

Research Assessment Exercise 2020

Impact Overview Statement

University: The University of Hong Kong

Unit of Assessment (UoA): 14 mechanical engineering, production engineering (incl. manufacturing & industrial engineering), textile technology and aerospace engineering

Total number of eligible staff of the university in the UoA: 27

1. Context

The UoA, comprising the Department of Mechanical Engineering (ME) and the Department of Industrial Manufacturing Systems Engineering (IMSE), combines a mix of cutting-edge fundamental and applied research with strong engagement with government policymakers and industry partners. As a result, the research has led to significant progress in tackling a range of challenges related to the environment, consumer electronics, the logistics industry, automobiles and the healthcare system. The UoA is focusing on making an impact on the building of safer and more resilient megacities through a balance of forward-looking fundamental and applied research on Cyber Physical Systems Analytics (CPSA), Energy, Advanced Materials, Sustainability & Environment, and Robotics & Control.

2. Approach to impact

The UoA has aligned its strategic goals with the University's '3+1 Is' vision: combining internationalization, innovation and interdisciplinarity for impact. Alongside its commitment to long-term research impact through "blue-sky" fundamental research, the UoA seeks to achieve general, 'applied' impact through collaborations with research end-users, engagement with the general public and incentivizing members of the UoA by the following; to coordinate these efforts, a post of Associate Dean on Innovation (filled by Dr. Henry Lau from the UoA) has been created, together with a supporting research officer post.

Embedding user-engagement throughout the research process: The UoA supports its researchers in connecting with research end-users during the planning stages of research projects. For instance, two colleagues from ME secured two projects with a total of HKD 15M from the inaugural Research Impact Fund (RIF) 2019-2020, with support from industrial sponsors, as well as from the University, Faculty and Department. The UoA's commitment to exploring new industrial applications of its research has resulted in a number of successful ITF funding bids in collaboration with external users, such as General Motors (China) Investment Co. Ltd., PI Electronics (Hong Kong) Ltd, Cathay Pacific. ***Building external collaborations:*** As well as encouraging individual investigators to seek external collaborations, the UoA, together with the Faculty and the Technology Transfer Office of HKU initiate visits to other companies (e.g., Alibaba, ASM) and invite potential partners (e.g., Korea's Ministry of Trade, Industry and Energy, BASF SE, Hong Kong - Zhuhai - Macao Bridge Management) to HKU to explore collaborative opportunities. Furthermore, through the advisory boards and alumni base of the UoA, members of the UoA receive feedback on industrial and market needs.

Emphasizing outreach and knowledge-exchange activity: Knowledge exchange (KE) is now a component in HKU's annual Performance Review and Development (PRD) exercises, and in evaluation for tenure and promotion. Members of the UoA (Dr. M.X. Huang, Dr. Henry Lau and Prof. George Huang) have been KE awardees for their work on lightweight steels, virtual reality systems and RFID-enabled real-time manufacturing platforms respectively. For example, in the last three years, more than 20 large-scale VR systems (imseCAVE) have been deployed in companies, government departments and institutions in Hong Kong and the Greater Bay Region. ***Promoting effective communication:*** Besides funding colleagues to attend conferences, the UoA has been promoting its work by enhancing the effectiveness of the communication through funding support to host conferences, such as The 13th International Conference on Indoor Air Quality & Climate (Indoor Air 2014). Colleagues in the UoA promotes their work to relevant industries and potential collaborators by engaging with them

at the conferences. Key research breakthroughs are routinely reported through media briefings, press releases, departmental brochures and webpages. **Providing incentives for applied research:** Colleagues in the UoA have been incentivized and encouraged to participate in consulting work with external organizations and companies, such as CLP Power HK Ltd., Nike Inc., Boeing Co., MTR, HIT and Comac. The UoA also provided matching funds to support Platform Technology Funding, which helps incubate and develop collaborative projects with industries and external partners to enhance the impacts of research projects. **Supporting external competitions and exhibitions:** The UoA has been supporting colleagues and their teams to participate in external competitions, such as the World Virtual Reality Innovative Conference and the TechConnect Global Innovation Awards (two winning innovations in 2018), and in exhibitions, such as the 46th and 47th International Exhibition of Inventions of Geneva in 2018 and 2019 (five winning teams, including one gold award with the Congratulation of the Jury). These help to demonstrate research results and connect to potential industrial collaborators and end-users.

3. Strategy and plans

The key objective is to enhance the vitality and sustainability of the research through establishing areas of excellence in sustainability, health technologies and frontier technologies. **Key strategic partners:** The UoA seeks to enrich its relationship with local communities through its work with government departments, such as the Electrical and Mechanical Services Department, and with local companies, such as DHL, Cathay Pacific, MTR, ASM Pacific and Fong's Industries Co. Ltd., to work on locally relevant problems. The UoA has also been very strong in generating policy impact worldwide. On environment control for health, the work of Y.G. Li's has led to guidelines from the World Health Organization (WHO) on infection control in healthcare settings, including the management of epidemics in resource-limited countries. Commercially, colleagues from the UoA not only work with start-up companies, such as Aptom Group, which was recently listed in NASDAQ, but also establish new start-ups supported by the Technology Start-up Support Scheme for Universities at HKU (Living Tissues Co. Ltd, EN Technology Ltd, Eonzen Technology Co. Ltd, Flectrode Ltd, Hactis Ltd, VOTANIC Ltd, VOTANIC (Zhongshan) Technology Ltd, and CommaTech Ltd). **Capacity building:** To extend the reach and significance of future research impact, the UoA has invested in new staff with a wider range of backgrounds, such as in biomedical engineering and robotics, healthcare logistics and financial technology. The UoA also equips students with a mindset focusing on impact by encouraging undergraduate integrated projects with industrial partners, such as Fong's Industrial Co. Ltd and LouisVuitton (Hong Kong) Ltd. **Specialist support and governance:** The UoA has invested in large equipment to meet the emerging needs of colleagues in collaborating with industrial partners. E.g., in 2013-14, the UoA purchased a state-of-the-art metallic 3D printer for producing high-resolution metallic structures.

4. Relationship to case studies

Consumer electronic devices: The creation of novel Fresnel lenses for photoplethysmogram sensors in smartwatches, as well as the development of a cost-effective nanoimprinting manufacturing process by Dr. W.D. Li, has led to the production of an estimated five million smartwatches carrying these lenses. The work is projected to generate significant health impacts through the monitoring of consumer health status. The UoA has provided critical infrastructure and support that has enabled these impactful results, including patent-filing support, funding for early demonstration and contract consultation. **Low-emission automobiles:** The invention of a new process for producing high-strength, lightweight steels for automobiles by Dr. M.X. Huang has led to a saving of 20% of the weight of automobiles, which translates to a significant reduction in subsequent car emissions. The advice and support provided by the UoA and the Technology Transfer Office of HKU enabled the collaborations with external collaborators, such as General Motors and China Baowu Steel Group Co. Ltd.