Research Assessment Exercise 2020
Impact Overview Statement

University: The Hong Kong University of Science and Technology
Unit of Assessment (UoA): 13 - Computer Studies/Science (incl. Information Technology)
Total number of eligible staff of the university in the UoA: 41

(1) **Context**

This UoA comprises the Department of Computer Science and Engineering in the School of Engineering. During the review period, we broadened our focus from primarily basic upstream research to midstream research to spur transfer of our technology breakthroughs to industry and society in our core computer science areas, such as AI and Databases. This has been achieved in collaboration with and with funding support from our **main non-academic users**, namely the IT industry and other sectors seeking cutting-edge IT solutions to on-going and emerging business needs.

Main types of impact: ***Economic impact*** via i) entrepreneurial *commercialization* of faculty and students' research, generating *over 15 start-ups* from 2014-19, *job creation*, and *new and improved services* for other businesses and their customers. Examples over the review period have included AI technology for banks through unicorn 4Paradigm (Yang, https://www.4paradigm.com/, CB Insights Feb 2019); and indoor localization technology for shopping malls from Compathnion (Chan, http://www.compathnion.com/). ii) adoption of our technologies in the daily operations and flagship products of global IT companies, such as Huawei, Tencent, and Microsoft (K Chen, Q Yang). We also deliver ***impact on education, health, and quality of life*** through improved provision of services, e.g. our e-learning technology (T Pong) now integrated into the HKMOOC e-learning course provider site, benefiting platform users; and technologies adopted for a remote monitoring system for chronic disease management at Shenzhen's People's Hospital (Q Zhang), serving over one million users.

Beneficiaries: In addition to users, our *beneficiaries* are wide-ranging, including start-up employees, customers over a range of industries, patients, IT professionals, Hong Kong shoppers and tourists, social media companies, banks, and e-learners.

(2) Approach to impact

The UoA has employed multiple mechanisms to cultivate an impact research culture over RAE2020 to work toward achievement of our vision of research excellence in both academia and knowledge transfer of our discoveries into societal applications that improve people's lives. These include:

- **Securing major grants to support midstream research:** With many UoA faculty now substantiated, we have moved strategically to boost our academics' work with industry on midstream research and technology transfer. To reinforce this, two University research institutes (Big Data Institute, led by L Chen; and Great Smart Cities Institute, associate director L Chen) and seven UoA joint labs (see below) were established in the review period. The UoA was also able to increase non-UGC/RGC locally funded projects to 98 ($130.30M) compared with 35 ($49.40M) in RAE2014. For example, K Chen's team implemented a high-performance RoCE network for WeChat's deep learning system, bringing a three-fold improvement in training speed for WeChat applications such as Moments Classification, Dialog System, and Image Recognition. The Chen team also invented the world's first AI-driven network brain (https://cloud.tencent.com/developer/article/1072209) for Huawei Network Mind.
- **Joint labs with major IT firms**: We established seven joint labs with major IT companies (DiDi, Face++, Naver, Tencent, WeBank, Xiaomi, and Xunlei) over the review period, in addition to the Huawei and MSRA joint labs set up before 2013. Products adopting our technology as a result include Tencent's Wechat news recommendation system (Q Yang) and WeBank's AI systems (Q Yang). The former impacts over one billion users, while the latter are being used for customer services, marketing, advertising and modeling, benefiting 200 million people and 600,000 companies.
- **Technology transfer and commercialization**: Faculty and their research students have transferred technologies into 16 start-ups assisted by the University's Entrepreneurship Center (led by G Chan since 2016) and Technology Transfer Center. In addition to those highlighted in Section 1, these include P-Sense (Chan, www.p-sense.com/, customer indoor behavioral data), Yfisoft (Chan,

http://yfisoft.com/web/, mesh WiFi solutions), Everest Innovation Technology (Quan, www.everest-innovation.com/, 3D image reconstruction), Sourcebrella (C Zhang, www.sourcebrella.com/, quality and security IT development tools), illustrating the range of our impact. We also filed 110 patents.

- **Innovation-related external competitions:** We encourage UoA members to participate in such contests to boost visibility of our technology and enable faculty and students to engage with industry and potential beneficiaries locally and beyond Hong Kong (e.g. Hong Kong ICT and APCITA awards, Wharton-QS Stars Awards Global Competition).
- **E-learning initiatives:** HKUST gained first-mover status as the first Asian university partner for Coursera (joined 2012) and edX's (joined 2013) Massive Open Online Courses e-learning platforms. Led by the UoA member (T Pong), HKUST has offered more than 40 MOOCs, attracting over one million learners globally. With the data collected, UoA members (D Yeung, H Qu) developed innovative e-learning technologies that are changing the landscape of education by providing a set of intuitive, interactive, and comprehensive learning analytics and visualization tools to MOOC instructors, students and developers.
- **Internal support:** All these achievements have been enabled internally through a supportive environment empowered by specific measures, for example, i) fostering non-academic user networking through regular industry forums; ii) provision of departmental seed funding to showcase projects with potentially large impact (e.g. Quan's 3D image construction; Qu's VisMOOC system; Chan's indoor localization technology); and iii) opening up inclusion of a research impact statement in faculty's annual merit-based review submission from 2016 onward.

(3) Strategy and plans

Our major plans for supporting impact over the next six-year period include:

- **Expansion of seed funding for showcase demos**: Following the provision of additional departmental funding to raise wider awareness of UoA technologies with major impact potential over RAE2020, we now plan to extend this strategy in coming years through more such funding for UoA technologies with substantial prospective impact.
- **Further participation in funding schemes encouraging industrial collaboration**: In particular, the Innovation and Technology Fund (ITF) and more recent Artificial Intelligence and Robotics InnoHK cluster (AIR@InnoHK), administered by Hong Kong's Innovation and Technology Commission. UoA members are actively involved in multiple AIR@InnoHK proposals with leading or participating roles.
- **Widening industry connections**: We will continue expand our connections with industry in five ways: (i) organizing regular research and technology forums; (ii) stepping up connections with alumni working in senior positions at major IT companies through social media groups; (iii) offering adjunct faculty positions to senior IT experts in the industry; (iv) disseminating news of internship opportunities at major research labs; and (v) establishing more joint research labs with industry.
- **Guangzhou campus development**: We are actively participating in the founding of the new HKUST Guangzhou campus, and will explore opportunities to transfer our technologies to industry in the Greater Bay area. Of the Guangzhou campus's 10 main "research thrusts", we will continue to actively lead the AI thrust and play a major role in the four other IT-related thrusts.

(4) Relationship to case studies

The three impact case studies illustrate different aspects of the UoA's approaches to impact. One key approach is to work closely with major companies on *technology transfer*, enabling our research to quickly reach huge numbers of beneficiaries through these companies, as shown in the Zhang case on utilizing the internet of things for smart healthcare. The Chan case focused on location-based sensing and leading to three start-ups is an example of our successful *championing of entrepreneurship* based on commercialization of original technology generated by our faculty and students. The Pong and Qu case on learning analytics illustrates our success in *securing major grants* to support midstream research, *building recognition* for our technologies *through competitions*, and developing open platforms and software systems in order to impact larger numbers of users.