ANNUAL REPORT 2018/19

Recurrent Funding for Knowledge Transfer for the 2016-19 Triennium

submitted to University Grants Committee



香港大學 THE UNIVERSITY OF HONG KONG

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EXECUTIVE SUMMARY

Knowledge Exchange (KE) has become entrenched at The University of Hong Kong (HKU). It is closely entwined with our academic endeavours and is part of our value system.

In 2018/19, the University continued to encourage interdisciplinarity in KE. A new series of KE seminars, Interdisciplinary Quick (IQ) Talks, was launched to promote interdisciplinarity and to share evidence-based knowledge on challenging issues from multiple perspectives with the community. The inaugural event of IQ Talks was well attended with over 200 participants from government departments, institutions, secondary schools and technology companies. The University also allocated \$2 million to conduct the Interdisciplinary KE Project Fund Scheme, which was introduced in 2015/16, again to support KE projects that are underpinned by interdisciplinary research of HKU. The funding has successfully encouraged cross-Faculty KE projects, attracting 31 quality proposals, of which 16 were supported.

To recognise and reward the significant impact that our academic staff had made in harnessing and translating knowledge to benefit society, the University presented the eighth year of the Faulty KE Awards and the fourth year of the university-level KE Excellence Award in 2018/19. The five awarded projects showcased in this report demonstrate the continuous effort of HKU researchers to engage in work that responds to social needs and to enrich the community with their expertise and discoveries in partnerships with government departments and external organisations. For example, HKU Law academics, in collaboration with parents' support groups, proposed a Special Needs Trust that has been adopted by the Government. The Trust lets parents or caregivers of Hong Kong individuals with cognitive impairment leave funds from their estate to care for their offspring, while the Government acts as trustee to manage the trust fund.

In the aspect of innovation and technology transfer, the Technology Transfer Office (TTO) had set up an Industry Liaison Team with the aim to further enhance the relationship between the HKU research community and the industry as a whole. TTO again participated in the International Exhibition of Inventions of Geneva. This year, 10 HKU inventions were conferred a total of eleven awards and prizes.

Looking back to the 2016-2019 triennium, the development of KE and impact agenda of the University has been remarkable, including the advancement in the University's human resources policy to include the weighting for KE in the performance review of professoriate staff, the introduction of new KE funding schemes to support interdisciplinary KE work and impact evidence collection, and the launch of DreamCatchers and iDendron to facilitate and inspire innovation and entrepreneurship. HKU's Vision 2016-2025 charts the University's direction to build on our internationally recognised accomplishments and become Asia's Global University. To achieve this, the University focuses on the '3+1Is': Internationalisation, Innovation and Interdisciplinarity, all converging on Impact. These themes will continue to guide our KE development.

1. DEEPENING INSTITUTIONAL CAPACITY FOR REALISING AND CORROBORATING IMPACTFUL RESEARCH

KE, together with Teaching and Research, form the three pillars that underpin all the activities of HKU. KE, being a natural consequence of research and teaching, is at the heart of the wide range of activities that our faculty members undertake with the non-academic sectors of our society. As stated in the HKU Vision 2016 – 2025, the University's mission is to create positive impact on the society and the Knowledge Exchange Office (KEO) is supporting the impact agenda for the University through multiple parallel activities.

1.1 Interdisciplinary Quick Talks

Interdisciplinary Quick (IQ) Talks is a new HKU KE series launched by KEO to promote interdisciplinarity and to share evidence-based knowledge on challenging issues from multiple perspectives with the community.



The inaugural event of this KE series, with the title 'Open Data Open Possibilities', was successfully held on February 15, 2019 at HKU with over 200 participants from different sectors including government departments, institutions, secondary schools, and technology companies.

The following talks were delivered by HKU researchers at the event:

- Opening Up Data: Facilitating Reuse of Public Information while Minimising Negative Consequences Professor John Bacon-Shone, Social Sciences Research Centre and Knowledge Exchange Office
- AI and Big Data to Advance Well-being and Society

Professor Victor Li, Department of Electrical and Electronic Engineering

• Disaggregated Data and its Potential for Corrective Justice in an Age of Inequality Ms Puja Kapai Paryani, Department of Law

• "Finding the Needles in a Haystack": Identification of Illegal Dumping of Construction Waste Using Urban Big Data

Dr Wilson Lu, Department of Real Estate and Construction

- *Open Genomic Data for Studying Infectious Diseases* Dr Tommy Tsan Yuk Lam, School of Public Health
- *The Archivist and Access: Custodian and Guide, not Gatekeeper* Mrs Stacy Belcher Lee, University Archives

This event provided an opportunity for the HKU researchers to share with the public their views and project outcomes using open data, and discussed new ideas for interdisciplinary research and knowledge exchange that could be made possible by open data.

1.2 Interdisciplinary KE Project Fund

The Interdisciplinary KE Project Fund Scheme was introduced as a one-off funding exercise in 2015/16. In 2018/19, the University allocated \$2 million to conduct the exercise again. This funding exercise is to encourage interdisciplinarity in KE, which is one of the (3+1)Is (Internationalisation, Innovation and Interdisciplinarity, converging to create Impact) in the 'HKU Vision 2016-2025', the strategic outline that defines HKU as Asia's Global University.

The Interdisciplinary KE Project Fund aims to facilitate interdisciplinary KE projects that have the potential to create social, economic, environmental or cultural impacts for industry, business or the community by building on interdisciplinary research in the University, with priority given to cross-Faculty collaboration. Projects should last for no more than two years. The funding has successfully encouraged cross-Faculty KE projects, attracting 31 quality proposals, of which 16 were supported (list at <u>Annex I</u>).

1.3 Impact Case Histories

The five examples described below are among those recognised in our KE Award Schemes this year.

Introducing the Special Needs Trust to Hong Kong

For many years, parents of children with special needs live with an agonising worry: since their children are unable to manage their own financial affairs, what will happen to the assets the parents set aside for the children's care and well-being once they pass on? The trust is an ideal mechanism for professional asset management, but the capital and fees involved place it beyond the means of most families.



The research of Professor Lusina Ho and Associate Professor Ms Rebecca Wing Chi Lee of the Department of Law has directly led to the setting up of a special needs trust (SNT) in Hong Kong. They proposed an SNT model that saves costs by pooling the funds contributed by parents for investment.

Their suggestions were submitted to the Government in an informal policy paper in October 2015 and they received a quick response. In February 2016, the Government set up a working group to investigate the feasibility of establishing an SNT and appointed Ho to provide expert advice on the SNT's design. Ho and Lee also collaborated with the Concern Group of Guardianship System and Financial Affairs, an NGO, to provide supporting data and convinced the Government that a government-managed SNT was both desirable and feasible.

After allocating HK\$50 million to set up an SNT office in February 2018, the Government formally launched the SNT in December 2018. The SNT is able to benefit the families of some 250,000 individuals whose disability (be it intellectual disability, mental illness, or autism) renders them unable to manage their own property affairs. It also affords parents peace of mind in knowing that, upon their passing, their children's well-being will not be affected.

In having a government act as trustee, Hong Kong's SNT is the first of its kind in the world. On the back of its success, NGOs in South Korea invited Ho and Lee to explain the workings of the SNT to the Korean Government, which then decided in 2018 to launch its own SNT.

Professor Ho and Ms Lee received the University's KE Excellence Award 2018 for this project. More details are at <u>Annex II-A</u>.

RFID-Enabled Building Information Modeling (BIM) Platform for Prefabrication Housing Production in Hong Kong



Dr Wilson Lu and his team in the Department of Real Estate and Construction and the Faculty of Engineering developed the RFID-enabled Building Information Modelling Platform (RBIMP) which integrates emerging information technologies in order to improve the project delivery. The RBIMP brings lots of benefits to the construction industry, the environment and the society as well. According to the feedback of end-users, the RBIMP improves the information exchange between stakeholders, ensuring smooth supply chain and on-site construction. The RBIMP also helps control

the quality of construction work. In addition, the site environment becomes much safer than before and less construction waste is generated during the construction process.

Dr Lu's team received the Faculty KE Award 2018 of the Faculty of Architecture. More details are at <u>Annex II-B</u>.

Impacting Early Childhood Policy in East Asia and the Pacific through Contextually-appropriate Assessment of Early Child Development



A large-scale international project, led by Professor Nirmala Rao of the Faculty of Education, developed the East Asia-Pacific Early Child Development Scales (EAP-ECDS), the first developmental assessment tool created on the basis of the culture and values of a world region. The EAP-ECDS were lauded as one of the major events influencing early childhood development policy and practice in the

2017 Lancet series on Early Childhood Development. The impact of the EAP-ECDS research has been recognised through a Best of UNICEF Research award for "policy impact, innovative design, thoughtful use of available data, methodological rigour and potential replicability in both the country of origin and other country contexts" (UNICEF, 2015).

Professor Rao's team received the Faculty KE Award 2018 of the Faculty of Education. More details are at <u>Annex II-C</u>.

Bioinformatics Algorithms and Next-Generation-Sequencing (NGS) Data Analysis

Professor Tak Wah Lam and his team of the Faculty of Engineering initiated the algorithmic research on constructing compressed data structures to index the human genome in early 2000's. When high-throughput DNA sequencing (NGS) started to emerge in the late 2000's, the team's work helped the genomics industry (e.g., BGI, Sanger) to resolve the major computational bottleneck in aligning NGS data (specifically, from weeks/days to hours per sample) and achieve better accuracy. With ITF funding support, the team was able to extend their work to more sophisticated NGS analysis for biomedical applications, and more notably, re-designed and integrated NGS analysis into an easily-usable system for (medical) users with minimal bioinformatics background (e.g., Department of Health). In 2014, Professor Lam's team founded a spin-off company which built the first bioinformatics cloud in China (BGI Online) and helped boost the Mainland's BioIT industry.

Professor Lam's team received the Faculty KE Award 2018 of the Faculty of Engineering. More details are at <u>Annex II-D</u>.

Changing the practices of iSlave producers and the working condition of student-labourers in Apple supplier factories in China

Professor Ngai Pun extended her longstanding action research into labour rights to the widespread but previously unresearched phenomenon of the use of vocational school students as a new form of labour use in Apple's supply chain in China. This group, totalling over 20 million since 2008, are the "student laborers" who



fuel up China's economic growth in the post-financial crisis period. The findings have had an accumulated impact on: influencing the agenda of labour right investigations and campaigns launched by local and international NGOs; raising international media concern; and bringing about real changes of labour protection policy in business CSR realm.

Professor Pun received the Faculty KE Award 2018 of the Faculty of Social Sciences. More details are at <u>Annex II-E</u>.

1.4 Impact Project Funding Scheme

Apart from the Interdisciplinary KE Project Fund Scheme, the University continued to run the yearly Impact Project Funding Scheme in 2018/19, which has become an important enabler for our academic staff to benefit the broader community with their expert knowledge. In the reporting year, 98 proposals were received, of which 74 were supported. The list of project supported is available at https://www.ke.hku.hk/assets/doc/Impact Project Summary 201819 online eng. pdf. Two completed projects are highlighted below.

E-package of DIY Residential Tenancy Agreement



Many landlords and tenants may not want to engage a lawyer to prepare a residential tenancy agreement as it can be costly and time consuming. They simply buy a sample tenancy agreement from a stationery shop or download one from the internet, which are not satisfactory as these documents are not prepared and

reviewed by persons competent in tenancy law. To address this problem, Ms Dora Chan, Principal Lecturer in the Faculty of Law, prepared a bilingual "E-package of DIY Residential Tenancy Agreement" to provide the public with free and easy access to a residential tenancy agreement template and a set of guidance notes on the stamping, registration and filing of Form CR109 for a residential tenancy agreement. By using the template and the guidelines, members of the public can independently enter into a tenancy agreement for their residential homes without the costs and trouble of engaging a lawyer or an estate agent. Users of the E-package only need to fill in essential information such as the names of the parties, rental amount and terms of the tenancy, and they can quickly and easily prepare a proper residential tenancy agreement that would suit their situation. The introduction of the E-package received wide media coverage and there were an impressive page view count of 51,256 and a download count of 24,170 within 3 months after its launch (mid-June – August 31, 2018). Link to the E-package: www.clic.org.hk/en/topics/DIY_Residential Tenancy_Agreement

Promoting Friendly Outdoor Lighting Fixture Against Light Pollution

For more than 10 years, Dr Jason Pun, Principal Lecturer in the Department of Physics, and his team have been researching the extent of light pollution across Hong Kong and educating the public and school students its negative effects. In 2018/19, with the support of KE fund, the team organised the "Dark-Sky-Friendly Lighting Fixture STEM Competition" for secondary schools, along with seminars and workshops, on designing outdoor lighting fixtures which help improving energy efficiency while reducing possible adverse effects of light pollution. The competition was co-organised with Ho Koon Nature Education cum Astronomical Centre in association with the Hong Kong Space Museum. One of the winning schools created a model of a smart sensing street lamp array with adjustable light intensity based on the flow of pedestrian traffic, thus leading to a reduction in the intensity and the number of lighting fixtures required. The winning schools were also given the opportunity to display their work at the HK SciFest 2019 exhibition, attracting more than 3,700 members of the public and tourists. The competition provided hands-on experience for students to apply multiple technologies such as 3D printing, programmable microcontrollers and ultrasound sensors, enriching their STEM knowledge and at the same time, raising their awareness towards light pollution. The students were then able to share the knowledge they had learnt

about light pollution and lighting fixture with the visitors of the exhibition. With KE fund, Dr Pun's team also co-produced a bilingual education booklet on light pollution with the International Astronomical Union to introduce the studies of light pollution conducted by HKU to the global community.



