltd. (UDI), an HKUST-incubated start-up was founded by him a year later to provide intelligent unmanned vehicles for industrial use.

Tested extensively in the Foxconn industrial park and on the Huawei and SF Express campuses for navigating complicated routes which reached several hundreds of thousands of kilometers safely and smoothly, UDI's vehicles are equipped with all-terrain 3D imaging and sensor navigation technology, that give a chance to offer fast and accurate

contact-free means of distributing supplies like fresh fruit and vegetables, spraying disinfectant on streets and even broadcasting in severely affected areas during the COVID-19 pandemic in Shenzhen and Zibo of the Shandong province.

As a faculty member, Professor Liu and his research group, one of the first in the world to implement deep reinforcement learning with real robots, have received unfailing support from HKUST's Blue Bay X (BBX), a newly established incubator in the Futian Bonded Zone for its comprehensive facilities and services walking UDI from innovation to acceleration.

A GOLD STANDARD FOR DISINFECTION EFFICIENCY

Testifying their vital role in mitigating the risk of COVID-19 transmission, sales of hand sanitizers and surface disinfectants have rocketed during the pandemic. It is urgently necessary to develop effective and long-lasting community-level disinfection measures to buy time for epidemiologists and virologists to devise a longer-term, and hopefully permanent, solution to the crisis.

Taking an important step forward in this direction, a team led by Professor King-Lun YEUNG, Professor of the Department of Chemical and Biological Engineering (CBE) and Division of Environment and Sustainability, has developed a new antiviral coating, Multilevel Antimicrobial Polymer (MAP-1), that could be a game-changer in the sector.

Prof. King-Lun YEUNG from HKUST's Department of Chemical & Biological Engineering; Prof. Joseph KWAN, Adjunct Professor from the Division of Environment & Sustainability and Mr. Hamilton HUNG, Chief Marketing Officer of HKUST's industrial partner Chiaphua Industries Ltd. present the multiple opportunities in applications of the new coating formula MAP-1.

The development of this ground-breaking technology is the best example of cooperation between academia, industry and the Government. The HKUST-CIL Joint Laboratory of Innovative Environmental Health Technologies established by HKUST and Chiaphua Industries Ltd. (CIL) in May 2018 has successfully translated research on innovative environmental technologies into actual applications. MAP-1, being a potent solution for infection control, was then licensed exclusively to CIL for producing hand sanitizers and disinfectants for surfaces including fabrics and textiles in 2019. This successfully commercialized technology signifies as the most recent HKUST's lab to market accomplishment in our knowledge transfer journey, which benefits the society at large.

During the pandemic, this coating technology has been applied in more than 1,000 venues including daycare centers, elderly homes, schools and shopping malls, covering a total area of over 2 million square meters, with 99% of bacteria being inactivated. As collaboration continues, CIL has donated nearly HK$1.5 million worth of antimicrobial air filters, a powerful air purification technology developed by Professor Yeung's team in 2017, to various hospitals and schools in Mainland China, including Wuhan's emergency Huoshenshan Hospital.

NURTURING TECHNOPRENEURSHIP: STRENGTHENING ENTREPRENEURIAL CAPABILITIES AND START-UP INCUBATION/ACCELERATION

HKUST has paved a comprehensive start-up road for our entrepreneurs by synergizing and integrating various gap funding and entrepreneurship programs. We have played significant complementary roles at different stages of the entrepreneurial technology transfer chain, from innovation creation to building business start-ups based on HKUST projects. The TECHnopreneurSHIP (Tech-Ship) Program encourages matching between faculty and entrepreneurs while the BGF assists in building value around early-stage technologies and readying them for commercialization. Outstanding proposals from the BGF and the Dream Builder Funds (DBF) will be identified to nurture candidates for the TSSSU and the HKUST Entrepreneurship Fund (E-Fund). In addition to being incubated under the HKUST Entrepreneurship Program (EP), the University network will be leveraged to link the TSSSU and EP companies with potential business partners,

such as the incubation programs of the Hong Kong Science and Technology Parks Corporation (HKSTP) and Hong Kong Cyberport Management Company (Cyberport). By combining these programs with other entrepreneurial efforts on the University's campuses, such as entrepreneurship training and education programs, mentoring and incubation programs hosted by HKUST's Clear Water Bay (CWB) campus and Mainland platforms, the University strives to nurture the next generation of talented, responsible leaders to serve society by developing technological and scientific innovations.

TECHnopreneurSHIP (Tech-Ship) Program

To maximize the commercialization potential of HKUST technologies, the Entrepreneurship Center (EC), in collaboration with TTC and the Schools, has introduced the Tech-Ship Program that bridges and brings together faculty technologies and entrepreneurial students for technology-entrepreneurship development. Exclusively initiated by HKUST, the Program has been well supported by the Schools and faculty members with 162 students and alumni and 16 faculty technologies/research outcomes being put forward in just three months from April to June 2020, resulting in over 30 technopreneur partnerships. Riding on the positive result, further TECHnopreneurSHIP partnerships are being developed.

The TECHnopreneurSHIP Program offers matching between HKUST faculty and student entrepreneur.

Bridge Gap Fund (BGF)

In 2019–2020, HKUST launched the HK$5 million Bridge Gap Fund (BGF) in April 2020, a repositioned version of the Proof-of-Concept Fund (PCF), to facilitate performing technology validation in the pre-commercialization stage. BGF intends to strengthen PCF to facilitate HKUST technology towards commercialization by enriching the technology pipeline at HKUST for industry collaboration and/or adoption, or forming start-ups, thus enhancing the

Bridge Gap Fund, a repositioned version the Proof-of-Concept Fund is launched in April 2020 to facilitate technology commercialization.

willingness of HKUST research teams to participate in research and development (R&D) for commercialization. It also aims at creating more viable IP from HKUST's technology by promoting more translational research. BGF also works with the "Sustainable Smart Campus as a Living Lab" (SSC) for the provision of educational components. Thirty-four applications were received and 11 projects were supported with up to HK$0.5 million each. Out of the 11 projects, three projects that fulfill the criteria of SSC are supported with an additional seed grant of HK$0.1 million each.

HKUST Entrepreneurship Fund (E-Fund)

After a soft launch in August 2019, the E-Fund entered full operation in 2019–2020, with funding of HK$50 million to support the development of early-stage HKUST start-ups. In preparation for implementing the E-Fund's Co-Investment Model, 12 private co-investment partners, including institutional investors (both financial VC funds and corporate VC funds) and family offices/funds, were approved, and memorandums of understanding (MoU) were fully executed. In addition, under the HKUST-Initiated Investment Model, the E-Fund engaged 12 international advisors to offer guidance or advice on due diligence for investment during Investment Sub-Committee meetings. The advisory pool includes external VC experts and academic/faculty members, all with

The HKUST Entrepreneurship Fund (E-Fund) aims to provide support to promising early-stage HKUST technology start-ups.

tremendous experience in early-stage investment and/or technical backgrounds in different focal areas of technology. After assessing more than 70 companies, the E-Fund eventually selected to invest in three HKUST start-ups (Dayta AI

Ltd., D-Engraver Ltd. and SPES Tech Ltd.), with others currently under review. Encouragingly, the three are all HKUST Dream Builder Funds (DBF) and TSSSU awardees, showing the effectiveness of DBF and TSSSU funding in developing values in the KT chain. To facilitate collaboration and matching, the E-Fund website was recently launched to reach out to both start-ups and VC firms.

