

Research Assessment Exercise 2020

Impact Overview Statement

University: The Hong Kong University of Science and Technology

Unit of Assessment (UoA): 15 - chemical engineering, biomedical engineering, other technologies (incl. environmental engineering & nautical studies) and marine engineering

Total number of eligible staff of the university in the UoA: 13

(1) Context

This UoA comprises the Department of Chemical and Biological Engineering in the School of Engineering. Our main impacts are on the economy, healthcare sector, environment, and society through the development of innovative and sustainable chemical-related products and technologies related to research activities broadly aligned with three mutually reinforcing thrusts:

Process Systems Engineering: the core competency of chemical engineers, which focuses on the conceptualization, modeling, and design of chemical products and processes.

Advanced Materials, Energy and Environment: draws on our expertise in materials chemistry to create novel materials to address energy and environmental challenges, ranging from waste management to energy storage.

Bioengineering: molecular diagnostics, bioimaging, biomaterials and drug delivery, and systems and synthetic biology.

Our major non-academic user groups and beneficiaries are (i) chemical and allied industries; (ii) consumers and the public; (iii) government and professional bodies.

(2) Approach to impact

Over the review period, the Unit has vigorously promoted interactions and collaborations with potential users and beneficiaries and leveraged internal mechanisms to foster a positive research impact culture: i) *Promotion of interaction with industry and government to create collaboration opportunities*

The Department's industrial advisory committee, comprising experienced industrial leaders, has helped align our research with evolving industrial needs and connect Unit members to local and global companies. Through alumni, we also reach out via industrial site visits, internships, industry-sponsored final-year projects, and co-op experiences to connect students to potential employers, including government bodies, such as the Hong Kong Productivity Council. These *strong, active relationships enable us to pursue collaborations with established firms to improve processes or products* when opportunities arise (e.g. F. Gao: development and successful sale of injection molding equipment with advanced control systems with industry (2013-18), and polymer nanocomposite fibers for bulletproof vests with Dutch firm DSM; Yeung: with government departments and Chiaphua Industries Ltd - case).

ii) *Leveraging public funding opportunities to support nascent industrial collaborations*

Both the University and UoA encourage faculty to seek government funding with societal impact, primarily through the Hong Kong Government's Innovation and Technology Commission (ITC), which helps our researchers collaborate with local and mainland China companies. Over the review period of 2013-19, our faculty have successfully attracted this type of *funding for 18 projects totaling HK\$37M*.

iii) *Supporting and incentivizing knowledge transfer activities*

HKUST is committed to knowledge transfer, with incentives including sharing of royalties and project overheads with faculty inventors, linking such activities to University budget allocation, and through a flexible and balanced faculty consulting policy. The University also strongly supports entrepreneurship through its Entrepreneurship Center and Technology Transfer Center. Over the review period, Unit members leveraged such provision, establishing a total of **7** companies, including SPES Tech Ltd (Sun and students, biomedical materials based on "smart" protein hydrogel technology), and Hong Kong Power Technologies Group Ltd (Shao, F. Gao, to advanced membrane electrode assembly for fuel cells).

iv) *Direct engagement via workshops, community projects and public service*

We seek to broaden our research reach and impact on the wider community through several different direct mechanisms: a) In 2015, the Department organized a three-day *professional development workshop* on chemical process safety, bringing together local and international experts to train about 40 engineers. b) By *assisting communities in need through the direct application of technology and NGO partnerships*, for example, through Chau's innovative Student Innovation for Global Health Technology program (est. 2014), which at the same time embeds the idea of social impact in our next-generation researchers. Projects have included (i) an electronic medical record system serving slum inhabitants in Phnom Penh, Cambodia (partnering with One-to-One Charity), ii) early detection of diabetic retinopathy in Indonesia (partnering with Helen Keller International and Universitas Gadjah Mada). c) Share faculty's research knowledge and expertise through *leadership in relation to professional bodies*. For example, F. Gao has been President of the Society of Molding Technology since 2018; Lam participates in the Human Proteome Organization Proteome Standards Initiative, working to define mass spectrometry data exchange formats for academic and clinical use globally.

v) *Media dissemination*

Through the University's Public Affairs Office, Unit faculty's *research achievements are disseminated* through press releases and media interviews, as well as more in-depth features on television and YouTube, *which can help to draw the attention of potential partners and investors*. For example, Sun's hydrogel was featured in several local and national newspaper in 2017, with his SPES start-up attracting investment from Merck, Tsinghua Research Institute (Guangzhou), and ITC); and Chau's ocular drug delivery technology, was highlighted by a World Economic Forum video and YouTube channel (<https://www.youtube.com/watch?v=JDCmo6DEExk>) in 2018.

(3) Strategy and plans

Given the fruitful outcomes from our current approach to impact, we will continue to use a similar set of measures over the next six-year period, advanced by several key plans:

- The UoA plans to *increase full-time faculty numbers* from 15 to 20, providing a golden opportunity to evolve our faculty profile to stay at the forefront of scientific and industrial trends. Recruitment will proactively targets global talents who specialize in up-and-coming research areas, and have a track record and stated desire to incorporate translational research in their research programs.

- We recently secured a *HK\$500M donation* from the Li Ka Shing Foundation to launch a *new research institute in synthetic biology* to foster large-scale academic-industrial collaboration. With strong ties to industry (e.g. via an industrial consortium), the institute will bring together many researchers with complementary strengths to collectively pursue major projects with significant societal impact.

- With the recent commitment by the HKSAR Government to double R&D support, the majority targeting applied and translational research, opportunities for impactful projects are expected to skyrocket. We will seek to encourage our faculty to *leverage this additional funding* for further knowledge transfer activities with industry and other users.

(4) Relationship to case study

The Yeung case provides an exemplary roadmap for the UoA's impact approach and strategy. Basic research in materials and catalysts gave rise to patentable technologies. Widely available local public funding for applied research – supplemented by industrial support – sustained product development phase. The University's IP management and knowledge transfer policies and incentives ensured that the technologies were protected and promoted to interested parties, and enabled field testing in collaboration with public and private parties. Finally, commercialization was realized by entering into government contracts, licensing to established companies (Chiaphua Industries Ltd), deepening collaboration with these companies through joint laboratories (HKUST-CIL Joint Laboratory), and by forming start-up companies (Greenland Biotech and Artenano). Such a roadmap is followed by other department researchers at various stages of development.