2. TECHNOLOGY TRANSFER AND PARTNERSHIPS WITH INDUSTRY

The Technology Transfer Office (TTO) had actively engaged in technology transfer activities to promote and market the HKU translational research inventions. To enhance the relationship with the industry and HKU research community, TTO had set up the Industry Liaison Team to institutionalise the industry network of HKU research teams, conduct active marketing and enhance the commercialisation outcome.

2.1 <u>HKU Transparent Conducting Film Technology for Display and EMI</u> <u>Shielding Applications was conferred the Gold Award at Geneva's</u> <u>Annual Invention Competition</u>

The International Exhibition of Inventions of Geneva (IEIG) held annually in Switzerland is recognised as one of the most prestigious innovation exhibitions and technology competitions. With the objectives of publicising HKU's achievements in translational research and marketing its inventions and innovations, TTO participated in the 47th IEIG in 2019 together with and showcased 10 HKU inventions at the event.

The 10 HKU inventions were conferred a total of eleven awards and prizes amid the keen competition among all the inventions exhibited at the 47th IEIG. In particular, the invention developed by Dr Wendi Li and Dr Tony Feng of the Department of Mechanical Engineering on a high performance Transparent Conducting Film (TCF) technology for display and EMI shielding applications was conferred a Gold Award with the Congratulation of Jury. The technology was licensed exclusively to Flectrode Limited, a spinoff company of HKU, whose multimillion dollar production facility in Xiamen will be ready for mass production this



year. The new TCF developed by Flectrode is found to be more effective than the current TCFs used in displays. It is more economical to produce and has 100 times better conductivity than the existing technology. The new TCF also can improve the photovoltaic efficiency in solar cells, so more electricity is produced from light, including artificial light.

2.2 <u>Strategic Partnerships</u>

HKU x Cyberport FinTech Nucleus

HKU x Cyberport Fintech Nucleus is a platform for introducing HKU technologies and innovations in FinTech to the Cyberport Centre of Global FinTech Innovation. Fintech Nucleus provides live technology showcases developed by HKU start-ups for engaging with potential customers, and facilitates collaborations among HKU and other FinTech stakeholders in the region.

Since its inception in 2017, FinTech Nucleus has received hundreds of delegations from different parts of the world and they were presented i) the cutting-edge HKU technologies for best supporting FinTech business; ii) HKU's rapid-growing FinTech start-ups; and iii) HKU FinTech courses designed for financial institutions, private investors and government representatives, with the ultimate purpose of accelerating the adoption of financial and A.I. (Artificial Intelligence) technologies for better products and services.

2.3 <u>Technology Transfer Promotion</u>

China High-Tech Fair

HKU showcased innovations and technologies developed at HKU in the Hong Kong Pavilion of the 2018 China High-Tech Fair (CHTF) from November 14 – 18,

2018 at the Shenzhen Convention & Exhibition Centre. Highlights include: 'Nano-LED' developed by Dr Anthony HW Choi of the Department of Electrical and Electronic Engineering; and 'NJ Toothbrush' developed by Professor LJ Jin and Dr TC Ng of the Faculty of Dentistry. The exhibition attracted more than 550,000 visitors from 103 countries around the world.



BIO International Convention 2019



TTO attended the BIO International Convention (BIO) 2019 at Philadelphia from June 3 – 6, 2019 to promote technologies developed at HKU. BIO attracts biotechnology and pharma leaders from more than 8,400 companies for one week of intensive networking to discover new opportunities and promising partnerships.

The following four technologies from HKU were showcased at BIO 2019:

- A novel method for risk predication and accurate diagnosis of autoimmune diabetes developed by Professor Aimin Xu of the Department of Medicine
- A delivery and expression systems for anti-viral therapeutic molecules developed by Professor Kwok-Yung Yuen of the Department of Microbiology
- An immune-oncolytic method to treat solid tumors developed by Professor Zhiwei Chen of the Department of Microbiology

• A novel diagnostic biomarker and therapeutic target for treating hepatocellular carcinoma developed by Dr. Stephanie Ma from School of Biomedical Sciences.

Industry Forum on Display Technologies

The HKU-Industry Forum on Display Technologies was held on January 10, 2019 at HKU. The forum served as a platform for exchanging ideas and fostering deeper connections between HKU and the industry. Eight display companies and market intelligence companies participated in the event, including IHS Markit, Clarivate Analytics, BOE Technology Group Co. Ltd, China Star Optoelectronics Technology Co. Ltd., TCL Electronics, Guangzhou ChinaRay Optoelectronic Materials Co. Ltd, PlayNitride Inc., and Tianma Micro-electronics. Six HKU research teams showcased their innovative display technologies on OLED emitter materials, optoelectronic materials and devices, transparent conductive films and innovative LEDs. At the forum, speakers from leading display companies and market intelligence companies were invited to talk about the latest industry trends and market needs.

InnoCarnival 2018

HKU exhibited four research projects under the theme of 'Innovate for a Smart Future' for the InnoCarnival 2018, which was held at the Hong Kong Science Park from November 3 – 11, 2018. The projects showcased are as follows:

- *Highly-Efficient Membranes & Products* (Inventor: Professor Chuyang Tang, Department of Civil Engineering)
- Screw Thread Adapted Specifically to the Biological Mechanisms of *Human Bone* (Inventors: Professor Ka-Li Frankie Leung and Mr Xiaoreng Feng, Department of Orthopaedics and Traumatology)
- A Robotic Catheter System for MRI-guided Cardiac Electrophysiological Intervention

 (Inventors: Dr Ka Wai Kwok, Mr Ziyang Dong, Miss Ziyan Guo, Mr Kin Chung Denny Fu, Mr Kit Hang Brian Lee, Mr Chim Lee Cheung and Mr Martin CW Leong, Department of Mechanical Engineering)
- NJ Toothbrush

(Inventors: Professor LJ Jin and Dr TC Ng, Faculty of Dentistry)

2.4 Public Seminars and Professional Development Workshops

The following experts in technology transfer and entrepreneurship were invited to share with students and other technology transfer professionals their experience in driving innovation and commercialisation:

- 'What are Your Goals for Starting a Business? A Conversation with GOGOVAN' (October 11, 2018) Mr Reeve Kwan, Co-Founder of GOGOVAN
- 'BIG DATA ANALYTICS is Changing the Life of Researchers' (October 19, 2018)
 Dr Nejhdeh Ghevondian, Microsoft Principal consultant in Big Data Mr Michael Nemtsev, Microsoft AI Architect
- *'How AI can help you with disease diagnosis?'* (October 22, 2018) Dr Andy He, Microsoft Data Scientist
- *'Is Artificial Intelligence a Patentable Subject Matter?'* (October 22, 2018) Mr Gregory Turocy, Partner, AMIN, TUROCY & WATSON LLP
- 'Novel Synthetic Vaccines: Polymersome based delivery for Peptides' (October 26, 2018)
 Dr Madhavan Nallani, founder and CEO of ACM, Biolabs
- *'Tearing down of Blockchain Patents'* (October 30, 2018) Dr Christopher Benson, Partner, HGF UK
- *'TTO IP Seminar for School of Biomedical Sciences What is obvious is not obvious: a conversation with your patent attorney'* (November 8, 2018) Dr Chuan Gao, Partner, Kilpatrick Towsend & Stockton LLP
- 'From an Idea Generation to a Successful Commercialized Product A Conversation with HEYCOINS' (November 22, 2018) Mr Jack Chen, Co-founder and Chief Operating Officer, HEYCOINS
- *'Seminar on Innovation and Entrepreneurship in HKU'* (December 7, 2018) Dr SC Kim, Director of TTO & Director of iDendron, HKU Innovation and Entrepreneurship Hub
- *'Data Analytics with MATLAB'* (March 14, 2019) Ms Loren Shure, MATLAB

- 'Market Sizing: Is your idea or product worth working on?' (March 27, 2019)
 Ms Jessica Cheung, Senior Form Advisor at Entrepreneur First
- 'IP Seminar for HKU Startups: Why IP is Important for Startups? +Oneon-One IP Consultation Session' (March 28, 2019)
 Dr. SC Kim, Director of TTO & Director of iDendron, HKU Innovation and Entrepreneurship Hub
- 'Financial Modelling and Business Strategy Workshop' (April 15 18, 2019)
 Mr Douglas Abrams, Founder and CEO of Expara and Expara IDM Ventures
- 'Are You Ready for the Fourth Industrial Revolution? When Biotechnology Transforms Healthcare' (April 25, 2019) Dr Min-han Tan, Founding CEO & Medical Director of Lucence Diagnostics
- 'Common Questions raised by HKU's staff for Preparation of Contract Research Agreement' (May 29, 2019)
 Ms Eliza Kung, Senior Legal Counsel of TTO

3. FOSTERING INNOVATION AND ENTREPRENEURSHIP

3.1 <u>iDendron and DreamCatchers</u>



iDendron, the HKU innovation & entrepreneurship hub, with the aim to nurture entrepreneurial and innovative spirit on campus, provides support for HKU's early-stage startups and establishing interdisciplinary cooperation. iDendron also received funding support from The University for the iDendron Incubation Programme (iIP) to be launched in July 2019, which is designed to help early stage startups gain momentum through deep mentor engagement, investor relation building and exposure outreaching.

As the signature programme under iDendron, DreamCatchers covers a series of programmes including Seed Fund Competition (DreamCatchers 100K), Hackathon, Entrepreneurship Academy and other events for our students, staff and alumni.

- *Entrepreneurship Academy* (September November 2018) The 10-week Entrepreueurship courses, covering topics at the core of entrepreneurship, with a focus on integrating information and ideas from multiple perspectives in order to help participants recognise and gauge the critical factors in the commercialisation process of innovation.
- Public Forum David Lee: From HKU to Silicon Valley (November 28, 2018)

HKU alumnus David Lee (BBA (IS) 2003; BEng 2004), co-founder and CEO of Silicon Valley start-up NEX Team, staged a homecoming at HKU's iconic Main Building, where he worked on his first business idea as a student. David shared on his journey "From HKU to Silicon Valley", while HKU basketball players perform a live demo of HomeCourt, NEX Team's AI-powered iPhone basketball app. HomeCourt has been highlighted by Apple and backed by NBA luminaries like Jeremy Lin, Mark Cuban and Steve Nash.

• Ocean park x HKU Hackathon (June 9 – 20, 2019)

Co-organised by Ocean Park and HKU, Ocean park x HKU Hackathon, with the theme of 'Edutainment with Innovation', is the first experiential learning opportunity where HKU students and graduates from all disciplines and professionals developed innovative solutions for the Ocean Park in the fields of education, entertainment and conservation in the real setting of Ocean Park. 25 participants attended talks and workshops and interacted with experienced industry experts, who facilitated our participants to gain insight and spot the pain points during site visits in Ocean Park. Participants also interviewed the senior management team of Ocean Park face-to-face to further develop an in-depth understanding. This further assists the teams' innovative solution in the process of prototyping. Moreover, mentors, experts and professional in their respective fields, were invited to facilitate the creative process of our participants.

• DreamCatchers MedTech Hackathon (June 2019)

45 students from local universities and Stanford University, and young professionals from Hong Kong Science Park joined the one-week hackathon to experience Stanford Biodesign methodologies, design thinking, business model canvas, and to work in interdisciplinary teams to come up with prototypes of sustainable healthcare solutions.

• Support for HKU Students

iDendron has been supporting students to join various local and overseas innovation and entrepreneurship to realize their ideas by mentoring them and examples of awards are as follows:

- 1. Hult Prize Regional Winner in Ho Chi Minh City
- 2. Champion of Hong Kong Social Enterprise Challenge
- 3. 16 awards in the 5th Hong Kong University Students Innovation and Entrepreneurship Competition, including Grand Prize in startup category, first Class Award in Entrepreneurship Category (Cultural & Creative Service) and the First Class Award in (Energy, Environmental and Chemical Engineering)
- 4. 2 Finalist in HKXF FYP+ Supporting Scheme



3.2 <u>Technology Start-ups</u>

The Technology Start-up Support Scheme for Universities at HKU (TSSSU@HKU), which is supported by the Innovation and Technology Commission, has entered into its sixth round of application. A total of 33 applications were received in November 2018, and 25 start-up companies were awarded funding, totaling \$8 million. As of June 30, 2019, the TSSSU@HKU programme has supported 48 new technology start-up companies in total. 9 of them were admitted to the Cyberport's Incubation Programme and another 15 of them have been admitted to the corresponding programme at the Hong Kong Science and Technology Park. One start-up funded by TSSSU@HKU is highlighted below.