HKUST DREAM BUILDER FUNDS (DBF)

The DBF, comprising the HKUST Entrepreneurship Acceleration Fund (EAF), the Yeung Wing Yee Entrepreneurs Fund (YWYEF), the Alumni Endowment Fund (AEF) and the U*STAR Award (which was revamped in 2019 to synergize with the other funds), is one of the major sources of fund in the "Technologies & Entrepreneurship Eco-system@CWB" that offers students and faculty members financial support up to HK$0.2 million for different stages of entrepreneurship development and pave their way for a higher level of success such as receiving the TSSSU and E-Fund. In 2019–2020, over 60 innovation projects and HKUST start-ups were given over HK$1.2 million for pursuing their entrepreneurial development with guidance and support by EC.

Under the HKUST Dream Builder Funds, different funds are available to support various entrepreneurship developments.

TECHNOLOGY START-UP SUPPORT SCHEME FOR UNIVERSITIES (TSSSU)

The TSSSU was introduced by the Innovation and Technology Commission (ITC) in 2014. Recently, the ITC doubled the annual funding support to HK$8 million effective from 2019. In 2019–2020, 41% of the TSSSU awardees in 2019 are using HKUST technology and around 71% of the awardees have entered incubation programs organized by the HKSTP and Cyberport. The majority of these start-ups, around 88% of awardees, received external fund, and approximately 100 job and training opportunities were created by the awardees in the reporting year. Furthermore, the TSSSU 2020 attracted 43 applications, bringing the total number of TSSSU funding applications in the last seven years to 270. In the TSSSU 2020,

The HKUST provides support for home-grown entrepreneurs via the TSSSU Program.

14 start-ups were recommended to the ITC by the HKUST vetting committee, bringing the total number of HKUST affiliated TSSSU start-ups to 62.

HKUST ENTREPRENEURSHIP PROGRAM (EP)

Established in 1999, the EP has been providing support to establish technology-based start-ups among HKUST communities. Sixty-three technology start-ups were formed at the CWB campus with the help of the Program, of which five are in incubation while 58 have graduated from the Program. After the renovation of the incubation space at the CWB campus, the EP will be revamped to provide practical support such as human resources, finance/accounting, legal advice, mentorship to start-ups, and attracting and cultivating potential incubatees.

The HKUST Entrepreneurship Program (EP) is managed by the Hong Kong University of Science and Technology R and D Corporation Ltd. (RDC).

A campus-wide culture of innovation and entrepreneurial spirit is cultivated through a variety of entrepreneurship initiatives mentioned above, with an emphasis on technopreneurship focusing on start-ups built on HKUST technologies. By licensing HKUST technologies to promising start-ups, HKUST transforms its research output into products and services for public benefit. In 2019–2020, the number of HKUST active start-ups and spin-off reached 229, among them 20% leveraged HKUST technologies.

CONNECTING START-UPS TO THE MARKET

HKUST has been providing opportunities for affiliated start-ups to participate in marketing events, enabling them to showcase their products to potential customers. Below are some highlights of selected marketing events.

Start-up Launchpad October 2019: Dayta AI Ltd., an HKUST start-up providing cost-effective artificial intelligence (AI) solutions, showcased its cutting-edge technologies and products at the exhibition. Meeting potential collaborators at the show gave the teams opportunities to bring their technologies to stadiums in South Africa.

Dayta AI Ltd. showcases their product at the Start-up Launchpad October 2019.

Eco Expo Asia 2019: Over 300 exhibitors from 17 countries and regions, including two notable exhibitors supported by HKUST, Acoustic Metamaterials Group Ltd. (AMG) and Ocean Science (Hong Kong) Ltd. (Ocean Science) gathered at the exhibition to showcase their latest green products, equipment, and pioneering technologies. Focusing on noise problems, AMG provides soundproofing solutions and products using "metamaterials", a new class of multifunctional materials, while Ocean Science uses a high-efficiency, environmentally friendly marine antifouling agent to address marine ecological damage and other types of marine pollution.

HKUST supports two start-ups to join the Eco Expo Asia 2019.

Singapore Week of Innovation and TeCHnology (SWITCH): In addition to supporting start-ups' participation in trade shows, HKUST is committed to introducing home-grown researches and technologies to the world by featuring inventions from three main areas: (1) biotechnology, (2) electronics, information and communication technology, and (3) smart materials. Over 30 HKUST's pioneering inventions have been showcased in SWITCH, of which a live demonstration of a water distillation system drew the most attention and brought in many follow-up inquiries. One of the major organizers, Intellectual Property Intermediary of Singapore, visited the HKUST booth for this demonstration and assigned a manager to follow up on this technology's development. In addition, Apple Singapore Office expressed interest in an HKUST-developed location-sensing technology.

The live demonstration of a water distillation system developed by HKUST attracted huge attention at SWITCH.

HKTDC SmartBiz Expo 2019: Four HKUST start-ups showcased their services and products at the HKTDC SmartBiz Expo 2019. Designed to equip small and medium-sized enterprises for global growth, the event's Tech Zone offered the selected start-ups wider exposure and opportunities to connect with potential collaborators. By allowing HKUST start-ups to introduce their products and services to visitors, cutting-edge technologies from HKUST has been introduced to demonstrate commitment to supporting its start-ups.

HKUST supports four start-ups to join the HKTDC SmartBiz Expo 2019.

TECHNOPRENEURSHIP START-UP HIGHLIGHT: AQUMON BY MAGNUM RESEARCH LIMITED — ROBO-ADVISOR

Co-founded by alumnus Dr. Don HUANG of the Department of Mathematics, Magnum Research Limited was established in 2015 to revolutionize the concept of wealth management by bringing automation, transparency, and cost-efficiency to the process. The company developed AQUMON, a robo-advisory engine with unique algorithm-based technology. AQUMON optimally designs the portfolio allocation according to the risk preference of the investors, thus making global asset allocation affordable to regular investors.

Being the first "robo-advisor" with licenses granted by the Securities and Futures Commission of Hong Kong, AQUMON delivers robust services to both financial institutions and retail investors and let them benefit passively from global economic growth. After five-year-endeavor, AQUMON's intelligent investment engine has ranked first in Asia in terms of coverage of financial institutions with around 10 million end-users.

A robo-advisory engine to assist clients in global asset allocation developed by a HKUST Start-up - Magnum Research Limited.

2020 is a remarkable year for AQUMON. As much as how the COVID-19 pandemic has impeded the development of many traditional business activities, robo advisors have gained growth with the industry's digitization trend. The number of downloads of AQUMON got a 300% increase in 2020 compared with the previous year, making it one of the largest online investment advisory platforms in Hong Kong. AQUMON has recently closed the Pre-B round investment with over US$30 million, the largest round of investment of the digitalized wealth management industry.

HKUST has provided the company with incubation space through HKUST Entrepreneurship Program (EP) while HKUST Business School (SBM) and the Department of Mathematics (MATH) help recommend talented students to join the company.

STRENGTHENING KT INFRASTRUCTURE

FOSTERING THE CULTURE OF RESEARCH EXCELLENCE

In 2019–2020, HKUST received HK$550.9 million for funding 132 collaborative research projects to be jointly completed by local, the Mainland, and/or overseas collaborators.

InnoHK Research Scheme

Through the InnoHK research scheme, a major initiative of the Hong Kong Government to turn the city into a hub for global research collaboration, HKUST proposals for two research centers were awarded a total of HK$805 million. Within the scheme's Health@InnoHK research cluster, Professor Nancy IP, the Vice-President for Research and Development, is set to receive HK$503.5 million over five years to establish the Center for Neurodegenerative Diseases in Hong Kong with top-notch universities including Stanford University of Medicine and University College London. The center will focus on Alzheimer's disease, a prevalent form of dementia affecting almost 47 million people worldwide. Under AIR@InnoHK, Professor Zexiang LI (ECE) will be awarded

HKUST strives to originate frontier research by developing research strengths in a number of research areas.

