Research Assessment Exercise 2020
Impact Overview Statement

University: The Chinese University of Hong Kong
Unit of Assessment (UoA): 12
Total number of eligible staff of the university in the UoA: 32

(1) Context - context for the individual case study(ies)

UoA 12 is in the Faculty of Engineering and comprises all of Electronic Engineering (EE), part of the Information Engineering (11 academic staff) and Biomedical Engineering (3 academic staff who were in EE prior to 2018). The research activities in the UoA include solid state electronics, photonics, microwaves, integrated circuits, robotics, multimedia signal processing, wireless communications and information-theoretic networking research and biomedical devices. These activities fall within one of the University's major strategic research areas (Information and Automation Technology), and enable other major strategic research areas (Translational Biomedicine and Environment and Sustainability). They also fall within the scope of the focus on AI and Smart City, identified by the Innovation and Technology Bureau of Hong Kong. Beneficiaries of our research include related ICT industries and medical devices.

(2) Approach to impact - the unit's approach to impact during the assessment period

Within the UoA, impact stems from basic research that is informed by industrial needs. The vision behind the creation of the Faculty of Engineering by Charles Kao in 1991, with its strong focus on information and communications technologies, was derived from the appreciation of the increasing importance of Information technology to society. The recruitment of the top researchers in network theory, signal processing and wireless technologies ultimately led to the impact cases developed. The UOA seeks to develop impact by:

1) Motivating and encouraging research commercialization activities: The Faculty has established a Center for Innovation and Technology (CINTEC) which helps professors to develop projects with commercial values, find potential industrial partners, find funding sources, and to learn from their experiences.

2) The UOA's staff appraisal system gives strong encouragement to staff to obtain external funding to support their research. A key performance indicator is the external grants including both ITF and RGC grants, in reviews for promotion of academic staff. We also take into account other contribution to the profession, and international visibility e.g. participating in the creation of new industry standards. Both applied ITF grants and academic research funding have enabled non-academic impact. CUHK also provides knowledge transfer support when there is good potential for use in industry or spin-off companies. As an example of our work on standards, the IEEE standard 1708-2014 on wearable cuffless blood pressure measurement devices was based on the research in this UoA. The IEEE standard had major contributions from YT Zhang and C. Poon from EE.

3) The staff appraisal system encourages and the Outside Practice policy (allowing 1 day for "outside practice") facilitates academic staff to work with industry with research contracts, consultancy agreements and test service contracts. Our industry partners include Qualcomm, Huawei, NVidia, Google, Microsoft Research Asia, ZTE, Smartone and others. These collaborations help our academic staff identify research problems relevant for industry. For example the UoA supported funding of the R.F. Radiation Research Measurement Laboratory, and it sought ISO/IEC17025 accreditation in 2010 because of industry partner needs (it remains the only laboratory in Hong Kong accredited by IEC for mobile terminal Over The Air (OTA) measurement and calibration). Open source distribution of software/databases is also encouraged for knowledge transfer.

(3) Strategy and plans - strategy and plans for supporting impact

The UoA support impact by coordinating, providing internal resources (e.g. for building R.F. Radiation Research Measurement Laboratory) and encouraging collaboration with industry. The interaction with industry is helped by the involvement of prominent industry experts in the EE Advisory Board (e.g. Frank Soong, Microsoft Research Asia, a n expert on speech processing) and the requirement for academics to visit companies (as academic advisors) where our students working as interns in the work-study program (e.g., in partnership with companies like ASM Pacific Technology, AsiaSat, Smartone, VTech, IBM, etc). These help foster collaborations.

The recruitment strategy of the UoA is the key long term strategic factor underlying impact development. We make use of the collective wisdom of the UoA academics staff to identify directions for future hiring strategies, and in addition to the Deans' stated policy of hiring the "best of the very best", the UoA also plans for establishing and maintaining critical mass of impactful researchers. The knowledge transfer policy rewards our inventors with 25% of the proceeds of patents and allow 20% time of academic staff for outside practice.

(4) Relationship to case studies

The three case studies presented for evaluation in this UoA demonstrate the breadth of our impact stemming from academic research and the importance of strengthening linkages with industry:

- The "Analytical Circuit Model Extraction for Robot Automatic Tuning of Microwave Filtering Devices" case study originates from the interactions with the wireless communication industry by the main investigator of this study, Prof. Ke-Li Wu. This knowledge resulted from the industry service contracts to use the ISO/IEC17025 accredited OTA test laboratory, prior to his initial theoretical findings on microwave filter tuning. The academic work tacked a difficult bottleneck in the manufacture of high performance filters for wireless communications. A spin-off company created by Prof. Wu has launched the first fully automated tuning of microwave filters, replacing the expensive and highly expert manual tuning previously used in industry. A company is commercially exploiting this new technology for tuning microwave filters.

- The "Industrial and commercial impact of spoken language technology" case study was initially motivated by the lack of spoken Cantonese resources in the then developing computer applications. As a first pioneering step, a very comprehensive database of Cantonese speech phonemes/words was developed in a collaboration between three main investigators. This database was then shared with (licensed to) various international companies, which enabled them to provide new services in Cantonese. The initial academic collaboration further developed into higher-level use of the database for speech technology which because widely used as an open source resource. An example is an award-winning speech enhancement software which was successfully integrated by the industry into various products. A spin-off company in Shenzhen exploits the outcomes of this research.

- The "Network Coding is Changing the Landscape of Network Communications" case study was originally motivated by the relative lack of efficiency of communication networks at the time, due to independent processing of information packets. Arising from academic research, Network Coding was then invented to increase network throughput, reduce delays and make networks more robust. The huge advantages of optimizing network parameters by encoding groups of packets have led to the adoption of this technology in various settings (e.g., cloud storage), and its likely recommendation by standard organizations. An Area of Excellence funding was awarded to develop further Network Coding. Several spin-off companies are currently thriving, spreading this new technology in the network industry.