



ANNUAL REPORT 2015/16

Recurrent Funding for Knowledge Transfer

submitted to
University Grants Committee



香港大學
THE UNIVERSITY OF HONG KONG

July 2016

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EXECUTIVE SUMMARY

Translating knowledge and discovery into societal impact is the University's ultimate goal, and Knowledge Exchange (KE)¹ is regarded as the engine of impact. The UGC's earmarked funding for Knowledge Transfer (KT) has enabled the University to build capacity and develop strategies that take HKU knowledge from the campus to the community through technology transfer, entrepreneurship, community engagement, and knowledge access.

The university-wide KE Excellence Award was launched in the reporting year, which was a natural development of the Faculty KE Awards introduced in 2011, but with stronger emphasis on significance of impact. The project recognized by the inaugural KE Excellence Award, which applied dental age assessment to address the social issue of unregistered births in the region by a team in the Faculty of Dentistry, serves as an excellent example of the impact of HKU's KE beyond Hong Kong.

This year also saw a substantial increase of new technology start-up companies formed by HKU researchers to commercialize their research outcomes. Since its launch in 2014/15, the Technology Start-up Support Scheme for Universities at HKU (TSSSU@HKU) has funded 13 start-ups formed by our researchers, including eight new ones in the latest round. These start-ups have the potential to create impact on society when their new products encompassing HKU technologies are launched to the market in a few years' time.

We also launched the HKU DreamCatchers 100K this year to provide seed fund for young entrepreneurs to kick off their businesses, attracting over 140 applications. Our links with local and overseas partners continue to grow in both breadth and depth, for example, with Cyberport, Hong Kong Science Park, MIT and Stanford University in promoting innovation and entrepreneurship, and with the UK universities through our impact workshops.

The University's new strategic document, i.e., HKU Vision 2016-2025, centres around the (3+1)Is: *internationalisation*, *innovation* and *interdisciplinarity*, which converge to create *impact*. The University aims to play a leading role in innovation as the key driver of Hong Kong's future.

HIGHLIGHTS OF KE DEVELOPMENTS IN 2015/16

1. Emphasis on Impact

Impact Cases

Our Faculty KE Awards each year recognise and celebrate outstanding KE accomplishment in each Faculty. Demonstrable benefits to the community, business/industry, or partner organizations, as well as quality of the knowledge, and quality of the engagement process are the criteria for selection. This year the KE Excellence Award at the university level was launched, which is based on similar criteria, but with stronger emphasis on outcome and significance of impact. We are pleased to see that the project recognized by the inaugural KE Excellence Award, which was done by a team in the Faculty of Dentistry, as detailed below, serves as an excellent example of the impact of HKU's KE beyond Hong Kong.

¹ In this report, "KE" is used when referring to HKU's mission, whereas "KT" is used when referring to the UGC's earmarked funding for Knowledge Transfer.

Dental Development: An Aid to Give Identities and to Inform General Health

Dr Hai Ming Wong and a team of PhD and BDS students in the Faculty of Dentistry have applied dental age assessment to address the social issue of unregistered births in the region. The lack of a registered identity can make it difficult for children to get an education and medical treatment and may leave them vulnerable to abuse. The team has brought dental age assessment and oral health education programmes to two villages in India, where nearly 60 per cent of births are unregistered. Their public awareness programme has reached about 500 families in rural areas of India, and about 150 undocumented children in rural welfare homes had their age estimated through their efforts. They have established a charity, the D.O.B. (Date of Birth) Foundation, the first of its kind in the world to promote accurate birth records. In addition, about 200 dentists and forensic practitioners in India and Hong Kong have been trained in dental age assessment. They have also transferred knowledge of dental development and oral health care to teachers of primary schools and orphanages in rural areas of Guangxi, China. The team was awarded the inaugural KE Excellence Award of HKU. More details are at [Annex I](#).