HK$301.5 million for his five-year project to set up the Hong Kong Center of AI, Robotics, and Electronics (HK CARE) for Prefabricated Construction with the University of California, Berkeley and Tsinghua University.

Theme-based Research Scheme projects

A five-year project, led by Professor Guanghao CHEN, Chair Professor of the Department of Civil and Environmental Engineering and his team, with the joint effort from five local universities and two overseas institutions, was funded HK$30 million for improving the reuse efficiency of wastewater by combining novel membrane, chemical and biological treatment, and resource recovery technologies, to produce potable water, recover biochemicals from saline wastewater while generating minimal undesirable brine and sludge.

Collaborative Research Fund projects

Professor Jianan QU (ECE) was funded HK$2 million for building a high-res 2-photon microscope with adaptive optics for in vivo imaging of brain structures in living animals. HK$3.72 million was granted to Professor Xuhui HUANG from the Department of Chemistry (CHEM) to set up a cluster with more than 460 state-of-the-art GPUs applications that require single-precision calculations, such as molecular dynamics simulations and whole-genome sequencing analyze. Besides, HK$6.03 million is granted to Professor Henry YAN (CHEM) to create efficiency-improved non-fullerene organic solar cells.

Hong Kong Jockey Club Charities Trust project

HK$13.03 million was granted for Professor Gary CHAN (CSE) to co-develop with the Jockey Club Center for Positive Ageing and St. James' Settlement a cost and battery-efficient GPS iBeacons-based mobile crowdsourcing system for tracking dementia patients. It is expected to serve around 100,000 patients and their care-givers.

Projects Funded by Ministry of Science and Technology (MOST) in Mainland China

MOST continues to be a major project fund source in Mainland China: RMB25.6 million for Professor Mingjie ZHANG from the Division of Life Science (LIFS) to set out a project involving around 60 personnel from one local entity and five institutions in Hong Kong and Mainland China. Professor Yu CHEN (LIFS) and his expert team from Shanghai, Beijing, London, and HKUST have also, through the University's Shenzhen Research Institute (SRI), secured HK$12.34 million to perform multidimensional analysis of biomarkers for Alzheimer's disease in the Chinese population.

SET UP HONG KONG'S FIRST INSTITUTE OF SYNTHETIC BIOLOGY

HKUST has received a donation pledge from the Li Ka Shing Foundation to establish Hong Kong's first institute of synthetic biology. As the world's population is increasing, the institute is expected to become a global hub for education, research, and entrepreneurship in this emerging interdisciplinary field, placing HKUST and Hong Kong at the forefront of efforts to innovate, develop, and commercialize biotechnological solutions to meet the challenges of supply and sustainability in every area of life.

Mr. LI Ka-Shing, Chairman of Li Ka Shing Foundation (left) pledged a donation to establish an institute of synthetic biology.

TECHNOLOGY TRANSFER ENDEAVORS

INVENTIONS, PATENTS, INTELLECTUAL PROPERTIES, CONTRACTS, AND SERVICES

HKUST has tirelessly sought to develop a comprehensive and robust intellectual property (IP) portfolio critical to its KT missions. Through its business arm, HKUST R and D Corporation (RDC), the University has partnered with the private sector in a wide spectrum of technology areas. RDC's total income through contract research, consultancy, and testing services, including projects initiated by HKUST's Mainland platforms, reached HK$106.7 million in 2019–2020, a 17% increase compared to the previous year.

LICENSING AND RELATED ACTIVITIES

HKUST has been proactively exploring channels and opportunities for IP licensing to the commercial sector. Besides RDC's licensing activities, HKUST is also a pioneer in the Massive Open Online Course (MOOC). Since the start of this initiative, 56 HKUST

Significant impact cases of HKUST in fighting the COVID-19.

MOOCs are featured on Coursera and edX through partner license arrangements, with 2 million enrollments recorded. Apart from individual courses, HKUST also offers content customization in Fintech, Web and Mobile App Development, and Business English. Together with the licensing income generated from MOOCs and the Mainland platforms, the

overall licensing income of the University in 2019–2020 was HK$8.9 million, a 24% increase compared to the previous year, demonstrating that HKUST's IP is of high value, which contributes significant social impact. Impact cases of HKUST's contribution to fighting the COVID-19 pandemic were illustrated on P.2-4.

Significant figures of KT regarding inventions, patents, licenses, IP, contracts, and services are listed below.

Invention Disclosures	New Patent Applications Filed & Granted	Cumulative Active Pending Patent Applications and Granted Patents	No. of Active Licensing Agreements
147	286 / 74	1,673	113
IP Licensing Income Generated (*Cash Received*)	MOOC Licensing Income (*Cash Received*)	Contract Research & Income Generated (*Cash Received*)	Consultancy Projects & Income Generated (including Analytical & Testing Services) (*Cash Received*)
HK$6.3 million	HK$2.6 million	218 / HK$100.8 million	369 / HK$6.0 million

In order to optimize the development of our patent portfolios, a new IP management team (IP team) was set up and headed by a professional IP Head to identify strategically and engage disruptive potential IP for commercialization opportunities in a timely manner. On the other hand, the Cluster Technology Business Development team (BD team) would work more aggressively with industry partners, especially for those who have extending partnership with HKUST, to strengthen industrial collaboration. A variety of technopreneurship programs are also offered to encourage technology utilization from technology based start-ups. The entrepreneurship initiatives taken by HKUST have been portrayed on P.4-7 and P.16.

CULTIVATING AN INNOVATION AND ENTREPRENEURSHIP ECOSYSTEM

Entrepreneurship is an important and integral component of KT at HKUST. In addition to offering entrepreneurial education and training to students, HKUST also provides different platforms to support entrepreneurial endeavors for our faculty, students and alumni in the effort to foster entrepreneurial spirit. Working together with Schools, faculties and other HKUST units at the CWB campus as well as through Mainland platforms, the EC is responsible for cultivating student entrepreneurial spirit, creating a vibrant entrepreneurial ecosystem, and connecting resources, technologies and people for entrepreneurial endeavors that bring value to local, regional and global communities.

MENTORHUB@HKUST

The newly launched MentorHUB@HKUST (mentorHUB) offers a more dynamic and effective mentorship model and experience by allowing participants to access to multiple mentors and mentees according to their interests, developmental needs and stage, anytime and anywhere, resulting in real-time feedback and just-in-time outcome to facilitate start-ups' growth within six months. In 2019–2020, with 56 veteran mentors, the mentorHUB attracted 159 mentees from 64 start-up teams across 11 fields and industries.

The MentorHUB@HKUST is launched in 2019–2020.

ONE-MILLION-DOLLAR ENTREPRENEURSHIP COMPETITION 2020

HKUST runs the One-Million-Dollar Entrepreneurship Competition in eight regions in China – Hong Kong, Macao, Beijing, Guangzhou, Shenzhen, Zhongshan, Foshan, and the Yangtze River Delta, which is an important cradle of successful start-ups across borders.

In 2019, a total of 1,265 teams participated in the regional competitions of which 35 outstanding regional teams entered the Competition's Grand Final held on September 6, 2019 in Nansha. The Grand Final winner went to "eFlexPV Ltd." (eFlexPV), a team led by Professor Henry YAN (CHEM). Riding on the patented technology, the team continues to develop highly efficient and stable third-generation organic photovoltaic (OPV) materials, devices and modules. The team was also one of the awardees of TSSSU in 2019–2020 and a successful TECHnopreneurSHIP start-up.

The regional competitions were largely supported or sponsored by different commercial partners, governmental agencies such as the Sino Group, the Bank of China, the China Construction Bank, Hicore Tech, GF Securities, the Shui On Group, the Mills, Yunzhou Technology, TianAn-cyber Park, and universities, etc.