Lifespans Limited

Lifespans Ltd. is a medical device startup company founded in Hong Kong in 2015. It is dedicated to develop innovative orthopaedic implants that are safer, and more effective at treating elderly patients – especially those prone to fractures of the hip, shoulder, and spine due to osteoporosis. The company was co-founded by Sloan Kulper, a graduate from HKU, Dr Christian Fang, Professor Frankie Leung, Professor William Lu and Dr Erica Ueda Boles of the Department of Department of Orthopaedics and Traumatology. The company received TSSSU for three consecutive years (2017- 2019) and leveraged on this to raise sizeable private investment for the commercialisation of their technology and the development of the company.

Their work as inventors of the underlying IP of the Lifespans Soft Tip was awarded a Silver Medal at Inventions Geneva 2018. Besides, Lifespans won a number of prizes and awards in 2018. In September, Lifespans won a Silver Medal in Hangzhou (Gongshu) start-up competition, with US\$5,000 immediate cash prize and automatic entry into the application process for a US\$500,000 grant. In November, the company was awarded the grand prize at the ASEAN Finals of the Hello Tomorrow start-up pitch competition for companies, outcompeting over 200 applicants from the Asia Pacific region. Lifespans also won the first runner up and audience choice awards at the finals of the Cocoon Hong Kong start-up pitch competition in December.

4. COMMITMENT TO KNOWLEDGE ACCESS AND COMMUNITY ENGAGEMENT

4.1 Faculties' Core Activity

All Faculties are committed to public engagement to share knowledge and raise awareness on important issues facing society. A wide variety of activities were conducted in the reporting year, including public seminars, press briefings/ conferences, publications on mass media, international competitions, and two-way KE through the new media etc. For example, the Faculty of Business and Economics organised a number of public KE lectures and seminars covering topics such as new geo-politics and geo-economics amidst the US-China conflicts to enhance the public understanding on timely and important business and economics issues.

Faculties also continue to pursue achievement in community impact, engagement and collaboration with external partners beyond the University to leverage the synergy between different stakeholders for social good in Hong Kong. For example, the Faculty of Social Sciences jointly organised a two-week Water Fun Fest with



Ocean Park to enhance public's consciousness on water sustainability and multiple values of freshwater. The 2-week Water Fun Fest successfully attracted over 130,000 people with publicity materials reaching out to the entire Hong Kong population.

Another example is the development of websites and mobile apps. Faculties of Dentistry, Education and Engineering completed website revamp in the reporting year. The website revamp facilitates the user to easily search for information, access to the Faculties' knowledge, and learn about the KE contributions and achievement of the Faculty members. In order to reach out to the public in a more effective way, Faculties also developed mobile apps such as 'HKcBirds: Common Birds of Hong Kong' jointly developed by the Department of Computer Science of the Faculty of Engineering and the Hong Kong Bird Watching Society and 'Newssary', a free Chinese-English news glossary app, developed by the Faculty of Arts. Both apps were awarded as the 'Healthy Mobile Phone / Tablet Apps' of the year at the '2018 Meritorious Websites Contest and Healthy Mobile Phone / Tablet Aps Contest' organised by the Office for Film, Newspaper and Article Administration, HKSAR Government.

4.2 <u>Strengthening Research Communication Skills for RPg Students</u>

(a) HKU Visualise Your Thesis (VYT) Competition:

Visualise Your Thesis is a new initiative introduced by The University of Melbourne that challenges Research Postgraduate students (RPg) to present their research in a 60 second, eye-catching digital display. HKU VYT is officially launched by KEO in 2019. This Competition provides another valuable opportunity for the HKU RPg students to develop research communication skills for a general audience. It also serves as a platform for the RPg students to enhance their digital literacy, which is another useful skill set for researchers nowadays. The Champion will represent HKU in the inaugural International VYT Competition (online) organised by The University of Melbourne later this year.

(b) Training Sessions on Research Communication Skills for RPg Students Mr Simon Clews, Director of the Melbourne Engagement Lab of The University of Melbourne, was invited to deliver training sessions for the HKU RPg students in December 2018. These sessions provided support to RPg students on strengthening their writing skills and communication skills to explain and present their research for non-specialist audiences.

4.3 Student KE Projects

The KT funding was used to support 32 student KE projects in the reporting year while the University also makes use of other funds to encourage students to undertake community projects, for example, the Service 100 Fund and the We Are With You Project Scheme that are administered by the Centre of Development and Resources for Students. Examples include 'Experiencing Life in Phayar Taung Monastery' organised by Social Sciences students to provide diverse learning opportunities and improve learning environments for the students in Myanmar; and 'Promoting Mental and Physical Development through Playing and Active Learning at Samart School' organised by a team of students from Arts and Science to facilitate the physical and social competency of the children in Cambodia by constructing a safe, multi-functional playground for them.

5. QUANTITATIVE INDICATORS AND FINANCIAL REPORT

Given the broad definition of KE of the University, our performance indicators are not limited to the UGC required metrics, but also other indicators that are highly relevant to the University's KE efforts. Two tables on the UGC and HKU performance indicators respectively are at <u>Annex III</u>. The internal distribution of KT funding allocation is summarised at <u>Annex IV</u>.

6. LOOKING AHEAD

The first round of RIF had a strong response from HKU, with 18 projects with HKU involvement obtaining funding support. This illustrates the willingness of researchers to prioritise research with strong translational potential. The submission of the first round of impact cases in RAE2020 will highlight the broad range of HKU knowledge exchange leading to impact, across the whole university. As UGC has accepted our suggestion that submitted impact cases will be in the public domain, we plan to analyse all the cases and associated outcomes, in order to fine-tune our impact and knowledge exchange strategies for the next two trienniums.

We are also strengthening our innovation capacity in mainland. HKU and Guangdong Pharmaceutical University (GDPU) are jointly setting up an Innovation Platform with Zhongshan city government, which will provide Biomedical incubator, Good Manufacturing Practice (GMP) and animal facilities to support CFDA approval of the medical products based on HKU technologies.

The Technology Transfer Office (TTO) is also planning to set up satellite TTO offices in Zhejiang Institute of Research and Innovation and Shenzhen to strengthen the collaboration with mainland industry partners.

HKU has been demonstrating the highest growth rate in Entrepreneurship development for last several years. To keep up the momentum and cope with the ever increasing demands for next level of performances, iDendron and TTO are initiating the iDendron Incubation Programme (iIP), which is a 6-month rolling programme designed to help early stage start-ups with first-hand market intelligence, supported by industry specialists and investors, as well as entrepreneurial and business resources from the University and its network through intensive mentor engagement, building investor relations and maximising exposure.

The University of Hong Kong August 1, 2019

Faculties	Co-Project Coordinators	Project Title	Summary Description
Architecture Arts	Mr Thomas How Kheng TSANG Department of Architecture Professor Giorgio BIANCOROSSO School of Humanities (Music)	Soundtecture: Density as Intensity	This project brings together the Department of Architecture and Department of Music at HKU along with three leading KE partners in an exploration of the relationship between sound and architecture. The project combines musical and architectural expertise to deepen the understanding of the effects of Hong Kong's extreme built environment on its sound ecology, create knowledge that will impact the conception and use of performing arts venues, and inspire the creation of new public artworks informed by the mutual implication of sound and architecture. Outcomes will include workshops, publications, new compositions, performances, and site-specific installations and public artworks.
Arts Law	Dr Janny Hiu Chi LEUNG School of English Dr Anya ADAIR School of English Dr Daniel MATTHEWS Department of Law	Growing Legal Empathy: A Law and Literature Education Programme for Hong Kong Teenagers	This project targets secondary school students in Hong Kong from a range of socio- economic demographics. It aims to enable these teenagers to achieve new ways of understanding, articulating, and critiquing the legal structures and social issues of contemporary Hong Kong. The aim will be achieved by providing local education workshops, undertaking global outreach to design and promote new lesson structures, and constructing a publicly-available online database of teaching resources. The project will apply the tools and methods of new directions in law and literature developed by current interdisciplinary research at HKU, in a youth- education context.
Dentistry Social Sciences	Professor Chun Hung CHU Faculty of Dentistry Dr Celia Hoi Yan CHAN Department of Social Work and Social Administration	Providing Oral Health Care and Sleeping Health Care to the People with Mental Disorders	This project aims to empower an NGO (New Life Psychiatric Rehabilitation Association, NLPRA) to deliver oral and sleeping health care to patients with mental disorders in their community centers by providing knowledge about mental disorder-specific oral and sleep health care to the staff of NLPRA, and to deliver educational sessions about sleep hygiene and longitudinal dental health service to the patients at NLPRA community centers, thus ultimately improving the oral and general health of patients with mental disorders.
Education Dentistry	Dr Karen Man Kei CHAN Faculty of Education Dr Katherine Chiu Man LEUNG Faculty of Dentistry	Keep On Talking and Eating: Establishing a Volunteer Program to Prevent Chewing and Swallowing Problems in Older Adults	Chewing and swallowing problems are common in older adults and have negative impact on their physical and mental health. The Swallowing Research Laboratory of HKU has identified dental problems and oral muscle weaknesses as factors associated with older adults' swallowing problems. The Laboratory and the Faculty of Dentistry of HKU have been implementing evidence-based training programs for older adults to improve their oral hygiene and oral muscle functions. This project aims to pull the two disciplines together to establish a joint program that trains volunteers to provide dental health education and oro-motor exercises to prevent chewing and swallowing problems in at-risk older adults.

Faculties	Co-Project Coordinators	Project Title	Summary Description
Education Engineering	Dr Cecilia Ka Yuk CHAN Centre for the Enhancement of Teaching and Learning	Enhancing Generic Competencies in Engineering Industries	This project targets the problem that engineering graduates are lacking in generic competencies, such as self-confidence, teamwork and adaptability, which are of importance to the professional field. To enhance generic competencies, employers are targeted for high influential value to engineering graduates. It aims to heighten awareness and enhance some of the generic competencies of engineering graduates. Adopting developed instrument, model and platform from the project team's research and working together with external partner organisations and businesses, this project will develop procedures for recording graduate engineers' performance in generic competencies and provide short online training videos suitable for today's graduates.
	Department of Electrical and Electronic Engineering		
Education Engineering	Dr Peter COBB Faculty of Education	Digging the Past Together: International Public Engagement in Near Eastern Archaeological Research	Archaeology investigates our shared human heritage through the survey and excavation of places with past activity and the study of objects. This project aim to introduce the archaeological process and to communicate the results of the project team's research to multiple audiences as part of a fieldwork project in the Near East. Through onsite group visits, local Armenian primary and secondary school students will gain hands-on experience with excavation. Videos, photographs, and 3d models captured in the field will populate a public exhibit in Hong Kong, including virtual reality experiences. A multifaceted and multilingual social media strategy will reach
Social Sciences	Professor Wenping WANG Department of Computer Science		
	Dr Zhu XU Department of Architecture		
	Dr Tom MCDONALD Department of Sociology		nong Kong, mainana onna, and international audiences.
Engineering	Dr Chok Hang YEUNG Department of Civil Engineering	Innovative Citizen Science Project for Mapping Microplastics	This project aims to leverage an innovative optical technology to develop a citizen science kit that can assess the abundance and types of microplastics in aquatic systems. Through engaging the public, educators and students in this citizen science
	Professor Edmund Yin Mun LAM Department of Electrical and Electronic Engineering	in Hong Kong	project, a database on the distribution and abundance of microplastics in different parts of Hong Kong will be established to inform stakeholders on the extent of microplastics pollution in our environment. A long-term monitoring scheme of microplastics can also be devised.
Engineering Business and Economics	Dr Wei PAN Department of Civil Engineering	Knowledge Exchange on Modular Integrated Construction (MiC) for Sustainable Development in Hong Kong	This project aims to make strategic and impactful contributions to the future sustainable development of Hong Kong in line with the burgeoning promotion of technology and innovation in Hong Kong, the Greater Bay and the Belt & Road by
Social Sciences	Professor Haipeng SHEN Faculty of Business and Economics		exchanging the knowledge on disruptive Modular Integrated Construction (MiC) based on the world-leading research at HKU. The aim will be achieved by applying a 'KAP' framework, namely (1) exchanging Knowledge on disruptive MiC for
	Dr Winnie Wai Yi LAW Faculty of Social Sciences		sustainable development with industry and society; (2) shaping Attitude of stakeholders towards innovation via various social engagements; and (3) guiding Practice of innovation driven sustainable development.