Architecture Teaching Kit for All Secondary Schools in Hong Kong



Ms Tris Kee and Dr W.S. Wong of the Department of Architecture have worked with schools, the Education Bureau, the Hong Kong Institute of Architects and local practicing architects to devise the first comprehensive teaching kit for Architecture for secondary schools in Hong Kong. The teaching kit connects architecture to the liberal arts, science, art and technology through four books of 40 units each, and pioneered an e-learning platform for architecture. Teacher training was provided through seminars,

workshops and field trips, and 12 videos have been produced to support the materials. The kits were distributed to all secondary schools in Hong Kong, benefitting more than 112,800 students. The project was nominated by the Hong Kong Institute of Architects in 2014 for the Golden Cube award sponsored by the International Union of Architects. The kit has enhanced secondary school students' knowledge of architecture and appreciation of the built environment and related fields, such as local culture and global urban issues. The team was awarded the Faculty KE Award 2015 of the Faculty of Architecture.

Migrant Worker Advancement Project

Mr David Bishop of the School of Business has collaborated with governments, the United Nations through the International Organization for Migration and the International Labour Organization, and NGOs on the advancement of migrant worker rights in Hong Kong and beyond. To find commercial and legal solutions to the longstanding problems facing migrant workers in Hong Kong, particularly the charging of illegal placement fees by employment agencies, he co-founded Fair Employment Agency (FEA). FEA is a social enterprise employment agency that only charges placement fees to employers rather than migrant workers. FEA has already successfully placed more than 300 domestic workers, saving them

from over 100 years' worth of free labor that might have otherwise be required to pay off their debt. In addition, he also launched and co-chaired the Domestic Workers Roundtable in 2015, which was the first ever cooperative roundtable on migrant labour issues in Hong Kong. It was attended by major migrant labour NGOs in Hong Kong, and representatives from 10 different governments. Mr Bishop was awarded the Faculty KE Award 2015 of the Faculty of Business and Economics.



Knowledge Exchange of e-Learning Technology and Pedagogy in Hong Kong and Overseas

Dr Wilton Fok of the Department of Electrical and Electronic Engineering mentored his graduates in developing iClass, a mobile e-learning platform that enables students to share knowledge immediately with their teachers and fellow students, enabling simultaneous interaction across the whole class. The Cyberport Creative Micro Fund has provided funds and incubation to the iClass spin-off, IT Wake Ltd., to further commercialise the system.



iClass also drew Apple Inc.'s attention and was introduced to Apple resellers and educators in Mainland China. Over 50 schools in Hong Kong, Macau, Hangzhou, Shanghai and Guangzhou are using the system. This project changes the way teachers conduct interactive classes and has introduced a new concept of e-learning to schools. The success of the project led to funding of HK\$9.6M by the Education Bureau for the development of interactive e-textbook in Mathematics and Computer subjects for primary and

secondary schools in Hong Kong. This project won the Hong Kong ICT Award in 2012 and 2014 and represented Hong Kong for the Asia Pacific ICT Award in 2012. The team was awarded the Faculty KE Award 2014 of the Faculty of Engineering.

Clinical Legal Education Programme

The Clinical Legal Education (CLE) Programme established by Mr Eric Cheung and his team in the Department of Law is the first programme of its kind in Hong Kong that fills a gap in society by providing wide-ranging non-means tested pro bono legal service to the community through partnerships among law teachers, students and outside pro bono lawyers. Since its launch in January 2010, more than 850 clients have received free legal advice; miscarriage of justice has been rectified in more than 10 successful criminal appeal cases and various successful legal aid applications in both civil and criminal actions upon free legal representation through the CLE programme; and an erroneous approach to the merits test by the Legal Aid Department has been rectified upon a successful case handled by the CLE programme. The team and students have received very positive feedback from clients, and there has been wide media coverage (including in a TVB documentary series) and burgeoning demand from the public for CLE service. The team was awarded the Faculty KE Award 2015 of the Faculty of Law.