FlexPV Ltd. wins the championship at the HKUST-Yuexiu Group One-Million-Dollar Entrepreneurship Grand Final Competition 2019.

H² INNOVATION CHALLENGE

An online competition took place during the COVID-19 pandemic that aims to stimulate students' creativity in developing ideas in smart aging and gerontechnologies for the silver hair market in the GBA. Eighty-six teams consisted of 299 contestants from 18 nationalities, and 21 tertiary institutions located in five cities/regions took part in the competition. The winning ideas have been adopted by Humansa of the New World Development for their gerontechologies business. It is another real example of collaboration and effective integration of student innovation with the commercial sector through entrepreneurship events.

H² Innovation Challenge aims to stimulate students' creativity in developing ideas in smart aging and gerontechnologies.

HONG KONG TECHATHON 2020

Hong Kong Techathon 2020 is a joint initiative from the Hong Kong Science and Technology Parks Corporation (HKSTP) and local universities to encourage innovative ideas and provide funding opportunities.

Co-organized by HKSTP, HKUST, and other six local universities, this 42-hour challenge enabled programmers, engineers, designers, marketers and entrepreneurs to work collaboratively over a weekend to develop ideas and prototypes and pitch for seed fund and incubation support. HKUST members have again demonstrated a strong entrepreneurial spirit and ability, with 30% out of the 260 participants was HKUST students, and 8 out of the 12 winning teams (2 out of 3) were HKUST members.

The first virtual banking hackathon invited over 20 alumni mentors and industry practitioners to render support.

HKUST SATELLITE ACTIVITIES IN SUPPORT OF HONG KONG FINTECH WEEK

Committed to nurturing talent for the finance industry's advancement, HKUST Business School (SBM) unveiled a series of activities for students and the industry to support InvestHK's Fintech Week 2019. The first was an industry panel on "Banking 4.0," delivered in partnership with the Fintech Association of Hong Kong, which attracted nearly 100 alumni and industry attendees. The School then organized Hong Kong's first virtual banking hackathon, Bizkathon@HKUST. Sponsored by three virtual banks, the event challenged 25 teams to develop innovative trust-winning and automation solutions in just 24 hours. Finally, the Blockchain Business Model Challenge was held for recruiting teams from HKUST and other institutes to deepen the understanding of blockchain technology and foster fintech development in Hong Kong.

REINFORCING INDUSTRIAL ENGAGEMENT AND COLLABORATION

JOINT RESEARCH UNITS WITH INDUSTRIAL PARTNERS

In 2019–2020, seven joint institutes/centers were established to reinforce KT processes, talent development, and research innovation, of which the HKUST-Bright Dream Robotics Joint Research Institute (HBJRI), the HKUST-Kaisa Joint Research Institute (HKJRI) and the HKUST Collaborative Innovation Center (HCIC), have supported 21 projects, comprising more than HK$46 million.

HKUST-Kaisa Joint Research Institute (HKJRI): HKJRI is established in collaboration with Kaisa Group Holdings Ltd. to support translational development in new materials, Internet of things (IoT), fintech, and healthcare. HKJRI has supported 5 projects in new materials and IoT with a fund amount of HK$14.4 million.

HKUST and Kaisa Group Holdings Ltd. (Kaisa) establish the HKUST-Kaisa Joint Research Institute (HKJRI).

HKUST and Guangdong Bright Dream Robotics (BDR) establish the HKUST-Bright Dream Robotics Joint Research Institute (HBJRI).

HKUST-Bright Dream Robotics Joint Research Institute (HBJRI):

In 2018, HKUST received a HK$200 million donation from Guangdong Bright Dream Robotics (BDR), a wholly-owned subsidiary of Country Garden Holdings Company Ltd., to set up the HBJRI, for carrying out "smart living" research in construction and restaurant robotics, AI, and big data, thus supporting the transition of Hong Kong and the GBA into a knowledge-based economy. HBJRI supported a total of 11 projects with fund amount of HK$27 million in HKUST and Guangzhou HKUST Fok Ying Tung Research Institute (FYTRI).

HKUST Collaborative Innovation Center (HCIC):

Jointly established with the Beijing Institute of Collaborative Innovation (BICI), the HCIC was set up in June 2020 to provide proof-of-concept funding for projects with the potential to translate into commercialized products, with focuses on advanced materials and devices, electronics and devices, energy and the environment, healthcare, and intelligent systems and robotics. This arrangement has led to an agreement for project funding between HKUST and the Greater Bay Area Institute

Student Orientation Session of the 2020 Pilot Innovation Leader Program

of Collaborative Innovation (GICI), established by the BICI, Guangdong Government, and leading universities in the GBA. HCIC supported a total of 5 projects with a fund amount of HK$5 million.

HKUST becomes the first Asia-Pacific university to partner with EY to participate in the development of the EY Advanced Technology Tax Lab.

FIRST ASIA-PACIFIC UNIVERSITY TO PARTNER WITH EY ADVANCED TECHNOLOGY TAX LAB

HKUST has become the first Asia-Pacific university to partner with EY, a global leader in professional services, to participate in the development of the EY Advanced Technology Tax Lab. Bringing together experts in data science, machine learning, and business research, this unique collaboration will facilitate joint research and technology development to solve complex real-life tax issues. With the digitalization of the tax profession, HKUST and EY will helm efforts to apply advanced and emerging technologies to the collection, analysis, and sharing of digital tax data. The partnership also offers internship and employment opportunities for HKUST students as well as exchange opportunities for faculties.

DELOITTE CHINA'S "BEST MANAGED COMPANIES" PROGRAM

The School of Business and Management (SBM) has been participating in Deloitte China's "Best Managed Companies (BMC)" Program as the sole Strategic Knowledge Partner since 2018. After rigorous reviews, interviews, and specialist research, 23 Mainland China private companies across different sectors were selected as the inaugural China Best Managed Companies winners in 2019. Supported by SBM, Deloitte China conducted a nation-wide survey on the enterprise management and operation of private companies across different industries in Mainland China and released its first Whitepaper on China Best Managed Companies in 2019.

Faculty of HKUST presented the survey on the tech landscape in Greater China.

ENHANCING COMMUNITY ENGAGEMENT

HKUST has been organizing events for industry practitioners, the private sector and the public as part of its KT endeavors. In the reporting year, it organized 500 public lectures, workshops, seminars and public engagement activities, along with 39 performances and exhibitions of creative works.

The sudden outbreak and widespread of the COVID-19 caused the cancellation of a number of events. Striving to maintain "Business as usual" and even stay ahead by adopting innovation during the pandemic, HKUST reacted quickly to cope with the dilemma by switching the events online. Without restrictions of venue and even border, virtualizing the events such as the "Online talks - Dialogue with Deans on Future Perspectives" organized by the SBM, the One-Million-Dollar Entrepreneurship Competition and its sub-events, can accommodate more participants of different ages and nationalities, making the total number of attendees surged to 4.6 million, an 81% increase compared with the previous year. With a significant increase in the number of participants, HKUST can disseminate knowledge to more people and thus benefit the general public to a large extent. Highlights of HKUST's community engagement activities in 2019–2020 are provided below.

STEM + E CONSORTIUM 2020

Organized by the STEM+E Consortium comprised of SBM members, HKSTP, and six prominent local secondary schools, over 70 secondary school students have joined the Program to gain exposure to innovative technologies and key challenges faced by environmental protection initiatives, technology commercialization, and adoption. Kicked off in January 2020 with a design thinking workshop and start-up team pairing, the Program proceeded with KT and business consultation meetings and concluded with the final pitch in May 2020, where the teams presented their proof-of-concept business plans to the judging panel. Since its inception in 2018–2019, the Program has laid the foundation for more collaborations to cultivate an innovation and entrepreneurship culture among secondary students in the future.