Faculties	Co-Project Coordinators	Project Title	Summary Description
Law Education	Professor Simon Ngai Man YOUNG Department of Law Dr Chi Kim CHEUNG Faculty of Education	Rule of Law Education Seminars in Primary and Secondary Schools	This project aims to bring high quality education concerning the rule of law to secondary schools and primary schools. By mutual training of HKU law and education students and pairing them up to teach the rule of law in secondary and primary schools, this project will enhance the knowledge of the rule of law of the new generation of Hong Kong and demonstrate the social responsibility of our HKU students.
Law Engineering	Professor Anne Shann Yue CHEUNG Department of Law Professor Benjamin Chi Ming KAO Department of Computer Science	Artificial Intelligence for Legal Services: Sentencing Wizard on Drug Trafficking	This project aims to pilot the application of artificial intelligence technologies in providing a practical legal research tool for social workers, teachers, legal professionals, and the general public by developing a drug trafficking sentence forecast system.
Medicine Dentistry	Professor Patrick Chiu Yat WOO Department of Microbiology Dr Rory M. WATT Faculty of Dentistry	Antimicrobials and Infection Control: Emergence Of Drug Resistance & Novel Pathogens	This project aims to organise workshops on antimicrobials and infection control so as to introduce the safe and effective use of antimicrobials, to prevent the emergence of resistance, to recognise novel pathogenic microbes and their susceptibilities and to promote the importance of infection control to minimise spread of antimicrobial resistant pathogens. The target audiences include the microbiology laboratory professionals, medical practitioners, medical students, dentists, dental students as well as senior secondary school students interested in the medical/dental professions. Presentations, microbial test demonstrations, a laboratory tour and highly interactive discussions will be given and organized.
Medicine Engineering	Dr Vince Varut VARDHANABHUTI Department of Diagnostic Radiology Dr Ka Wai KWOK Department of Mechanical Engineering	Demystifying Al/Robotics – Making Sense of Emerging Uses of Artificial Intelligence and Robotics in Medical Applications	This project aims to promote public awareness of artificial intelligence (Al). People can find the use of Al already in our everyday lives, but yet the general public is unaware of the rapid pace in which Al is moving to change the way we live. At the cutting edge of Al technology, there are real concerns about what the Al can do from not only the research community but also the public (e.g. fear of Al replacing jobs). In a series of public lectures, the project team will host panel discussions on these important topics with leading experts in academia and industry with interactive questioning from the audience.

Faculties	Co-Project Coordinators	Project Title	Summary Description
Medicine Social Sciences	Dr Gary Kui Kai LAU Department of Medicine Dr Vivian Weiqun LOU Sau Po Centre on Ageing	A Mobile Application for Stroke Patients and Their Caregivers in Hong Kong and Shenzhen	This project aims to develop a secondary stroke prevention mobile application for both stroke patients and their caregivers in Hong Kong and Shenzhen, which can be used as a user-friendly tool to detect and monitor vascular risk factors, psychosocial health and caregiver burden. The application would also serve as a convenient tool for stroke patients and caregivers by providing educational materials relating to stroke as well as useful information for informed decision making.
Medicine Social Sciences	Dr Jojo Yan Yan KWOK School of Nursing Professor Rainbow Tin Hung HO Department of Social Work and Social Administration	Mindfulness Yoga for Parkinson's Disease (MY-PD)	Parkinson's disease (PD) is a common neurodegenerative disease that results in various dysfunctions and disabilities as it progresses. All these conditions affect not only the physical health of patients but also their psychological well-being. Mounting evidence suggests the prominent role of psychological distress in aggravating motor symptoms, thereby leading to increased disability, high healthcare burden and poor health-related quality-of-life (HRQOL). This project aims to develop a mobile-friendly 'Mindfulness Yoga for Parkinson's Disease' (MY-PD) webpage that provides an online 3-day MY-PD course, aiming to enhance psychological well-being and HRQOL of the PD community, and to promote the public awareness of mindfulness yoga for chronic illness management.
Science Law	Dr Caroline DINGLE School of Biological Sciences Ms Amanda WHITFORT Department of Professional Legal Education	Knowledge Transfer for Informed Prosecution of Wildlife Crimes: Forensic Evidence	This project aims to provide up-to-date information to wildlife crime prosecutors about the use of forensic evidence in presenting cases and sentencing wildlife offences in Hong Kong. An updated dossier of wildlife crime impact reports will be developed. Training workshops will also be organized.
Social Sciences Arts	Dr Yu Te HUANG Department of Social Work and Social Administration Dr Vivian Kuang SHENG School of Humanities (Fine Arts)	Enhancing Community Empathy for and Wellbeing of Sexual Minority Youth Through Arts	This arts-based, three-phase project aims to promote mental health among and community inclusion towards sexual minorities. Phase one involves a development and delivery of arts-based LGB affirmative therapy to sexual minority youth. In the phase two, exhibitions of artworks created by phase-one participants will be organized both on HKU campus and at a community venue to foster community empathy for and alliances with sexual minority communities. Exhibition viewers will take part in a response art-making activity to express their support for sexual minority communities. Post-exhibit group discussions will be held for the phase one participants to reflect on the response artworks.

University: The University of Hong Kong (HKU)

Faculty: Faculty of Law

Title of case study: Introducing the Special Needs Trust to Hong Kong

(1) Summary of the impact (indicative maximum 100 words)

Our research has generated: (i) a proposal to establish a Special Needs Trust (SNT) to provide otherwise unaffordable professional asset management service for individuals with cognitive impairment; (ii) the first territory-wide survey to generate supporting data; and (iii) public education of the SNT.

The Government adopted our proposal. It appointed one of us to the feasibility working group on the SNT, and announced its launch by early 2019 in three consecutive Policy Addresses, pledging funding of HK\$50 million in the 2018 Budget. Already generating significant interest overseas, the HK SNT is the first of its kind in the world.

(2) Underpinning research (indicative maximum 500 words)

Our research involved four aspects.

(1) 2014 – present: University legal research

Since 2014, we published articles that provide a critical and systematic assessment of existing legal mechanisms for financial planning for people with cognitive impairment in Hong Kong [1], such as wills, private trusts, statutory guardianship and enduring powers of attorney. We observed that a private trust remained the most flexible and reliable legal tool for financial management, but the cost of setting up a private trust in Hong Kong was prohibitive to most families with modest wealth. We recommended a model of the SNT that would achieve cost-saving through, among other design features, pooling the funds contributed by parents/caregivers of these vulnerable individuals for management and investment. This allows the SNT to provide otherwise unaffordable professional trust services for those with modest means. The research was reported in [2].

(2) 2015 – present: Empirical research and engagement with NGOs and the special needs community

Since 2015, we have worked closely with NGOs. In March 2016, we collaborated with the Concern Group of Guardianship System and Financial Affairs, an NGO to carry out the first territory-wide empirical study of parental opinions on the usefulness of existing mechanisms and the possibility of introducing an SNT to Hong Kong. The study was completed successfully with over 2,500 valid responses to our questionnaire survey. The survey results confirmed our assessment that existing legal mechanisms for financial planning were inadequate and that there was a strong demand for an SNT to be established in Hong Kong. The survey reports [3] were published and disseminated to the public, interested NGOs and the Government. We have continued to work closely with various local NGOs to campaign for the introduction of an SNT in Hong Kong. These include delivering talks and workshops, training students and parent volunteers, and attending media interviews (see below).

(3) 2016 – present: Collaboration with international experts

We developed our work further in consultation with international experts in Asia and the West.

We identified best practices and innovative developments in statutory guardianship, enduring powers of attorney, and SNTs. The research will be reported in the form of a comparative study of the relevant laws and practice across selected jurisdictions in Asia and the West to be published by the Cambridge University Press in 2019 ([4]).

(4) 2016 – present: Professional advice to the Government

Ho was appointed to the Feasibility Working Group set up by the HKSAR Government in 2016 to provide expert advice. Our research and advocacy have influenced the HKSAR Government's decision to introduce a ground-breaking government-led and government-managed SNT for people with cognitive impairment in Hong Kong. The proposed operational framework of such a trust is reported in [5].

Lee was appointed Assistant Professor in the Department of Law in 2005 and promoted to Associate Professor in 2010.

Ho was appointed Lecturer in the Department of Law in 1992 and promoted to Associate Professor and Professor in 1999 and 2006 respectively. She is currently Harold Hsiao-Wo Lee Professor in Trust and Equity.

(3) **References to the research** (indicative maximum of six references)

[1] Ho, "Financial Planning for the Elderly: Antiquated Law in a Modern Financial Centre" [2014] <u>Hong Kong Law Journal</u> 795-808; **Lee & Ho**, "Respecting Autonomy in Decision Making: Guardianship and Trust for Persons with Intellectual Disabilities in Hong Kong", paper presented at the <u>2016 National Conference on Reflecting Will and Preference in Decision Making</u> (Australian Guardianship and Administration Council, Sydney, October 2016); **Lee**, "Advancing protection for individuals with intellectual disability: Challenges and opportunities of advocacy by third sector organisations in Hong Kong", paper presented at the <u>13th Conference of the</u> International Society for Third Sector Research (Vrije Universiteit Amsterdam, July 2018).

[2] Ho & Lee, "Introducing the Special Needs Trust to Hong Kong" (2017) 23 <u>Trusts & Trustees</u> (Oxford: Oxford University Press) 1111-1121.

[3] Lee & Ho, "Ascertaining the Need for a Special Needs Trust in Hong Kong: Report on Key Findings and Observations" (Faculty of Law, <u>The University of Hong Kong</u>, January 2017), 31 pages (in English) and 29 pages (in Chinese).

[4] Ho & Lee (eds), Special Needs Financial Planning: A Comparative Perspective (Cambridge: <u>Cambridge University Press</u>, forthcoming 2019).

[5] Ho & Lee, "Reforming Enduring Powers and Launching a Special Needs Trust in Hong Kong", in [4] above.

A large part of this research project was funded by the following competitive research grants:

Lee and Ho, General Research Fund of the Research Grants Council (project number: 17612916) (HK\$825,800), 2016-2019.

Ho, General Research Fund of the Research Grants Council (project number: 17614318) (HK\$434,298), 2019-2021.

(4) **Details of the impact** (indicative maximum 750 words)

The innovative proposal brought about by our research was adopted by the Hong Kong Government to address a long-standing demand in civil society to enhance the public infrastructure for protecting individuals with cognitive impairment. Details of our impact are:

(1) Government adopts Special Needs Trust on the back of our research

For years, the parents of individuals with cognitive impairment live with an agonising worry: after the parents' passing, how to find a reliable manager of the assets devoted for their children's care? Based on the legal and empirical research described in section 2, we proposed an SNT that has been adopted by the Government to tackle this thorny issue. In October 2015, **Ho** submitted an informal policy proposal to the Permanent Secretary for Social Welfare advocating the SNT, and received a quick response. In the Policy Address of 2016, the Government announced the establishment of a Working Group on Feasibility Study of the SNT, and appointed **Ho**. In the next Policy Addresses of 2017 and 2018 and the Budget of 2018, the Government made an express commitment to set up an SNT based on the model proposed by us, namely that the Government would act as trustee. In February 2018, the Government pledged HK\$50 million to set up a dedicated office to launch the SNT by early 2019 (**[1]**).

Throughout the Government's preparation of the SNT, **Ho** has provided legal advice, supporting data obtained from a survey conducted by us in collaboration with an NGO, and policy suggestions on the features of the SNT. The research fostered a strategic partnership between the Government and the University, and also provided a successful example of tripartite partnership between the special needs community, the University and the Government. **Ho** represented the Working Group to attend all four public consultation forums conducted by the Government between February and March 2018 ([2]). The proposed SNT framework was also discussed in the LegCo meetings in May and July 2018 ([3]).

(2) Empowering and partnering with NGOs in advocating law reforms

Since 2015, we have served as honorary advisors of the Concern Group of Guardianship System and Financial Affairs, a local advocacy group to provide professional advice on matters relating to the legal protection of people with cognitive impairment.

Subsequently, in March 2016, we collaborated with the said Concern Group to conduct the first territory-wide Questionnaire Survey of opinions amongst some 2,500 parents. In January 2017, we organised a large-scale press conference, which was attended by about 200 members of the public and the media, to present the survey findings. Among the findings was that over 50 per cent wished that the Government act as trustee of the proposed SNT. Their wish was accepted by the Government, which takes the unprecedented step hitherto not seen in other places to act as trustee.

Since 2017, we have delivered numerous talks to NGOs. In May and June 2018, we organised two bilingual public forums on SNT. The forums were well-attended by over 600 parents, caregivers and social workers. After the forums, we provided training and support to a team of student and parent helpers to equip them to deliver similar talks to special schools and NGOs in the summer of 2018. Between June and October 2018, 23 talks were delivered to special schools and NGOs in Hong Kong, with over 1,500 participants attending so far ([4]).

(3) Influencing and informing policy debates on protection of people with cognitive impairment

We attended extensive newspaper and radio interviews with the media ([5]).

In addition, we developed a bilingual website to educate the public about the SNT. We also maintained a Facebook page to post updates of the progress of our research and advocacy ([6]). The website features a publicly accessible database which is regularly updated by us and contains useful information on SNT, adult guardianship and enduring power of attorney. The websites equip parents/carers of people with cognitive impairment, policy-makers, researchers, disability-rights campaigners, and others with a convenient means of locating information essential for mutual learning.

(4) Sharing of Hong Kong experience with jurisdictions interested in establishing a Special Needs Trust

The current SNT model proposed for Hong Kong, in which the government leads and manages the SNT, will be amongst the first of its kind in the world and provides an example of an affordable state-run SNT system. We were invited to present our research and advocacy to researchers and policymakers in Australia, Mainland China, Japan, South Korea, Amsterdam, and Taiwan ([7]).

Our research project was awarded the Faculty Knowledge Exchange Award 2018.