Impact Workshops

We continue our efforts to learn from the UK experience in its Research Excellence Framework (REF) 2014 exercise, which gave 20% weighting to impact for the first time, in order to raise the awareness of our researchers about the importance of achieving and corroborating impact beyond the academia. In the reporting year, the following impact workshops by experts from the UK universities were organized by the Knowledge Exchange Office in collaboration with the Faculties concerned:

- ‘Geology and Geographical Information Science in Forensic Science’
 Dr Alastair Ruffell and Dr Jennifer McKinley
 School of Geography, Archaeology & Palaeoecology
 Queen’s University Belfast
 September 18, 2015
- ‘How to Analyse the Non-academic Impact of Research from 6,679 Narratives? Analysis of the UK REF2014 Impact Case Studies’
 Dr Saba Hinrichs-Krapels
 The Policy Institute at King's
 King's College London
 September 25, 2015
- ‘Research Impact Assessment in the Research Excellence Framework: Laurels for the Hardy!’
 Professor Hugh McKenna
 Pro-Vice-Chancellor (Research and Innovation), University of Ulster
 Chairman of the UK REF 2014 Sub-panel 3: Allied Health Professions, Dentistry, Nursing and Pharmacy
 December 9, 2015
- ‘The UK REF Process - from Outputs to Impact’
 The late Professor Glyn Humphreys
 Department of Experimental Psychology, University of Oxford
 Chairman of the UK REF 2014 Sub-panel 4: Psychology, Psychiatry and Neuroscience
 January 13, 2016
- ‘Research + Impact = Dentistry+’
 Professor Damien Walmsley
 School of Dentistry, University of Birmingham
 June 2, 2016



2. Strengthening Technology Transfer

Continued efforts are made to enhance the technology transfer function under the KE mission, not only in commercialization but also in bringing in induced contract research projects that support further research on licensed technologies. A set of new procedures was established for the administration of collaborative research projects funded under the University-Industry Collaboration Programme (UICP) of the Innovation and Technology Commission (ITC) such that the Technology Transfer Office may engage with industrial partners sooner as new UICP projects are being planned.

Examples of HKU Technologies Transferred

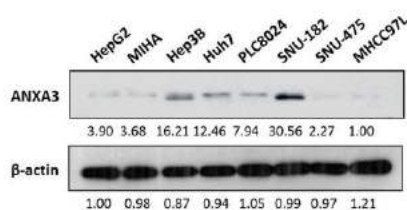
Launch of a Novel Human Blood-flow Visualization Invention to the Market

Vector Projectile Imaging (VPI), an innovative blood flow visualization and analysis technology developed by the Biomedical Ultrasound Laboratory of the Department of Electrical and Electronic Engineering, has been launched to the market. This patent-pending technology was licensed exclusively to a leading manufacturer of medical equipment and it has been successfully developed and incorporated into the latest premium models of the manufacturer's ultrasound scanning and visualization systems.



VPI is an imaging innovation that substantially transformed the way that flow information is acquired, estimated and rendered in comparison to existing colour flow imaging techniques. In addition to the ability to handle very complex flow imaging such as laminar, vortex, secondary and retrograde flows, VFI enables real-time visualization of the corresponding direction and magnitude of blood flows in blood vessels and arteries with very high framerate at millisecond time resolution. Such non-invasive, versatile and time-resolved visualization of blood flows in human arteries is of high diagnostic importance because it may facilitate clinical detection of abnormal vascular conditions.

Launch of a Diagnostic Monoclonal Antibody, Anti-ANXA3, by a Commercial Partner



HKU's high-affinity monoclonal antibody that works against Annexin A3 has just been launched to the market. This patent-pending technology was developed by the School of Biomedical Sciences and commercialized by a renowned bio-reagent company.