The STEM+E Consortium 2020 kick-off ceremony on January 18, 2020.

HKUST's two humanoid robots performed a dance with music at the Intelligent Robot Contest 2019 in Seoul.

CHAMPION IN SPORTS DANCE CATEGORY OF INTELLIGENT ROBOT CONTEST IN SEOUL

Showcasing two humanoid robots dancing K-pop, the HKUST Robotics Team was crowned champion in the sports dance category of the Intelligent Robot Contest 2019 in Seoul. This was the first time a Hong Kong team won in this category, defeating high-performing competitors from Japan, Korea, Canada, and Mainland China. Being praised for robots' stability and rhythmic precision, the winning Humanoid Team comprised five engineering undergraduates who collaboratively deployed their knowledge and experience gained at HKUST to design robotic dance moves and match them to an appropriate song.

HKUST President's Cup Won by AI-based Lip Reading Device

The HKUST President's Cup, which rewarded undergraduate students' innovation, was awarded in 2019 to the first-ever wearable lip-reading device. Invented by two second-year students, with Professor Brian MAK (CSE)'s support, this AI-based device circumvents the limitations of audio-based hearing aids by relying solely on visual information. It is named "Helen" after Helen Keller, who overcame the challenges of being blind and deaf to become one of the twentieth century's leading authors and activists. Assisted by HKUST, the two student entrepreneurs are now busy improving the device's usability, with the ultimate goal of launching "Helen" as a commercial product.

Two second-year students won the top prize in the 2019 HKUST President's Cup.

Hong Kong's First E-Verified Certification Platform Based on Blockchain Technology

HKUST has launched a novel blockchain-based platform named "Blockcerts" to authenticate official documents such as graduation certificates and academic transcripts. The innovative platform is expected to set the trend among Hong Kong universities to promote a paperless and sustainable campus and tackle the problem of academic forgery. By the end of July 2020, HKUST graduates will begin receiving cryptographically signed and tamper-proof e-versions of their graduation diploma certificates. Part of HKUST's SSC campaign, the Blockcerts initiative has received strong support from employers and the industry as

HKUST faculty demonstrates how different HKUST documents can be verified using different devices.

a highly secure, user-friendly, and environmentally sustainable alternative to the conventional paper verification process.

Active Mainland Engagement

HKUST (Guangzhou) Campus Moves Forward

Riding on the "Unified System, Complementary Campuses" Framework, the new Hong Kong University of Science and Technology (Guangzhou) (HKUST(GZ)) campus in Nansha creates an exceptional opportunity for the University to seize and develop to the next level of excellence to integrate HKUST's mission and priorities holistically, with KT as one of the three focuses. The two campuses will be treated as living laboratories, conducive for all members to be bold and committed to the world's collective future, with priority given to projects addressing "grand challenges" and showing the ability to sustain impacts over time.

Impression of the HKUST(GZ) campus.
Photo credit: KPF

The first cohort of 109 HKUST(GZ) students joined in 2019–2020 at CWB has shown strong interest and active participation in entrepreneurship opportunities, with around 60% of them participated in various entrepreneurship events and competitions organized and funding provided by the EC. This demonstrates the opportune and potential synergies being developed with the "Unified System, Complementary Campuses" framework. Together with CWB, the HKUST(GZ), and other platforms in Mainland China, the University has strategic plans to facilitate entrepreneurship development and technology transfer in the GBA for students and faculty members on the two campuses.

THE GUANGZHOU HKUST FOK YING TUNG RESEARCH INSTITUTE (FYTRI)

As the largest University's strategic platforms in Mainland China, FYTRI works closely with the local government and

The Guangzhou HKUST Fok Ying Tung Research Institute (FYTRI) exerts HKUST's influence in the Greater Bay Area.

over 300 enterprises from various industries and conducted 680 research projects, with a total project fund of RMB600 million over the years. Postdoctoral Innovation Practice Base was established in 2018 to accommodate postdoctoral fellows. The Supercomputing Service Platform supported over 110 million core-hours to users in Hong Kong. The International Smart Manufacturing Platform (ISMP) supports enterprises to achieve "Made in China 2025" by accelerating transformation of science and technology into products that are highly competitive in the market. To be integrated with the HKUST(GZ), the synergistic impact of FYTRI in the GBA would be further enhanced.

HKUST SHENZHEN-HONG KONG COLLABORATIVE INNOVATION RESEARCH INSTITUTE (SHCIRI)

Situated in the Shenzhen-Hong Kong Innovation and Technology Cooperation Zone, SHCIRI was established at the Futian Bonded Zone in 2019 with a total space of 6,900 square meters and served as a unique and strategic platform for the University to leverage the combined competitive advantages of Hong Kong and Shenzhen, and further enhance the overall position and capacities in the region and beyond. SHCIRI is committed to fostering frontier research advancement, KT, and industry collaboration, as well as providing quality executive education. SHCIRI will enable our faculty members to apply resources from the Futian District Government and participate in R&D mega projects, with a preliminary plan to set up "3T" research hubs in biotech, infotech, and fintech.

The HKUST Shenzhen-Hong Kong Collaborative Innovation Research Institute (SHCIRI) is established in May 2020 at Shenzhen.

HKUST FOSHAN RESEARCH INSTITUTE FOR SMART MANUFACTURING (FRISM)

HKUST also expanded its collaboration with Foshan beyond Nanhai District Government to include Foshan Municipal Government and signed a tripartite collaboration agreement in 2019 that included the establishment of the HKUST Foshan Research Institute for Smart Manufacturing (FRISM) at the CWB campus. RMB250 million research and entrepreneurship fund is committed by Foshan Municipal Government and Nanhai District Government for the period of 2019–2023. The new institute will enhance KT endeavors, foster incubation and facilitate the commercialization of smart manufacturing technologies.

HKUST Foshan Research Institute for Smart Manufacturing (FRISM) will enhance KT endeavors related to smart manufacturing technologies.

HKUST-ZHONGSHAN JOINT INNOVATION CENTER (ZJIC)

The HKUST-Zhongshan Joint Innovation Center was established at the CWB campus, with total funding of RMB39 million from the Zhongshan Municipal Bureau of Science and Technology to support the operations of ZJIC, sponsor the HKUST One-Million-Dollar Entrepreneurship Zhongshan District Competition and provide funding to translational projects. As of June 2020, 6 projects were awarded with a total fund amount of HK$10.6 million.

ENTREPRENEURSHIP INITIATIVES IN THE GREATER BAY AREA

To serve the entrepreneurship needs of the HKUST community beyond Hong Kong, the newly decorated Guangdong-Hong Kong-Macao International Youth Entrepreneurship Hub in Nansha, together with the Blue Bay, BBX in Shenzhen, the HKUST Foshan Center for Technology Transfer and Commercialization in Foshan, are aiming to be the showcase for the HKUST community to conduct entrepreneurship activities at the GBA. HKUST Mainland Platforms currently support 93 start-up and spin-off companies altogether.

The newly decorated Guangdong - Hong Kong - Macao International Youth Entrepreneurship Hub of the Guangzhou HKUST Fok Ying Tung Research Institute at Nansha.

Nansha: Launched in 2015, the Guangdong/Hong Kong/Macao International Youth Entrepreneurship Hub (E-Hub) aims to build a comprehensive demonstration platform for young innovators and entrepreneurs of Guangdong, Hong Kong, Macao and other GBA cities. The incubator was newly decorated and comes into service this year. The E-Hub provides support to 56 companies and 8 spin-offs.

Blue Bay Incubator has established an eco-system with four schemes to support HKUST entrepreneurs and start-ups at different stages.