(5) Sources to corroborate the impact (indicative maximum of 10 references)
[1] (i) Hong Kong Policy Address 2016, para 158 <<u>http://policyaddress.gov.hk/2016</u>>; (ii) Hong Kong Policy Address 2017, para 190 <<u>http://policyaddress.gov.hk/2017/eng/</u>>; (iii) Hong Kong Budget 2018-19, para 176 < <u>https://www.budget.gov.hk/2018/eng/pdf/e_budget_speech_2018-19.pdf</u>>; (iv) Policy Agenda, Hong Kong Policy Address 2018, p. 164 <<u>https://www.policyaddress.gov.hk/2018/eng/pdf/Agenda.pdf</u>>.

[2] (i) Membership of Ho with the Working Group on Feasibility Study of Special Needs Trust, Labour and Welfare Bureau. (ii) Represented the Working Group in public consultations on the SNT organised by the Labour and Welfare Bureau, March-February 2018.

[3] Discussions of the SNT at various Legislative Council meetings: (i) LegCo Panel on Constitutional Affairs, 30 April 2018; (ii) LegCo Panel on Welfare Services, 14 May 2018; and (iii) LegCo, 11 July 2018.

[4] (i) Organised / delivered public forums and workshops on SNT; and (ii) Provided training and support to student and parent helpers to deliver talks on SNT to special schools and NGOs.

[5] (i) Attended interviews with the following newspapers/social media: Lianhe Zaobao (Singapore), TV Most, RTHK Radio 1, AM 730, The Standard, and Oriental Daily. (ii) SNT was also reported in various news reports.

[6] Website: https://snt.support/. Facebook page: https://www.facebook.com/hkusnt/.

[7] Presented to academics, NGOs, and policy-makers in Australia, mainland China, Japan, South Korea, Amsterdam and Taiwan.

University: The University of Hong Kong (HKU)

Faculty: Faculty of Architecture

Title of case study: RFID-Enabled Building Information Modeling (BIM) Platform for Prefabrication Housing Production in Hong Kong

1. Summary of the impact (indicative maximum 100 words)

Our research impacts extend across various aspects of prefabrication housing production. We developed the RFID-enabled Building Information Modelling Platform (RBIMP) which ntegrates emerging information technologies in order to improve the project delivery. The RBIMP brings lots of benefits to the construction industry, the environment and the society as well. According to the feedback of end-users, the RBIMP improves the information exchange between stakeholders, ensuring smooth supply chain and on-site construction. The RBIMP also helps control the quality of construction work. In addition, the site environment becomes much safer than before and less construction waste is generated during the construction process.

2. Underpinning research (indicative maximum 500 words)

In today's market, prefabrication housing production (e.g. public housing projects in Hong Kong) faces several serious challenges. First, data collection from prefabrication manufacturing to onsite construction uses paper-based manual operations. Thus, the captured data tend to be incomplete, inaccurate, and inadequate. Second, information sharing among different parties is confined due to the adoption of traditional methods of communication such as e-mail, phone calls, and fax. Third, collaboration among various stakeholders heavily relies on real-time information, such as when it comes to the status and location of prefabricated components. Such information, however, is often delayed, causing poor visibility and traceability as construction progresses.

Our research, led by Prof. George G.Q. Huang (IMSE, HKU), Dr. Wilson W.S. Lu (REC, HKU), Prof. Thomas, Ng (CE, HKU) and external partner Prof. Geoffrey Shen (BRE, PolyU), addresses the above-mentioned challenges by designing and developing the RBIMP which deals with the project delivery processes and real-time information visibility and traceability. The RBIMP integrates additional dimensional information, e.g. progress and cost, to extend the original BIM model to a multi-dimensional one, which uses service-oriented architecture (SOA) as a critical innovation to enable the platform as a service (PaaS). In addition, the IaaS (Infrastructure as a Service) level of the RB IMP includes hardware and software layers. The hardware layer consists of the Smart Construction Objects (SCOs) and the RBIMP Gateway. SCOs are construction objects which are equipped with RFID devices and thereby converted into "smart" objects. The RBIMP Gateway connects, manages, and controls the SCOs through defining, configuring, and executing the operations. The RBIMP Data Source Management Service (RBIMP-DSMS) level provides not only a self-service portal for managing platform infrastructure and service provision but also services across the RBIMP to support Software as a Service (SaaS) and to handle the IaaS. The RBIMP-DSS level contains three primary management services, including prefabrication production service (PPS), prefabrication transportation service (PTS), and on-site assembly service (OAS), for various stakeholders at different stages of the construction lifecycle.

2.1 Prefabrication production service

PPS is responsible for generating best schedules and tactics for the operational convenience of prefabrication manufacturers. Various cutting-edge models and algorithms are adopted in the development of the service. Several sub-services, such as planning service, scheduling service, and production execution, are exploited to facilitate operations of manufacturing prefabricated

components.

2.2 Prefabrication transportation service

PTS is responsible for real-time management and control of the logistics of the prefabricated component from manufacturer to assembly site, which includes cross-border logistics between Mainland China and Hong Kong. Several sub-services, such as transportation planning and scheduling, fleet management, real-time transportation monitoring, and cross-border logistics execution, are exploited to facilitate operations when delivering prefabricated components.

2.3 On-site assembly service

OAS is responsible for facilitating various assembly operations, supervisions and quality checking on the construction site. BIM is integrated into the development of this service to visualize and monitor assembly progress. Several sub-services, such as on-site assets management, real-time supervision, and real-time feedback are exploited to facilitate assembly of prefabricated cast components.

3. References to the research (indicative maximum of six references)

This project led to a number of academic journal and conference papers. Six of them are listed below. The project team members received a Young Innovator Award from the Hong Kong Construction Industry Council in 2015. Paper 5 was put as the "Research highlights" on the first page of the Journal.

[1] Chen, K., Xu, G., Xue, F., Zhong, R. Y., Liu, D., & Lu, W. (2018). A physical internetenabled building information modelling system for prefabricated construction. International Journal of Computer Integrated Manufacturing, 31(4-5), 349-361.

[2] Zhong, R. Y., Peng, Y., Xue, F., Fang, J., Zou, W., Luo, H., ... & Huang, G. Q. (2017).

Prefabricated construction enabled by the Internet-of-Things. Automation in Construction, 76, 59-70.

[3] Chen, K., Lu, W., Wang, H., Niu, Y., & Huang, G. G. (2017). Naming objects in BIM: A convention and a semiautomatic approach. Journal of Construction Engineering and Management, 143(7), 06017001.

[4] Niu, Y., Lu, W., Liu, D., Chen, K., Anumba, C., & Huang, G. G. (2017). An SCO-enabled logistics and supply chain-management system in construction. Journal of Construction Engineering and Management, 143(3), 04016103.

[5] Niu, Y., Lu, W., Chen, K., Huang, G. G., & Anumba, C. (2016). Smart construction objects. Journal of Computing in Civil Engineering, 30(4), 04015070.

[6] Chen, K., Lu, W., Peng, Y., Rowlinson, S., & Huang, G. Q. (2015). Bridging BIM and building: From a literature review to an integrated conceptual framework. International Journal of Project Management, 33(6), 1405-1416.

External grant information:

1. Public Sector Trial Scheme (ITT/003/18LP). Title: Trial: RFID-Enabled Building Information Modelling (BIM) Platform for Prefabrication Housing Production in Hong Kong. HK\$2.99million. April 2018 - October 2019.

2. Innovation and Technology Fund (ITP/045/13LP). Title: RFID-Enabled Building Information Modelling (BIM) Platform for Prefabrication Housing Production in Hong Kong. HK\$8.88million. March 2014 - July 2016.

3. Innovation and Technology Fund (ITF) Internship Programme 2014. Title: RFID-Enabled Building Information Modelling (BIM) Platform for Prefabrication Housing Production in Hong Kong. HK\$0.29million. March 2014-March 2016.

Internal grant information:

1. HKU Post Doctor Fellowship (PDF)/Research Assistant Professor (RAP) 34th Round 2015. Title: BIM-and loTs-oriented Smart Construction Objects (SCOs): The Elementary Particles of Future Construction, 36 months.

2. HKU Application for RPg Places from Central Pool 2015/16. Title: Bridging BIM and Buildings (BBB), Unbinding Bounded Rationality.

3. HKU Post Doctor Fellowship (PDF)/Research Assistant Professor (RAP) 29th Round 2012. Title: Enhancing housing production in Hong Kong through BIMatzing offshore prefabrication, 36 months.

4. Details of the impact (indicative maximum 750 words)

Prefabrication housing production has been widely adopted in the global construction industry due to its advantages such as less construction waste and energy consumption than in-situ casting and wet trades. Our research proposed RBIMP to further leverage the performance of prefabrication housing production. The key impacts are summarised below:

- Improvements have been made to the prefabrication production in several aspects. Firstly, the data required by the factory and those exchanged with other stakeholders become more accurate and reliable. The paperwork at the production stage is reduced by 48.3%. Secondly, the ability of responding to design and job plan changes are much stronger. The management of the factory has become more efficient due to real-time information sharing. The production efficiency thus has been improved. The production lifecycle and waiting time for delivery are enhanced by 40% and 25% respectively. Lastly, construction resources are optimized as a result of decision making based on real-time data from the production sites. The full use of real-time data has been made via visibility tools. Time spent on locating prefabricated components is reduced by 31.25%.
- Both technical and business perspectives of the prefabrication transportation have been improved. For the technical perspective, RBIMP enables convenient information sharing through web services-enabled technologies. Information sharing could be easily achieved among different modules and systems. The paperwork for transportation is reduced by 40%. In addition, the RB IMP improves the efficiency of information collection. The mobile app well integrates the NFC module and GPS module of smart phone to realize real-time transportation information collection. It reduces hardware investment for collecting such data, and also decreases the burden of using the system. The time spent on order picking is decreased by 40%. For the business process and operation perspective, RBIMP helps the logistics providers adopt better services to the factory by making full use of the data from production, logistics companies have a dynamic tracking and control function for visualizing delivery of prefabrication components, and cross-border logistics and supply chain management has become more efficient.
- The main contractors benefit from knowing the real-time information of prefabricated components. The data collection on site has become effective, reliable and more value-added. The time spent on checking the on-site assembly of prefabricated components is reduced by about 46.67%. The BIM model of RB IMP can be accessed through many devices, e.g. PC, tablet, mobile phone, which ensure remote access to real-time information for controlling the quality of construction work. In addition, the RB IMP increases the accuracy rate of on-site assembly from 99.85% to 100%. Since a single prefabricated component is large in size and costly in energy, the improved assembly accuracy is significant in terms of the energy and labour saving. Therefore, with the help of RB IMP, sustainable construction can be better achieved. The whole on-site main contractor team is more resilient when facing design changes,

order changes, or changes due to repairing defective components.

• The RBIMP not only offers the architecture, engineering, construction, and operations (AECO) industry more efficient and sustainable prefabrication housing production. Its proven success in reducing material waste, labour hours and thus overall costs, as well as their increasing use within the industry, contributes to a positive political environment that allows the government to demand developers employ RBIMP before approving and/or financing a capital project. Based on the Multi-Perspective Model which proposes that as an innovation proves its superiority over the common practice, it is appropriate that government and non-government agents encourage its use over the business as usual method. At the beginning of 2018, the Hong Kong government mandated thirty of its major infrastructure projects adopt BIM in their design and construction stages. According to the Hong Kong Housing Authority's Sustainability Report 2015/16, the agency has 45 active building sites utilizing BIM technology. Furthermore, the RBIMP helps to implement the Hong Kong Construction Industry."

5. Sources to corroborate the impact (indicative maximum of 10 references)

[A] Video of the project: <u>https://www.youtube.com/watch?v=n8IRrweePic</u>

[B] Fung A. (Deputy Director of Development & Construction Division, Hong Kong Housing Authority). BIM in Hong Kong: What is your Contribution? http://www.acehk.org.hk/image/data/20170714%20(ACEHK%20Breakfast%20Talk)_Ada%20Fu ng.pdf

[C] Project website: <u>http://www.autom.hk/bimp/</u>

[D] Pilot Study Report (Feb. 2016). RFID-Enabled Building Information Modelling (BIM) Platform for Prefabrication Housing Production in Hong Kong. [available upon request]

University: The University of Hong Kong (HKU)

Faculty: Faculty of Education

Title of case study: Impacting Early Childhood Policy in East Asia and the Pacific through Contextually-appropriate Assessment of Early Child Development

1. Summary of the impact (indicative maximum 100 words)

A large-scale international project developed the East Asia-Pacific Early Child Development Scales (EAP-ECDS), the first developmental assessment tool created on the basis of the culture and values of a world region. The EAP-ECDS were lauded as one of the major events influencing early childhood development policy and practice in the 2017 Lancet series on Early Childhood Development. The impact of the EAP-ECDS research has been recognized through a Best of UNICEF Research award for "policy impact, innovative design, thoughtful use of available data, methodological rigour and potential replicability in both the country of origin and other country contexts" (UNICEF, 2015).

2. Underpinning research (indicative maximum 500 words)

Early Childhood Development (ECD), the period of human development from conception to the age of 8, sets the foundation for life-long development. Converging evidence from neuroscience and from developmental, educational and economic sciences highlights the importance of ECD for human capital formation. Investing in ECD has been lauded for yielding "exceptional returns", being a "powerful equalizer", and not leaving disadvantaged children "behind at the starting gate of school".

