Research Assessment Exercise 2020
Impact Overview Statement

University: City University of Hong Kong
Unit of Assessment (UoA): 13 - computer studies/science (incl. information technology)
Total number of eligible staff of the university in the UoA: 31

(1)   Context

The research carried out by our academic unit serves a wide range of non-academic user groups, including organisations such as telecommunication industry, financial institutes, transportation corporation, and NGOs. Our research provides solid foundations for the industry and education sectors to improve productivity, enhance effectiveness and increase efficiency in various applications. For example, the AI system designed by Dr. Andy Chun is one of the key factors contributing to the 99.9% on-time performance of the Mass Transit Railway (MTR), which benefits 5 million passengers per day in Hong Kong. The work of Dr. Hong Xu's graph processing system was deployed in production at Tencent, and is able to efficiently analyse a large graph connected by millions of users for applications such as fraudulent activity detection. Prof. Horace Ip's team applied immersive technologies for the greater benefit of society, promoting social inclusion, preserving local culture and ritual practices, and bringing more public attention to under-privileged classes.

(2)   Approach to impact

We are committed to building relationships with government, industry, and the public, and support knowledge transfer activities that extend and amplify the impact of our research. Knowledge transfer is not possible without external relationships, so we support service and outreach activities by which staff can connect with research beneficiaries. These relationships in turn inform our research in ways that increase the opportunity of impacting the wider society.
Public bodies: Staff serve on several advisory committees within the Office of the Government Chief Information Officer, e.g. committees for Enriched IT Programme in Secondary Schools, Cloud Computing Services and Standards, and Cybersecurity Infohub. They also served on the Professional Development of Teachers and Principals Committee for the Education Bureau and on the Technology Advisory Panel for Hong Kong Science and Technology Parks.
Industry: Staff engage directly with industry, speaking at company events, e.g. Google, Huawei, HP Enterprise, Fuji Xerox, Dell EMC, and the French National Railway Company (SNCF), and soliciting donations/contract research, e.g. Tencent, Intel, Microsoft and Qualcomm. We also maintain connections to industry through alumni, who serve as mentors to our students, and undergraduate students who complete a full-time 9-12 months of placement in their third year with companies such as Siemens, OOCL, HP, Thomson Reuters, Intel, IBM and HSBC.
Public Engagement: We organised open events to promote computer science topics, such as the Summer Summit on Cryptocurrency and Blockchain Technologies 2019, Workshop on AI in the Era of Big Data 2018, Croucher Foundation Advanced Study Institute on Information Security and Privacy in Social Networks and Cloud Computing 2014. We also promote computer science education through different events, e.g. Google Computer Science for High School Workshop, talks, e.g. Hong Kong Jockey Club CoolThink Parent Education Seminars (encouraging computational skills in children), in advisory roles, e.g. STEM Academy Hong Kong and Hong Kong Science Museum, and technology interviews with Economist, Financial Times, TVB, SCMP, Ming Pao and Sing Tao.

We have significantly increased our participation in mechanisms that allow our expertise and research outcomes to benefit society and industry by means of knowledge transfer. The main mechanisms available to us are 1) *Knowledge Transfer Schemes*: Places ongoing fundamental research on the path to commercialization. Competitive funding schemes, like the Quality Education Fund (QEF) for technology development and pilots for education, or Innovation and

Technology Fund (ITF) for industry-partnered projects through seed and match funding; 2) *Contract Research and Consultancy*: Collaborate with external parties in conducting applied research, and/or developing a product or service that they identified as important. The former generally involves a significant research component that underpins further development, while the latter tends to be a transfer of expertise through development, advisory role or professional service; and 3) *Direct Engagement*: External parties are directly involved in an end-to-end process from fundamental research to commercialization of the research results, e.g. academic collaboration with industry researchers on topics of mutual interest, or research centres with industrial partners, such as the Applied Research Centre for Advanced Digital Media Technology (TFI) and the Centre for Decentralized Trust Computing (Alphamirai).

There is strong central support for knowledge transfer, from the Research Office (legal and budget arrangements for contract research and funding schemes), the Outside Practice Administrative Unit (legal and budget arrangements for consulting) and the Knowledge Transfer Office (handling intellectual property and benefit sharing arrangement for all knowledge transfer mechanisms, building industry links and technology promotion). Our efforts have resulted in a significant increase of knowledge transfer projects, e.g. 19 ITF and 18 contract research projects commenced in the RAE period (compared to 1 ITF and 7 contract research projects in the previous period), with prominent companies like Huawei, Microsoft, Qualcomm, Pendo Technology, Shangri-La Group and PwC. In the RAE period, external funding received for knowledge transfer has increased four-fold and now accounts for approximately 51% of our external funding portfolio.

(3) Strategy and plans
Our academic unit will keep materializing our research outcomes into impactful real-world applications through knowledge transfer and the development of strategic partnership and joint initiatives with industry, non-profit organizations and government. It has been demonstrated in our impact cases that our department has been very successful in adopting this strategy to discover novel algorithms deployed by industry (e.g., Dr. Hong Xu's graph processing system adopted by Tencent), develop innovative technologies for the education sector (e.g., Prof. Horace Ip's research on immersive media-enabled learning programme delivered by schools and NGOs), and implement effective solutions to solve real-world problems (e.g., Dr. Andy Chun's AI system contributed to the 99.9% on-time performance of the Hong Kong MTR).

Our Department has identified a number of "grand challenge" themes to explore different research initiatives: 1) Integration of the real and virtual worlds through augmented/mixed reality and computer vision; 2) Development of a smart urban infrastructure through intelligent sensing/wearable computing; 3) Fortification of cyberspace through cybersecurity/privacy-enhancing technologies; 4) Enhancement of personalized learning through brain-computer interface and machine learning.

(4) Relationship to case studies
Our three case studies can be linked to all three knowledge transfer mechanisms.
1) I/O Stack Optimization: Huawei engaged our staff through contract research. The work with Tencent was through direct engagement, with our staff collaborating on fundamental research with their research staff during which the work was identified as having the potential to be commercialized by Tencent.
2) AI research for automatically scheduling engineering works for Hong Kong MTR: This case is a combination of direct engagement and contract research. Our staff worked on fundamental research with MTR technical staff, after which our staff was engaged to also develop the system through contract research.
3) Immersive Media Technologies for Education: Knowledge transfer grants (QEFs) were obtained to develop and pilot research outcomes for use in schools, with the provision of teacher training and equipment to the schools at no cost.