Shenzhen: The Blue Bay Incubator (Blue Bay) of HKUST Shenzhen Research Institute (SRI) received the Top Incubator Special Recognition Award of the Guangdong-Hong Kong-Macao region and was conferred the National Level Maker Space by the Torch High Program under the Ministry of Science and Technology of the People's Republic of China. Blue Bay also received RMB1 million from the Innovation and Entrepreneurial Carriers Funding Program of Qianhai, Shenzhen. Riding on the success of Blue Bay, the Blue Bay X (BBX) was launched in 2020 at the newly registered SHCIRI and has already recruited the first batch of incubatees with a total of five HKUST affiliated incubatees.

LOOKING FORWARD

The new triennium has brought unprecedented hardship. Social incidents and the COVID-19 posed unpredictable challenges to society. However, crisis has a way of creating opportunities and favoring the prepared. The pandemic has inadvertently increased people's awareness of the importance of technology. As the science and technology university in Hong Kong, HKUST has risen to the occasion of addressing pressing societal challenges through actively leveraging the University's research and talents. In 2020–21, the KT units will actively synergize available resources and collaborative opportunities by extending KT efforts through research platforms and operations in the GBA, including the development of the HKUST(GZ), as well as research and entrepreneurship platforms in Guangzhou, Shenzhen and Foshan. In the long term, HKUST will implement the new Strategic Plan of the University, which covers a "3+3" planning horizon from 2022–2023 to 2027–2028 to further cultivate innovation and entrepreneurial spirit, especially for students.

Performance Indicator	2018/19 (Achieved)	2019/20 (Achieved)
SECTOR-WIDE PERFORMANCE MEASURES (PMs)		
Income from Knowledge Transfer via Provision of Research and Business Services (Collaborative Research, Contract Research, Consultancies and CPD as defined in CDCF) (HK$)		
Collaborative Research & Contract Research (*Cumulative value* in the financial year) Note 1 & Note 2	$246.0M	$275.9M
Consultancy Note 1	$2.1M	$6.0M
Continuing Professional Development (CPD) courses Note 1 & Note 3	$699.3M	$748.1M
Income from Knowledge Transfer as Innovative Activity (Income generated from intellectual property (IP) as defined in CDCF, excluding income from start-up companies) (HK$)		
IP Income Note 4	$7.2M	$8.9M
Expenditure on Public Engagement Activities (Public Lectures, Performance Arts, Exhibitions and Others as defined in CDCF) (HK$)		
Public engagement activities except CPD courses Note 5	$13.9M	$16.8M
CPD courses Note 1 & Note 3	$443.0M	$444.3M
INSTITUTION-SPECIFIC KEY PERFORMANCE INDICATORS (KPIs)		
Technology Transfer and Commercialization by Number of Patents Filed, Granted and Used		
Number of patents filed in the year (*according to filing date*) Note 6 & Note 7	270	286 Note 8
Number of patents granted in the year (*according to issue date*) Note 6 & Note 7	82	74 Note 9
Number of patents used based on new contracts (*according to contract date*) Note 10	48	20
Number of patents used based on active contracts *according to contract period)* Note 11	260	241

Note 1 The number reported also includes income and expenditure of Collaborative Research & Contract Research, Consultancy, Continuing Professional Development (CPD) courses, generated by the Mainland platforms.

Note 2 The definition of Collaborative Research and Contract Research is per the UGC Common Data Collection Format (CDCF) which is counted according to: (1) cumulative value in the financial year (2) collaborative work of a UGC-funded institution with other UGC-funded institutions in a joint research project (Collaborative Research) (3) research projects other than coordinating and participating with other UGC-funded institution (Contract Research). This is different from the definition of Performance Indicators laid down by the UGC earlier in 2009 for KT reporting which is counted: (1) on yearly-basis and (2) according to research projects with at least two partners in addition to the institution, one of which is a government or public body (Collaborative Research) (3) according to research projects meeting the specific research needs of external partners which is likely to be a service that could otherwise be procured from non-higher education institution providers (Contract Research) (4) on cash receipt basis. According to this previous definition, the number of collaborative researches, and income thereby generated is 132 and $550.9M while the number of contract researches (other than those included in "collaborative researches" above), and income thereby generated is 218 and $100.8M.

Note 3 Income and expenditure reported includes taught postgraduate programs (including EMBA, MBA, MSc, MA, PgD) with reference to the definition of Continuing Professional Development (CPD) courses laid down by UGC under the CDCF.

Note 4 It includes both IP income from patent via RDC, the Mainland platforms as well as copyright of courseware via the University.

Note 5 This figure is based on the definition of social, community and cultural engagement events as per CDCF.

Note 6 The number reported also includes patents filed and granted by the Mainland platforms.

Note 7 Figures are counted based on the actual number of patents filed and granted according to the official filing date and issue date of the application with the respective patent office. This is different from the CDCF figures reported to UGC which is counted according to the: (1) number of country of filings and (2) number of patent types which is defined in accordance with the international patent classification (i.e. technology area) of the patents.

Note 8 As per CDCF Definition, CDCF Table 65: The number of patents filed is 316 and the number of inventions involved is 215 in the 2019/20 period.

Note 9 As per CDCF Definition, CDCF Table 66: The number of patents granted is 122 and the number of inventions involved is 69 in the 2019/20 period.

Note 10 Patents used (new) refers to the number of patents utilized by means of licensing during the reporting period, including rights granted as background IP in newly signed contracts with value according to the contract date. All used patents only counted once if it is included in more than one contract.

Note 11 Patents used (active) refers to the number of patents utilized by means of licensing during the reporting period, including rights granted as background IP in active contracts with value according to the contract period. All used patents only counted once even if it is included in more than one contract.

Performance Indicator	2018/19 (Achieved)		2019/20 (Achieved)	
Entrepreneurship – Number of Start-up and Spin-off Companies Funded and Incubated by HKUST Programs on Entrepreneurship				
Number of start-up companies [Note 12 & Note 13]	63		87	
Number of spin-off companies [Note 12 & Note 13]	138		142	
Total number of start-up and spin-off companies [Note 12 & Note 13]	**201**		**229**	
Number of entries (teams and participants) in HKUST-supported competitions [Note 14]	1,559	5,830	1,634	5,003
Number of teams for One-Million-Dollar Entrepreneurship Competition at the Clear Water Bay campus [Note 15]	117		151	
Number of teams for HackUST: Total Teams / HKUST Teams [Note 16]	129	103	83	55
Other Societal Contribution: Number, Participant Size and Diversity of Community Engagement Projects, Social Service Events, Art Related Functions				
Public lectures *(No. of activities / attendees)* [Note 5]	288	34,767	300	2,514,732
Performance arts *(No. of activities / attendees)* [Note 5]	112	14,368	29	7,892
Exhibitions *(No. of activities / attendees)* [Note 5]	30	137,157	10	25,337
Public, community and social services *(No. of activities / attendees)* [Note 5]	183	1,503,477	119	1,875,542
Other public engagement activities *(No. of activities / attendees)* [Note 5]	233	824,380	81	128,405
Total number of public engagement activities & services (No. of activities / attendees) [Note 5]	**846**	**2,514,149**	**539**	**4,551,908**
Number of faculty staff engaged as members of external advisory bodies including professional, industry, government, statutory or non-statutory bodies [Note 17]	462 / 660 *(70%)*		485 / 693 *(70%)*	

[Note 12] The figure includes the economically active start-up and spin-off companies being funded or incubated by the HKUST entrepreneurship programs located in the Clear Water Bay campus and the Mainland platforms. The entrepreneurship programs include the HKUST Entrepreneurship Program (EP), Technology Start-up Support Scheme for University (TSSSU) Program, U*STAR Award, Yeung Wing Yee Entrepreneurs Fund (YWYEF), HKUST Entrepreneurship Acceleration Fund (EAF), Alumni Endowment Fund (AEF) Student Start-up Grants, HKUST One-Million-Dollar Entrepreneurship Competition (regional competitions inclusive), and programs under the Blue Bay Incubator and Innovation & Entrepreneurship Center (I&E Center) of HKUST R and D Corporation (Shenzhen) Ltd. (RDCSZ) in Shenzhen, programs under the Guangzhou HKUST Fok Ying Tung Research Institute (FYTRI) in Nansha, and programs under HKUST Foshan Research Institute of Smart Manufacturing in Foshan.