<u>Need for valid data on holistic ECD</u>. Population-level monitoring of ECD is vital to inform educational and social policy. However, the paucity of culturally appropriate assessment tools contributes to the dearth of valid data on ECD in low- and middle-income countries (LMICs). The majority of our knowledge regarding child development is derived from Western, high-income societies but only 18% of children are born in high-income countries; the remaining 82% live in LMICs and more than one-quarter of the world's children live in the East Asia and Pacific region. By studying patterns and facilitators of ECD across different developmental domains in diverse LMICs of this region, our work contributes to an understanding of the universality of factors that influence ECD and the impact of risk and protective factors on early development and learning.

In the area of early childhood, outcome data have been limited to mortality and anthropometric indicators. Stunting data, for example, are available from countries across the world because assessment is universally agreed upon and straightforward to collect. However, there are currently no globally accepted tests of ECD outcome. This is possibly due to the concern that Western assessment tools may not be valid in LMICs due to cultural differences in both the overarching constructs to be assessed and in assessment techniques. The EAP-ECDS tools are the first developmental assessment measures created on the basis of the culture and values of a world region.

Process of development. The EAP-ECDS were conceived and piloted in 2010, validated in 2014 and the work is ongoing. In Phase I, the EAP-ECDS were developed based on a comprehensive desk review of the Early Learning and Development Standards (ELDS) from seven countries, and the construction of the scales was underpinned by these standards. In Phase II, the scales were piloted in three countries and Phase III involved a validation in six countries: Cambodia, China, Mongolia, Papua New Guinea (PNG), Timor-Leste and Vanuatu. Phase IV involved the development of a Short-Form and Phase V (ongoing) involves the use of the Short Form in Myanmar and other countries. Phase VI will analyse the impact of EAP-ECDS on national policy and the effects observed at the regional and international levels, and an impact case study will be carried out.

Names of key researchers.

HKU: Nirmala Rao, Diana Lee, Ben Richards (Faculty of Education), Patrick Ip (LKS Faculty of Medicine) and John Bacon-Shone (Faculty of Social Sciences)

Formerly Associated with HKU: Jin Sun (Assistant Professor at EUHK); Marie Ng (Associate Professor at University of Washington)2

HKU Faculty of Education Fellows: Yvonne Becher (Acting CEO, Child Development Centre); Mami Umayahara

3. References to the research (indicative maximum of six references)

The quality of the research is reflected in the scientific publications therefrom, the award of an international research prize, and numerous invitations for keynote/plenary presentations on child development measurement. The development of the EAP-ECDS has also contributed to prestigious invitations from UNICEF, UNESCO, WHO, the World Bank, OECD and the Brookings Institute to Nirmala Rao to participate as a specialist/expert/advisor in international meetings concerned with early childhood assessment and the Sustainable Development Goal (SDG) Target 4.2.

The annual Best of UNICEF Research programme showcases and recognizes high quality, high impact research being done under the auspices of the agency. Among 99 submissions of research in 2014, four were selected for special commendation by an eminent international external review panel. As noted earlier, the EAP-ECDS were selected for potential policy impact, innovative design, thoughtful use of available data, methodological rigour and potential replicability in both the country of origin and other country contexts.

Selected Outputs

1. Rao, N., Sun, J., Ng, M., Becher, Y., Lee, D., Ip, P., & Bacon-Shone, J. (2014). *Validation, Finalization and Adoption of the East Asia-Pacific Early Child Development Scales (EAP-ECDS).* UNICEF. <u>http://www.arnec.net/wp-content/uploads/2015/07/EAP-ECDS-Final-Report1.pdf</u>

2. Weber, A., Darmstadt, G.L., & Rao, N. (2017). Gender disparities in child development in the East Asia-Pacific. *The Lancet: Child & Adolescent Health.* 1(3), 213-224. DOI: 10.1016/S2352-4642(17)30073-1.

3. Rao, N., Sun, J., Richards, B., Weber, A. M., Sincovich, A., Darmstadt, G. L., & Ip, P. (2018). Assessing Diversity in Early Childhood Development in the East Asia-Pacific. *Child Indicators Research*, 1-20.

4. Sun, J., Zhang, L., Chen, E., Lau, C., & Rao, N. (provisionally accepted). Preschool attendance and executive function mediate socio-economic status–related early academic achievement gaps in East Asia and the Pacific. *Early Education and Development*.

5. Rao, N., Richards, B., Sun, J., Weber, A., & Sincovich, A. (revision in review). Early childhood education and child development in East Asia and the Pacific: A Four-country Study. *Early Childhood Research Quarterly*.

6. Richards, B., Bacon-Shone, J., & Rao, N. (revision in review). Socio-economic status and child development in East Asia-Pacific. *International Journal of Behavioral Development*.

Other research outputs based on the EAP-ECDS include over 12 international invited/keynote speeches, 10 international refereed conference papers/posters, 10 other journal articles in different stages of review/preparation, 5 other publications, 8 country-specific reports and policy/evidence briefs, and an EAP/ECDS brief.

Funding

Funds only cover technical support. The study of 8200 children and their parents with representative samples in 8 countries cost millions of dollars. Countries were funded separately to conduct the empirical research and separate funding for travel and local accommodation for the HKU consultant team was also provided.

- UNICEF Myanmar. Provision of Technical Support for EAP-ECDS. (2016-2017).HKD 275,278
- UNICEF Papua New Guinea. Baseline survey of ECCE facilities in AROB and PNG. (2016). HKD 407,160
- UNICEF Cambodia. ECD Scale in-depth Analysis. (2015-2016). HKD 99,119

- Asia Pacific Regional Network for Early Childhood (ARNEC). EAP-ECDS shortened version. (2015). HKD 93,600
- UNICEF (East Asia Pacific Regional Office), Validation, Finalization and Adoption of the EAP-ECDS. (2013-2014). HKD 1,536,397
- Asia Pacific Regional Network for Early Childhood (ARNEC). (2011-2012). HKD 150,045

4. Details of the impact (indicative maximum 750 words)

The EAP-ECDS were conceived as a regional project, funded and supported by UNICEF East Asia Pacific Regional Office and Asia Pacific Regional Network for Early Childhood (ARNEC). Thus, from its inception, collaboration and knowledge exchange among the governments and researchers of the participating countries were ensured through regional workshops as well as the follow-up activities by UNICEF country offices that closely work with the governments for ECD policy and programme development. UNICEF's and ARNEC's global and regional networks allowed ECD stakeholders in the region to be informed of the EAP-ECDS through conferences and media outreach.

Eight countries have already participated in the EAP-ECDS project: Cambodia, China, Fiji, Mongolia, Myanmar, Papua New Guinea, Timor-Leste and Vanuatu. In each country, a working group is formed, consisting of policy makers, researchers and other key ECD stakeholders because the EAP-ECDS administration was conceived not only a research exercise but opportunities for awareness raising and capacity development at the country level. Governments were very interested in implementing the EAP-ECDS in the context of evidence-led policy making and national government support was pivotal in obtaining large, nationally representative samples of children.

Country-level impact

National policy development. Phases III and VI produced country-specific findings and policy recommendations. Solid evidence of differences based on gender, urban-rural residence, ethnicities and family wealth as well as the importance of maternal education on ECD have been presented to and acknowledged by participating countries. Of particular note was the finding that participation in ECE programmes had a significant impact on ECD outcome. This finding has further fuelled efforts to scale up ECE programmes. In Cambodia, UNICEF commissioned HKU to conduct an in-depth analysis of the findings to better understand differences in developmental outcomes across demographic groups, which was presented to the National ECCD Committee chaired by the education minister and attended by 13 ministries. Further, PNG commissioned the HKU team to develop a baseline survey of preschool facilities and minimum operating standards and to help draft their national policy for early childhood care and education. HKU was also asked to give a second training as part of the training programme for the Cambodia Technical Working Group on *Curriculum Revision*. In Vanuatu, too, the EAP-ECDS are being used to guide the curriculum review and teacher training. Indeed, there have been several changes in the early childhood landscape since the first EAP-ECDS study began in 2010. These include the development of more equity-focused national ECD policy and action plan, a national core curriculum, and efforts to promote home-based early childhood learning and development through parent education (e.g. Myanmar ECCD Policy, 2014; Cambodia's National Action Plan on ECCD 2014-2018, 2014; Fiji's Policy in Early Childhood Education, 2013; Mongolia's National Core Curriculum for Pre-school Education, 2015).

Development of research capacity in low and middle-income countries. The HKU team conducted a three-day in-country training workshop in each of the participating countries to train a local research team on how to assess children using the EAP-ECDS, and closely advised the data collection process in order to transfer research skills (e.g. sampling, survey methods, data collection and analysis) and to ensure data quality. The successful administration of the Scales in all participating countries demonstrates the positive outcome of this approach. Moreover, the EAP-ECDS are now being used by the trained researchers in China, Cambodia and PNG for baseline assessment and programme evaluation. Further, the HKU team conducted a regional

training of trainers (ToT) in July 2017, with participants from: Cambodia, Malaysia, the Philippines, Republic of Korea, Singapore, Timor Leste and Viet Nam. In December 2017, Cambodia and Viet Nam received in-country training on how to administer the EAP-ECDS Short Form.

Global and regional level impact

The impact of the EAP-ECDS has been clearly strengthened by the well-respected regional network, ARNEC. The network became the custodian of the tool in late 2017 and it has done much to enhance the visibility of the tool through its partnerships and outreach.

Contribution to the monitoring of the Sustainable Development Goal (SDG) Target 4.2. The EAP-ECDS have been cited widely as a promising population-based assessment tool of holistic development of young children. Following this recognition and visibility of the EAP-ECDS, Nirmala Rao was invited to various high-level international technical meetings on the monitoring of the SDG Target 4.2. Of the indicators selected to measure the progress towards this target is: the percentage of children under age 5 years who are developmentally on track in health, learning and psychosocial well-being (indicator 4.2.1). The current proxy measure for global monitoring of this indicator is the Early Childhood Development Index (ECDI), developed by UNICEF, which is collected through parent survey and still requires development and testing. Notably, the EAP-ECDS are among a handful of tools that has informed the development of a new ECD measure for SDG Target 4.2.1 (UNICEF, 2017; UNESCO, 2017) and the EAP-ECDS can complement the improved ECDI through direct child assessment.

5. Sources to corroborate the impact (indicative maximum of 10 references)

UNICEF Office of Research (2015). Early childhood development in East Asia and Pacific: Culturally sensitive testing. In *Best of UNICEF Research 2015* (p.19-23) Florence, Italy. https://www.unicef-

irc.org/publications/pdf/00%20Best%20of%20UNICEF%202015_layout_web3.pdf

2. UNESCO (2016a). *Global Education Monitoring Report 2016*. Paris: UNESCO. (pp. 217-218) http://unesdoc.unesco.org/images/0024/002457/245752e.pdf

3. UNESCO (2016b). New horizons: A review of early childhood care and education in the East Asia Pacific. UNESCO Bangkok. Pp 42,

http://unesdoc.unesco.org/images/0024/002457/245728E.pdf

4. Black, M. M. et al., (2017). Early childhood development coming of age: science through the life course. *The Lancet*. 389, Issue 10064, 77 - 90

5. Carr, V., S. Kym, & Manson, E. (2018). Early childhood education in Papua New Guinea. In; Jaipaul L. Roopnarine, J. L., Johnson, J. E., Quinn, S. F. & Patte, M. M. (eds) *Handbook of International Perspectives on Early Childhood Education*. Routledge,

6. Fernald, L.C., Prado, E.L., Kariger, P. & Raikes, A. (2017). A toolkit for measuring early childhood development in low- and middle-income countries. World Bank, Washington, DC.

7. Grieshaber S. (2017). A Changed Agenda for Early Childhood Education in the Asia-Pacific. In: Li M., Fox J., Grieshaber S. (eds) *Contemporary Issues and Challenge in Early Childhood Education in the Asia-Pacific Region: New Frontiers of Educational Research*. Springer, Singapore.

8. Raikes, A. (2017). Measuring child development and learning. *European Journal of Education*, *52*(4), 511-522.

9. Rich-Orloff W., Camaitoga U. (2017). Understanding the Early Childhood Education Policies in Pacific Islands. In: Li H., Park E., Chen J. (eds) Early Childhood Education Policies in Asia Pacific. Education in the Asia-Pacific Region: Issues, Concerns and Prospects, vol 35. Springer, Singapore.

10. Wolf, S., Halpin, P., Yoshikawa, H., Dowd, A. J., Pisani, L. & Borisova, I. (2017). Measuring school readiness globally: Assessing the construct validity and measurement invariance of the International Development and Early Learning Assessment

University: The University of Hong Kong (HKU)

Faculty: Faculty of Engineering

Title of case study: Bioinformatics Algorithms and Next-Generation-Sequencing (NGS) Data Analysis

1. Summary of the impact (indicative maximum 100 words)

In early 2000's we initiated the algorithmic research on constructing compressed data structures to index the human genome. When high-throughput DNA sequencing (NGS) started to emerge in the late 2000's, our work helped the genomics industry (e.g., BGI, Sanger) to resolve the major computational bottleneck in aligning NGS data (specifically, from weeks/days to hours per sample) and achieve better accuracy. With ITF funding support, we were able to extend our work to more sophisticated NGS analysis for biomedical applications, and more notably, re-designed and integrated NGS analysis into an easily-usable system for (medical) users with minimal bioinformatics background (e.g., Department of Health). In 2014, we founded a spin-off company which built the first bioinformatics cloud in China (BGI Online) and helped boost the Mainland's BioIT industry.