[Note 13] The period of reporting is from 1 January to 31 December of the calendar year as per UGC Common Data Collection Format (CDCF) requirement.

[Note 14] This KPI aims at measuring how HKUST is doing to engage the wider community by organizing or co-organizing competitions to promote knowledge transfer/entrepreneurship. The intended competition participants are open to the general public and the participants were not limited to our students, staff and alumni. Competitions which are organized solely for HKUST community were excluded.

[Note 15] HKUST One-Million-Dollar Entrepreneurship Competition is one of Entrepreneurship Center (EC)'s annual flagship events. It is a platform for the students and alumni to realize their business ideas into a real business.

[Note 16] Hackathon@HKUST (hackUST and hardUST) is one of EC's annual flagship events. It has also become one of the largest hackathon organized in Asia. Participants from HKUST as well as other universities in Hong Kong and overseas hack out prototypes of hardware/software solutions over a weekend (non-stop) to solve real problems.

[Note 17] The data collected for this KPI is on a calendar year basis from 1 January to 31 December in accordance with the University administrative norm.

APPENDIX B – OTHER ACTIVITIES HIGHLIGHTS

1. Reinforcing Industrial Engagement and Collaboration

GUANGDONG-HONG KONG-MACAO JOINT LABORATORY OF INFECTIOUS RESPIRATORY DISEASE

Division of Environment and Sustainability at HKUST, the First Affiliated Hospital of Guangzhou Medical University, HKU-Pasteur Research Pole, Macau University of Science and Technology, Guangzhou Institute of Biomedicine and Health, and Guangzhou Kingmed Diagnostics Group Co., Ltd. established a joint laboratory, the "Guangdong-Hong Kong-Macao Joint Laboratory of Infectious Respiratory Disease" in October 2019. The Joint Laboratory aims to create a collaboration platform between world-class research teams in the region to address critical needs in basic and clinical research on the origin, spread, and epidemiology of infectious diseases, their pathogenicity and host-pathogen interaction to create better diagnostic tools and treatments, prevention and control strategies for infectious diseases.

Inauguration Ceremony of the Greater Bay Area Joint Laboratory of Infectious Disease of the Respiratory System.

SHENZHEN-HONG KONG INSTITUTE OF BRAIN SCIENCE

HKUST participated in the establishment of the Shenzhen-Hong Kong Institute of Brain Science, a platform to foster Hong Kong and Mainland collaboration in brain sciences and contribute to the public health and social and economic development in the Guangdong-Hong Kong-Macao Greater Bay Area.

HKUST participated in the establishment of the Shenzhen-Hong Kong Institute of Brain Science

CO-DEVELOPMENT OF CHINA'S FIRST FINTECH QUALIFICATION FRAMEWORK

HKUST signs a Memorandum of Cooperation with the China Banking Association to co-develop a professional qualification for Chinese fintech practitioners in China.

To enhance professionalism and ensure high quality in the fast-moving fintech industry, HKUST signed a Memorandum of Cooperation with the China Banking Association, Shenzhen University, and the China Construction Bank University to co-develop a professional qualification for Chinese fintech practitioners in China. Boasting unrivaled knowledge in the field, HKUST is the only Hong Kong institution represented in this pioneering collaboration with Mainland China. The University will work closely with its mainland partners to define, set, and promote industry-wide success measures for fintech practice and take a leading role in curriculum design and quality assurance.

STRATEGIC PARTNERSHIP WITH WISERS INFORMATION LTD. ON BUSINESS AND SOCIAL ANALYTICS

SBM signed an MoU with Wisers Information Ltd. (Wisers) to form a collaboration platform which brings together experts in data science, machine learning, business, and social science research, as well as a leader in all-media big data smart business intelligence solutions, to develop timely insights applicable to business and social problems. This will also include public policy research projects, a joint HKUST-Wisers Research Program on Social Impact, knowledge exchange between HKUST academic staff and Wisers experts, and more learning and career opportunities for students.

Prof TAM Kar Yan, Dean of HKUST Business School and Ms Denise CHE, Chief Executive Officer of Wisers, signed an MoU for the partnership.

IFMA ASIA PACIFIC AWARDS OF EXCELLENCE 2019 AWARDS

An Eco Diving Robot developed by Professor Tim WOO and the New World Property Management Company Ltd. won the Asia Pacific Innovation Award of IFMA Asia Pacific Awards of Excellence 2019.

Professor Tim WOO, Associate Professor of the ECE, teamed with the New World Property Management Company Ltd. to develop an Eco Diving Robot. This underwater robot project is the winner of the Asia Pacific Innovation Award of IFMA Asia Pacific Awards of Excellence 2019, an award that recognizes facility management programs and facility managers' outstanding achievements.

Recognizing innovative projects that bring something new to the organization or the Facility Management (FM) industry, the Asia Pacific Innovation Award is looking for benefits brought by the innovation. With research output successfully transferred to the industry, this collaboration is one of KT's best exemplars from the University to the industry.

BLUE BAY MONTHLY SHARING SERIES 思享匯

Group photo of 思享匯

In December 2017, Blue Bay launched a series of sharing events 思享匯 to provide an exchange platform for the entrepreneurial community with the aim of helping entrepreneurs to learn additional skills and network with industry contacts and investors. During the past two years, over 20 speakers from various fields, including senior managers from the industry with professional expertise, veteran investors, successful entrepreneurs, have been invited to share their valuable insights from different perspectives. In 2020, despite the influence of COVID-19, Blue Bay hosted an online sharing session and invited Prof. LIU Ming (CSE & ECE) and Dr. GAO Yibo from Department of Physics as guest speakers for the inaugural episode. Prof. Liu introduced the "Robot+AI" strategy of his company Unity Drive and its core technologies, such as all-terrain 3D-mapping and large-scale visual navigation. The autonomous driving vehicles developed have been deployed for the delivery of groceries since mid-February. Dr. Gao talked about microfluidic chip technology and how he was part of a team that developed the fastest coronavirus detection device, contributing to the fight against the spread of COVID-19 during the pandemic. Over one thousand people watched online.

WASHINGTON UNIVERSITY IN ST LOUIS SIGNS MOU WITH HKUST TO STRENGTHEN COLLABORATION

An MoU between McKelvey Engineering at Washington University (WashU) and the School of Engineering at HKUST focuses on collaboration to benefit research and teaching in the field of engineering and to further the internationalization of both institutions. The preliminary plan is to explore joint research activities, including seminars, conferences, and public lectures, and establish joint projects through collaborative education programs to facilitate student exchange.

HKUST Dean of Engineering Prof. Tim CHENG (front left) and James M. MCKELVEY, Prof. Aaron BOBICK, WashU Dean of McKelvey School of Engineering (front right), sign the MoU under the witness of the WashU delegates and HKUST representatives.

2. *Engaging the Community (Knowledge Transfer-related Social, Community, and Cultural Engagement Activities/Services)*

SECOND TIME ALL-ROUND CHAMPIONSHIP IN MATE INTERNATIONAL REMOTELY OPERATED VEHICLE COMPETITION

HKUST's Remotely Operated Vehicle (ROV) Team was crowned the All-Around Champion and Engineering Presentation Champion at the MATE International ROV Competition 2019 in Tennessee, U.S. Proudly representing Hong Kong, the ROV team defeated 24 other regional finalists to take the top spot for the second time—the only Asian team so far that gained this top accoladein the competition's 18-year history. The ROV team consists of 21 undergraduates from across the world studying various disciplines. Thinking like entrepreneurs, the students

Prof. Tim WOO (first right, back row), HKUST ROV Team members, as well as organizers of the MATE International ROV Competition

considered the potential of ROVs to ensure public safety, maintain healthy waterways, preserve history, and accomplished various complex missions using their innovative underwater robot. They also excelled in technical report writing and market presentation.

AIR QUALITY MONITORING APP DEVELOPED BY HKUST'S INSTITUTE FOR THE ENVIRONMENT

Researchers at HKUST's Institute for the Environment have developed a game-changing mobile app, "PRAISE-HK," which allows users to monitor air quality to reduce their exposure to pollution. Air pollution is the world's most significant environmental health risk, particularly in Hong Kong. Using big data and AI to track roadside emissions data from 30,000 Hong Kong road segments, the app provides highly accurate air quality analysis down to street level and up to two days in advance. Ultimately, the data collected will be used to develop personal pollution risk profiles and advise policymakers on measures to curb air pollution.


The PRAISE-HK App is available on both Apple Store and Google Play.

THE GUANGDONG–HONG KONG–MACAU JOINT LABORATORY OF COLLABORATIVE INNOVATION FOR ENVIRONMENTAL QUALITY

Jointly led by HKUST and Jinan University, and funded by Guangdong Province's Department of Science and Technology, the Guangdong–Hong Kong–Macau Joint Laboratory of Collaborative Innovation for Environmental Quality was established to advance air quality improvements. A major component of the collaboration is a world-leading volatile organic compounds (VOC) analytics laboratory at HKUST, expected to be operational by 2021. It will have the trace-level analytical capacity to narrow down contributing sources and enable better control and reduce ozone and particulate matter pollution.

HKUST-LED DEVELOPMENT OF INNOVATIVE RECHARGEABLE LIQUID FUEL

At the helm of a pioneering five-year cross-university research project, HKUST has developed an environmentally friendly rechargeable liquid fuel, known as "e-fuel," with the potential for global impact. The team's e-fuel fully recharges an electric
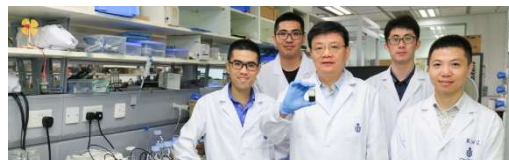
Professor ZHAO Tianshou (middle) and Professor CHEN Qing (first from left) and their research teams.

vehicle in minutes, whereas conventional battery technology takes hours. Like fossil fuels, it can be readily dispatched to the power grid, but it is entirely re-usable and carbon-neutral if charged with solar or wind energy. The high-loading lithium-sulfur battery on which the system is based has achieved the best performance ever recorded for a battery of its kind. Selected findings of the research have already appeared in the prestigious multidisciplinary journal *Nature Communication*.

AFCD Summer Course on Marine Ecology and Conservation 2019

The Agriculture, Fisheries and Conservation Department (AFCD) and the Department of Ocean Science (OCES) co-organized a three-and-a-half-day summer course on Marine Ecology and Conservation for 40 senior secondary school students in July 2019. The course comprised interactive lectures, field studies, and laboratory experiments to promote secondary school students' knowledge and awareness of marine conservation in Hong Kong.

AFCD Summer Course on Marine Ecology and Conservation 2019 is offered to secondary local school students.

Promoting Green Initiatives at Lunar New Year Fair 2020 (Po Hong Park, Tseung Kwan O & Man Yee Playground, Sai Kung)

The Environmental Protection Department, Environmental Campaign Committee, and OCES co-organized the Green Lunar New Year Fair in Po Hong Park, Tseung Kwan O, and Man Yee Playground, Sai Kung, on January 19–24, 2020. The Program aimed to encourage the public and stallholders to reduce waste production at the fair, to promote green messages, such as "bring-your-own cutlery," clean recycling, and upcycling of unused materials, and to provide support in resource rescue on the night of Lunar New Year's Eve.

HKUST co-organized the Green Lunar New Year Fair in Po Hong Park.

Showcasing Impact of HKUST's Innovation and Entrepreneurship Endeavors

The Public Affairs Office made videos to let the public learn more about HKUST's research achievement and start-up support.

To celebrate HKUST's endeavors in innovation and entrepreneurship in 2019–2020, the Public Affairs Office made a series of videos, covering not only HKUST's efforts to combat COVID-19 in various areas, but also its research achievements, the visions of its prominent faculty, and the entrepreneurial journeys of several HKUST members, to highlight HKUST's contributions to society.

3. *Enhancing Knowledge Transfer Supporting Infrastructure and Capabilities*

LIBRARY DATA ANALYTICS PLATFORM

The library has recently released its Library Data Analytics Platform, which provides interactive visualization capacity for analyzing data about the library and for reporting purposes. These data are collected from many library systems and applications, such as gate entry counts, virtual visits, PowerSearch usages, or infrastructure devices, such as WiFi connections, or manually collected by library staff.
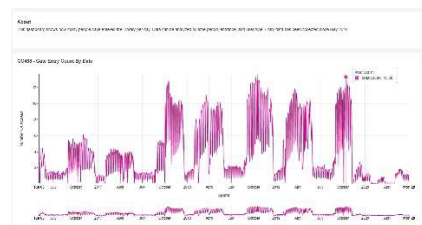

Library Data Analytics Platform developed by the HKUST Library.

This technological achievement is the result of an in-depth evaluation of products with enterprise-ready business intelligence capabilities, plus programming efforts for data feed automation. The product evaluation findings led to the implementation of the open-source software known as Apache Superset, which has capabilities comparable to commercial packages at the enterprise level, such as Qlik Sense or Microsoft Power BI. The Apache Superset is free of charge.

As of June 2020, seven dashboards have been released to the public (https://library.ust.hk/about-us/statistics/analytics) and have successfully embedded charts from the platform to SPD scholarly profile pages to showcase our researchers' publication patterns (e.g., https://repository.ust.hk/ir/AuthorProfile/tang-benzhong). The list of dashboards will increase as more data sources are brought into the system.

HKUST SCHOLARLY PUBLICATIONS DATABASE (SPD)-LINKED DATA PROJECT
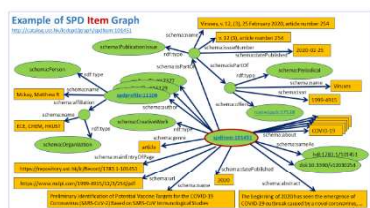
SPD Item Graph from the SPD-linked Data Project developed by the HKUST Library.

SPD metadata have been enabled as Linked Data, thus allowing computers to conduct semantic queries to the triplestore and interlink them with other data. Embedding JSON-LD data in SPD web pages also improve search engine optimization. As part of the project, publishers' open access policies were harvested from the Sherpa Romeo directory and converted into schema.org linked data. By interlinking these data with researchers' publications, data analytics were performed on HKUST's open access publication pattern. This has helped the researchers make informed decisions when negotiating transformative agreements with publishers and supported the researchers' responses to the University Grants Committee (UGC) in their open access consultation exercise. SPD-linked data are now Linked Open Data (LOD), forming part of the global database on the Internet, in line with the vision of Tim BERNERS-LEE when he designed the Semantic Web. The faculty encourages students to make use of SPD LOD in their Final Year Project.