2. Underpinning research (indicative maximum 500 words)

In 2001, we initiated the algorithmic study on constructing the compressed suffix array using an amount of memory that could only fit the compressed suffix array itself but not the "original" suffix array. We published the first such algorithm in COCOON 2002. Since then, we worked on a series of theoretical problems related to compressed text indexing (ISAAC 03, DCC 04, CPM 04, SODA 05, ESA 06, CPM 06, ISAAC 07, DCC 08, ISAAC 09, CPM 15; and seven journal publications). Envisioning the practical value of our theoretical work, we also paid attention to the application of our algorithms, in particular for indexing the human genome (first publication ALENEX 04). Meanwhile, our work caught the attention of the bioinformatics community (Lippert et al were the first to publish a bioinformatics paper (J. Computational Biology 05) based on our algorihtmic results). We have spent a few years to improve our DNA indexing software to suit bioinformatics requirement on relatively low similarity, and our work concluded that BWT (without further compression) was the most efficient compressed indexing scheme, with a release of the related software library in 2007 (followed by a paper in Bioinformatics 08). This work has been well received by the bioinformatics community as well as the algorithm community, and named in Paolo Farragina's invited talk on compressed indexing at ESA 10 as one of the two most successful applications.

In late 2000's, the emergence of high-throughput and low-cost sequencing (i.e., next generation sequencing NGS) revolutionized the genomics community. Yet to analyze the large amount ofNGS data was a big computational challenge (a single sequencer could produce a WGS dataset with a billion short DNA fragments in a few days). In 2008, we started to collaborate with BGI, a private genomics company which then had the largest sequencing throughput worldwide. By adapting our BWT indexing technology to tolerate the sequencing errors in short NGS fragments, we built a totally new core engine for NGS alignment for BGI (SOAP2, published in Bioinf01matics 09), which was tenfold faster and more accurate than before. Subsequently we extended our indexing technology to the GPU model and developed dynamic scheduling strategies to support GPU-based parallel alignment, the resulting software SOAP3 (Bioinformatics 12) and SOAP3-dp (PLOS One 13) have another tenfold of improvement (specifically, one million of DNA fragments can be processed in ten seconds on a single computer). Based on our index technologies, various analysis software has been developed subsequently (the latest example was for complex metagenome assembly (MegaHit, Bioinformatics 15)).

3. References to the research (indicative maximum of six references)

Academic work:

- (1) A Space and Time Efficient Algorithm for Constructing Compressed Suffix Arrays. TW Lam, K Sadakane, WK Sung, SM Yiu. COCOON 2002: 401-410.
- (2) Constructing Compressed Suffix Arrays with Large Alphabets. WK Hon, TW Lam, K Sadakane, WK Sung. ISAAC 2003: 240-249 Journal version: Algorithmica 48(1): 23-36, 2007).
- (3) Compressed indexing and local alignment of DNA. TW Lam, WK Sung, SL Tam, CK Wong, SM Yiu. Bioinformatics 24(6): 791-797 (2008)

Work inspired by the Genomics Industry:

- (4) SOAP2: an improved ultrafast tool for short read alignment. R Li, C Yu, Y Li, TW Lam, SM Yiu, K Kristiansen, J Wang. Bioinformatics 25(15): 1966-1967 (2009). (Google Scholar: 2,500 citations)
- (5) SOAP3: ultra-fast GPU-based parallel alignment tool for short reads. CM Liu, T Wong, E Wu, R Luo, SM Yiu, Y Li, B Wang, C Yu, X Chu, K Zhao, R Li, TW Lam. Bioinformatics 28(6): 878-879 (2012) (Google Scholar: 200 citations)
- (6) MEGABIT: MEGABIT: an ultra-fast single-node solution for large and complex metagenomics assembly via succinct de Bruijn graph. D Li, CM Liu, R Luo, K Sadakane, TW Lam. Bioinformatics 31(10), 1674-1676 (2015) (Google Scholar: 210 citations)

4. Details of the impact (indicative maximum 750 words)

- (1) BGI (Shenzhen 300766): BGI was the largest sequencing service providers worldwide in late 2000s. Since 2008, the alignment software SOAP2 has been BGI's primary analysis tool for their whole genome sequencing (WGS) service, supp01ting hundreds (if not thousands) of projects under a business model for collaborative research. SOAP2 has received a lot of citations from such projects (since 2013, BGI has used SOAP2 in, among others, at least 9 projects that led to publications in Nature series journals or Science).
- (2) Technology spinoff from the Department of Computer Science: In 2014, Professor TW Lam, Professor David WL Cheung and Dr Ruibang Luo of the Bioinformatics Algorithms Laboratory (BAL) co-founded a startup called L3 Bioinformatics Limited (L3B), and BGI invested two million USD into L3B. Around that time, managing large-scale NGS data and analysis demanded lots of resources and expeltise, thus depriving many users from conducting their own analysis. In this regard, L3B developed a public cloud platform for BGI to host the client's sequencing data and more importantly, to provide NGS analysis to the clients on a demand basis. This platform, called BGI Online, was launched on Amazon AWS in 2015 and was named as a key initiative when BGI went public in 2016.
- (3) Clinical applications: Our success in the basic analysis of sequencing data has motivated us to further develop computational applications for clinical diagnosis. This direction was well supported by the Government with the award of two ITF grants (PC TW Lam; Deputy PC David WL Cheung) with a total over 12 million HKD from 2013 to 2017 (we also received over 1.2 million HKD of matching fund from the industry). Among others, an ultrafast software tool called BALSA for detecting variants with superior quality has been developed on top of our alignment software SOAP3-DP. BALSA is supplemented with variant interpretation software (and databases). The Hong Kong Sanatorium & Hospital (HKSH) was the first pilot user of BALSA and its related software for cancer diagnosis.

- (4) Successful pilot scheme for analyzing Genetic Diseases at the Department of Health: In 2015, with the support of HKSH, we were awarded funding over 3 million HKD to launch a pilot scheme of NGS analysis at the Clinical Genetic Service (CGS) of the Department of Health. Before this scheme, CGS relied on a bioinformatics research team in HKU's Faculty of Medicine to analyze their NGS data, out-sourcing such analysis incurred long turn-around time (in terms of weeks) and the analysis, as inherited from biological studies, did not meet the clinical requirement (e.g., barcoding, panel coverage, quality control) and often) and produced undesirable results. The BALSA related software was set up in CGS in late 2015. Since then CGS was able to analyze over 2,000 samples (for Mendelian Diseases) in their clinic, and the turnaround time was reduced to hours. More importantly, the software allowed the doctors of CGS to obtain accurate diagnosis with ease (the last report showed that over 99% of variants detected were confirmed subsequently).
- (5) Technology transfer & BioIT in China: In late 2014, HKU has granted a non-exclusive source-code license of BALSA to L3B for a license fee of USD 150,000. L3B has drastically enhanced BALSA and created a new software ELSA. In 2016, United Electronics Limited (UEC) (Shenzhen 002642) also obtained a non-exclusive license of BALSA from HKU for USD 150,000, as well as an exclusive source-code license of ELSA and other related software from L3B for a total of RMB 18M. UEC targeted to use such tools in their Bio-IT products (in particular, Bio-Cloud and local NGS analytics for hospitals) in China.
- (6)Indirect impact: Our early work on indexing and alignment has inspired other teams in their development of alignment software. A typical example is BWA, which was developed by UK's Wellcome Trust Sanger Institute with reference to the source code of our software BTW-SW (as reported in BWA's publications doi:10.1093/bioinformatics/btp324; 10.1093/bioinformatics/btp698). BW A was used in the benchmark of genotypes of human genome sequencing by USA's National Institute of Standards & Technology; the result was published in Nature Biotech 2014 (doi:10.1038/nbt.2835). Furthermore, BWA was the primary analysis tool used for the 1000 Genomes Project, of which the main results have been published in Nature 2015 (doi:10.1038/nature15393 and 10.1038/nature15394).

5. Sources to corroborate the impact (indicative maximum of 10 references)

BGI's impact projects (on or after Oct 2013) that used SOAP2 (as mentioned in 4(1) above):

- A genomic variation map provides insights into the genetic basis of cucumber domestication and diversity. <u>http://www.nature.com/ng/journal/v45/n12/full/ng.2801.html</u>
- Whole-genome and whole-exome sequencing of bladder cancer identifies frequent alterations in genes involved in sister chromatid cohesion and segregation. http://www.nature.com/ng/j oumal/v45/n 1 2/full/ng.2798.html
- Genome sequencing of 161 Mycobacterium tuberculosis isolates from China identifies genes and intergenic regions associated with drug resistance. http://www.nature.com/ng/j oumal/v45/n I O/full/ng.2735.html
- Identification of a novel salt tolerance gene in wild soybean by whole-genome sequencing. http://www.nature.com/articles/ncomms5340
- The sheep genome illuminates biology of the rumen and lipid metabolism. http://science.sciencemag.org/content/344/6188/1168
- An integrated catalog of reference genes in the human gut microbiome. <u>http://www.nature.com/nbt/journal/v32/n8/full/nbt.2942.html</u>
- Identification and assembly of genomes and genetic elements in complex metagenomics samples without using reference genomes.

http://www.nature.com/nbt/journal/v32/n8/full/nbt.2939.html

- Genomic analyses provide insights into the history of tomato breeding. <u>http://www.nature.com/ng/journal/v46/nl l/full/ng.3117.html</u>
- Early allopolyploid evolution in the post-Neolithic Brassica napus oilseed genome. <u>http://science.sciencemag.org/content/345/6199/950</u>

ITF (Innovation Technology Fund) grant record (as mentioned in 4(3) above):

- ITF 6.8M (2015 2017): A Genomic Database for the Chinese Population with Applications for Precision Medicine, PI TW Lam;
- ITF 5.85M (2013 2015): A Genomic and Pharmaceutical Knowledge-based System for Clinical Diagnosis and Case Repository, PI TW Lam

University: The University of Hong Kong (HKU)

Faculty: The Faculty of Social Sciences

Title of case study: Changing the practices of iSlave producers and the working condition of student-labourers in Apple supplier factories in China

1. Summary of the impact (indicative maximum 100 words)

Prof. Pun Ngai extended her longstanding action research into labour rights to the widespread but previously unresearched phenomenon of the use of vocational school students as a new form of labour use in Apple's supply chain in China. This group, totalling over 20 million since 2008, are the "student laborers" who fuel up China's economic growth in the post-financial crisis period. The findings have had an accumulated impact on: influencing the agenda of labour right investigations and campaigns launched by local and international NGOs; raising international media concern; and bringing about real changes of labour protection policy in business CSR realm.

2. Underpinning research (indicative maximum 500 words)

The CRF project on "Learning to Labor: Social Media and Migrant Labor Protection in China" (2016-2019), led by Prof. Pun and supported by the Research Grants Council, University Grants Committee of Hong Kong, is the first large-scale research on the new generation of migrant workers coming from the vocational schools in China. Her research team is the pioneer to build a digital platform 'senseware' to provide knowledge on labour and gender protection. The CRF project builds on the work of the 20-University Research Group which was formed by Prof. Pun in 2010 when a wave of suicides occurred inside Foxconn plants. Unlike traditional rural migrant labour, this new source of labour subjects is driven from the vast amount of student interns from vocational schools under the auspice of the Chinese state and the demand of the market.

1. New forms of labour use in China identified.

With state support, the expansion of vocational education aims at training rural and urban labour force and providing millions of well-trained primary technical staff and skilled workers to meet the urgent needs of manufacturing (including global electronic apparel industries) and service sector in the post-financial crisis period. As children of migrants in many cities without an urban hukou, they are often barred from receiving even compulsory education in public schools and taking public examination in cities. They have no chance to have senior secondary level of education after graduating from the private schools for migrants. The appeal of urban life, along with the ease of entrance to vocational schools, specifically channels migrant youth into post-compulsory vocational education.

2. The working conditions of student interns inside Apple's supplier factories revealed.

This pioneering study provided the first ever evidence of the scale of students and graduates of vocational training schools being sent to industrial towns to work as cheap unskilled labour in manufacturing and electronic factories in China and the working conditions inside these factories. Field research in four regions of China showed that student interns from vocational training schools make up a significant part of the workforce in Foxconn factories to produce iPhones on assembly lines (from 10 % to 15%). Night shifts and overtime work are commonly required of student interns. Most of the students interviewed reported that they had to work ten hours per day causing problems of physical and mental health. This study has put the use of student laborers and their working conditions firmly on the public agenda. It has directly led to media investigations and campaigns organised by local and international NGOs targeting the transnational brands

especially Apple and their accountability for the working conditions in China.

3. Innovative research methods: constructing senseware

Pun's study goes beyond pure labor studies or communication studies by moving the sphere of scrutiny into the school, workplace and social media in order to make sense of the formation of a new working class, its new trends and contents. Moving beyond traditional models of trade unionism and labor NGOs, this CRF project contributes to a new paradigm of conceptualising vocational schools as sites of learning, communicating and organizing, and preparing students to be proper working-class subjects. Specifically, Pun's study built a "senseware" for migrant labor protection and to disseminate knowledge generated in this program among not only academic and public policy circles, but also NGOs, activists, and student-workers through training sessions, online engagement, and participatory action research.

3. References to the research (indicative maximum of six references)

Pun Ngai and Anita Koo (2018) "In Dialogue with Paul Willis's Learning to Labour: Class Reproduction and the Difference of Working-Class Culture at Contemporary Vocational Schools". Paper accepted by *British Journal of Sociology of Education*.

Smith, Chris and Pun, Ngai (2018), "Precarity and Class in China: An Unhappy Coupling", *Work, Employment and Society*. 32 (3): 599-615.

Pun, Ngai, Tommy Tse, and Kenneth Ng, (2017), "Challenging digital capitalism: SACOM's campaigns against Apple and Foxconn as monopoly capital." *Information, Communication & Society*, 1-16.

Jenny Chan, Pun Ngai and Mark Selden, (2015), "Interns or Workers? China's Student Labor Regime", Asian Studies, 11(1), March 2015: 69-99.

Pun Ngai, Jenny Chan and Mark Selden (2015), Dying for an iPhone: Apple, Foxconn and Lives of the Chinese Workers (in Chinese, Chung Hwa Book Co.). This manuscript has been translated and published into German, Italian, Spanish.

Pun, Ngai, et al. (2014), "Worker–intellectual unity: Trans-border sociological intervention in Foxconn." Current Sociology, 62:2: 209-223.

4. Details of the impact (indicative maximum 750 words)

The accumulated evidence and analysis of Pun's studies have led to three major areas of impact. These have greatly influenced the civil society and business policy for the improvement of the well-being of vocational school students.

A) Influence on investigations and campaigns held by local and international NGOs

This on-going research on vocational schools' students started in 2010. The accumulated information on the misbehaviour on student labour by Apple's suppliers like Foxconn has provided resources for a large number of local and international NGOs to launch relevant investigations and campaigns on labour rights. Directly inspired by the research, a Hong Kong based NGO Students and Scholars Against Corporate Misbehaviour (SACOM) was established with Prof. Pun as advisor. Since 2010, SACOM has run a series of high-profile consumer campaign calling for the improvement of the working conditions in Apple's supplier factories and actively demanding Apple and Foxconn to stop its practice of forcing vocational school students

to work excessively long hours in the iPhone production lines [5-1].

At the 10th anniversary of iPhone products in 2017, SACOM, with other international labour right NGOs, launched the iSlave at 10 Campaign in which Pun Ngai participated in a number of strategic meetings, to demand Apple to stop violating its own "Student Workers Protection" policy and local regulation in China [5-2]. The International Action Week of the campaign was supported by international NGOs from more than 10 regions including Bread for All (Switzerland), Sudwind (Austria), Solidaries (France) etc. Many of these NGOs explicitly acknowledged the contribution of Pun's research to their campaigns to promote awareness and sensitivity [5-3]. Materials were translated in Chinese, French, German, Catalan, Spanish and other languages.

B) Influence on international media

This research and the campaigns inspired by the research have raised international media attention on Apple's student- intern violations (for example, the Guardian in 2012 [5-1]). Another piece from the Guardian in 2013 [5-4] has quoted the workers' interview findings of Prof. Pun's research: "...Zhang's interview was one of 63 with student interns collected over two years in a forthcoming book by Jenny Chan, Pun Ngai and Mark Selden. The children's stories make upsetting reading."

After the launch of the iSlave at 10 Campaign in 2017, multiple international media have initiated their own investigation to disclose further on the issue. Financial Times has published articles confirming the student workers violation in Foxconn [5-5], and the social media, the Intium, has produced a special feature of Pun's interview on the labour protection in Foxconn [5-6]. Other media including Bloomberg, France24, Forbes, ARsTechnica, SCMP and others have also reported on the issue.

C) Influence on Apple's reactions and policy change

Most significantly, the accumulated impact of Pun's action research has influenced Apple's policy on student workers' protection. In addition to the inclusion of "Student Worker Protection" in its "Suppliers Responsibility Standards", Apple has also made student workers' right an important session of its auditing. In November 2017, four months after the launch of the iSlave at 10 campaign, Apple admitted in a statement that "During the course of a recent audit, we discovered instances of student interns working overtime at a supplier facility in China. We've confirmed the students worked voluntarily, were compensated and provided benefits, but they should not have been allowed to work overtime." [5-7]. Apple and Foxconn then took "immediate action to ensure that no interns are carrying out any overtime work". The number of student workers benefited was at least over 3,000 people in each internship period [5-8].

Another SACOM campaign inspired by this research has also brought direct changes to the working condition of Biel Crystal, the largest display screen manufacturer that occupies 60% of the global mobile phone glass screen market. The president of Biel Crystal met SACOM's representatives after the campaign and promised to make corrective measures on a series of labour right violations within two months. The number of workers who benefited was over 40,000 people [5-9].

D) Extension of impact from the electronic industry to the garment sector

Pun's research has prompted C&A Foundation to take the initiative to provide a grant of HKD 950,388 to support the project, Digital Platform for Migrant Labour and Gender Awareness in China [5-10]. In the grant agreement, it states, "The origin of this initiative is due to an academic research project on "Learning to Labour: Social Media and Migrant Labour Protection in China" (2016-2019). To reach this goal, we propose to further develop this empowerment program to extend our pilot academic project to have an industrial specific focus on fashion design and production students... We will also be able to test the relevance of the senseware content in preparing the students to realize their labour rights." [5-10]

With the support of C&A Foundation, the senseware will be formally launched in August 2018. In addition, there will be two sets of learning curriculum on labour rights and gender awareness which comprised of eight units of teaching materials covering sex education, sexual division of labour, workplace sexual harassment, gender hierarchy, gender status, and gender equity issues. A series of video production on labour and gender rights will also be produced (four videos of 30 minutes). A total of 50,000 workers will directly benefit from the learning curriculum as stated in the grant agreement [5-10].

To conclude, Prof. Pun was nominated as one of **50 outstanding women from around the world 2018** by Bread for all and Swiss Lenten Fund to celebrate 50 years of joint campaigning to defend human rights and a just and fairer world. [5-3]

5. Sources to corroborate the impact (indicative maximum of 10 references)

[5-1] Supporting Letter by SACOM (dated 20 April 2018);

https://www.theguardian.com/technology/2012/apr/01/apple-iphone-china-factories-forcedinterns

[5-2] https://zh-hk.facebook.com/hashtag/islaveat10?source=feed_text&__tn__=*NK-R

[5-3] Two_Supporting Letters by Bread for All (Switzerland), an international civic organization (dated 24 April 2018, and 17 July 2018);

https://m.facebook.com/story.php?story_fbid=2046936685335002&id=125653814129975 [5-4]

https://www.theguardian.com/commentisfree/2013/oct/14/forced-student-labour-china-apple [5-5]

https://www.ft.com/content/7cb56786-cda1-11e7-b781-794ce08b24dc;

[5-6]

https://theinitium.com/article/20170915-opinion-Foxconn/

[5-7]

https://www.theguardian.com/technology/2017/nov/21/apple-students-illegal-overtime-reports-iphone-x-foxconn-interns;

https://images.apple.com/supplier-responsibility/pdf/Apple_SR_2014_Progress_Report.pdf [5-8]

https://www.ft.com/content/292f223a-cf6f-11e7-b781-794ce08b24dc

[5-9]

https://web.archive.org/web/20170407180542/http://sacom.hk/bielcrystalpledge/

[5-10] Grant Letter by C&A Foundation and the agreement with HKU (dated 17 April 2018)

Annex III

Quantitative Indicators

Table 1

Performance Indicators Laid Down by UGC	2018/19
Number of patents filed in the year Note 1	206 Note 2
Number of patents granted in the year Note 1	66 Note 3
Number of licenses granted	120
Income (on cash basis) generated from intellectual property rights	\$26.9M
Expenditure involved in generating income from intellectual property rights Note 4	\$10.4M
Number of economically active spin-off companies Note 5	24
Net income generated (or net loss arising) from spin-off companies Note 6	(\$9.4M)
Number of collaborative researches, and income thereby generated Note 7	
 no. of projects income generated 	39 \$34.54M
Number of contract researches (other than those included in "collaborative researches" above), and income thereby generated Note 8	
 no. of projects income generated 	950 \$309.10M
Number of consultancies, and income thereby generated Note 9 - no. of projects - income generated	1,285 \$86.25M
Total of collaborative researches, contract researches and consultancies Note 10	
- no. of projects - income generated	2,274 \$429.88M
Number of student contact hours in short courses or e-learning programmes specially tailored to meet business or continuing professional development (CPD) needs Note 11	3,957,378
Income received from CPD courses Notes 11 & 12	\$593.6M

Performance Indicators Laid Down by UGC	2018/19
Number of equipment and facilities service agreements, and income thereby generated - no. of agreements - income generated	48 \$2M
Number of public lectures/symposiums and speeches to a community audience Note 13	1,588
Number of performances and exhibitions of creative works by staff or students Note 13	148
Number of staff engaged as members of external advisory bodies including professional, industry, government, statutory or non-statutory bodies	579

(Data as of early July)

Notes:

- 1. The number of patents granted is unrelated to the number of applications in a particular year.
- 2. The number of inventions involved is 146.
- 3. The number of inventions involved is 47.
- 4. The costs incurred in protecting all IPR in the reporting year are reported, without limiting only to those patents that were successful in generating income.
- 5. For commercialisation, the University through Versitech takes a dual approach of spin-off and licensing. In addition to spin-off companies, start-ups that are commercialising HKU technologies and funded by the Technology Start-up Support Scheme for Universities at HKU (TSSSU@HKU) have been included.
- 6. Versitech, HKU's wholly owned technology transfer company, is a minority shareholder in the spin-off companies. It is difficult to predict the companies' sales/turnover due to the volatile business environment. Only the net income (or net loss) of those companies with equity held by Versitech was reported because being the equity holder Versitech could obtain the financial information from those companies.
- 7. ITF projects with industrial sponsorship and other collaborative projects with at least two partners (one of which being a government or public body) were included.
- 8. Contract research projects commissioned by external organizations, and projects supported by funding schemes that allow non-higher education institutions to apply, including ITF projects without industrial sponsorship, Public Policy Research projects, and projects funded by the Food and Health Bureau, the SK Yee Foundation, Construction Industry Council, and Standing Committee on Language Education and Research (SCOLAR), were included. NIH projects have been classified as Contract Research since 2016/17.
- Consultancy and service projects for KE commissioned by external organizations to the University or Versitech, and consultancies undertaken by individual staff as outside practice (excluding clinical service and teaching in other tertiary education institutes) were included.

- 10. It is considered more appropriate to group collaborative researches, contract researches and consultancies together because it is sometimes not easy to classify projects into these categories.
- 11. Starting from 2018/19, the number of CPD courses includes self-funded Ug/TPg programmes and programmes offered by HKU School of Professional and Continuing Education (HKUSPACE) which are identified as for CPD purpose in accordance with the definitions of CPD set out in UGC's Common Data Collection Format (CDCF).
- 12. Net income was provided.
- 13. Community, cultural and KE-related events organised by the University and those delivered by academic staff at the invitation of external organisations were included.

Table 2

Other Performance Indicators of HKU	2018/19
Number of external advisory bodies membership held by HKU staff	2,797
Number of knowledge transfer websites Note 1	294
Number of postgraduate theses on open access Note 1	27,150
Download count of postgraduate theses to addresses outside HKU Note 1	104,380
Number of publications on open access Note 1	27,292
Download count of publications to addresses outside HKU Note 1	892,800
View count of HKU Researcher Pages from outside HKU Note 1	7,108,830
View count of HKU Research Postgraduate Student Pages from outside HKU Note 1	166,030
Number of staff available for media contact	640
Number of positive media impact related to knowledge transfer coverage, including print, on-line and electronic media Note 2	15,667
Number of placement/internships Note 3	3,591
Number of mentors from outside HKU for HKU students Note 3	1,149

Other Performance Indicators of HKU	2018/19
Number of appointments of external members to HKU advisory boards, committees or panels Note 3	427
Number of students (headcount) in non-UGC-funded taught postgraduate programmes Note 4	8,413

(Data as of early July)

Notes:

- 1. These seven indicators refer to the University's efforts in making knowledge accessible to society.
- 2. The number was obtained through the media impact project using an online news platform covering mainly local newspapers and magazines, and some multimedia outlets and websites to pool daily news reports concerning HKU that are KE-related.
- 3. As HKU sees KE as a two-way process, these three indicators refer to the University's efforts to learn from the community.
- 4. The non-UGC-funded TPg programmes generally respond to community needs for broadening/upgrading skills or life-long learning.

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