Annexin A3 (ANXA3) belongs to the annexin family of calcium-dependent phospholipid-binding proteins, up-regulation of which has been detected in a number of cancers. The detection is particularly significant in liver cancer patients. Liver cancer is the fifth most common cancer and the third leading cause of death related to cancer in the world. Each year, close to 600,000 people are newly diagnosed with primary liver cancer. The anti-ANXA3 antibody developed by HKU is expected to have high impact to society due to its high affinity and specificity over the traditional HCC biomarkers.

Technology Transfer Promotion

InnoCarnival 2015

HKU showcased the following 6 research projects under the "Life of Tree" theme at the InnoCarnival 2015, which was held at the Hong Kong Science Park from October 31 to November 8, 2015:

- Treating HCC using Probiotics (Dr Hani Said El-Nezamy, School of Biological Sciences)



- Bio-Engineered Bacteria for Cancer Therapy (Professor Jiandong Huang, School of Biomedical Sciences)
- Forced Suicide of Cancer Cells by Bacteria (Professor Jiandong Huang, School of Biomedical Sciences)
- Diabetes Risk Score App (Dr Angela Y.M. Leung, School of Nursing)
- New Technology for Improved Subtitle Presentation in Movies and Videos (Professor Wenping Wang, Department of Computer Science)
- Emulsion (Dr Anderson H.C. Shum, Department of Mechanical Engineering)

EmTech Hong Kong 2016

HKU was the Innovation Partner of EmTech Hong Kong 2016 held on June 7-8, 2016 at the Hong Kong Convention and Exhibition Centre. EmTech is the annual global emerging technologies conference hosted by MIT Technology Review, and it was held in Hong Kong for the first time. It brought together experts in emerging technologies, business leaders, innovators and entrepreneurs to discuss global issues and how to turn ideas into solutions, and how technology is going to change business, economy and our lives, using examples of Fintech, robotics and smart city. Over 400 participants including HKU representatives attended the event to discuss the latest trends in emerging and disruptive technologies.

The MIT Hong Kong Innovation Node, MIT's initiative to educate the next generation of global innovators in key areas of innovation practice and to deepen its links to Hong Kong, Shenzhen and the Pearl River Delta, was launched during this conference. The inaugural programme of the MIT Hong Kong Innovation Node, MIT Kickstart, was a week-long hardware mini-accelerator programme held in Hong Kong with 13 participants from MIT and 12 from universities in Hong Kong. HKU is one of the partners and 4 out of the 12 participants from Hong Kong were from HKU.

Public Lecture and Professional Development Workshops

The following overseas experts in technology transfer were invited to share with us and other technology transfer professionals in Hong Kong their experience in driving innovation and commercialization:

- Public Lecture: 'Open Innovation and Public-Private Partnerships'
Professor Raj Thampuran, Managing Director of Agency for Science, Technology and Research (A*STAR), Singapore
January 25, 2016
- 'Workshop on Innovations in Technology Commercialization'
Dr Kim Shin Cheul, Senior Vice President of Exploit Technologies Pte Ltd (ETPL), A*STAR, Singapore
April 21, 2016
- 'Accelerating the Translation of New Drug Targets (Drug Projects) for Industrialization'
Dr Micky Tortorella, Chief Technology Officer and Vice President for Drug Discovery and Technology Transfer, Guangzhou Institutes of Biomedicine and Health, China
May 25, 2016

3. Nurturing Entrepreneurship

Technology Start-ups

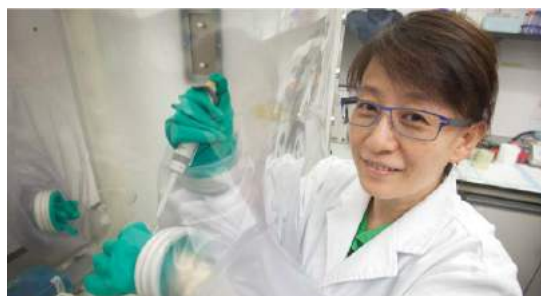
With support of the ITC, TSSSU@HKU has completed its third round of application. A total of 26 applications were received in February 2016 and 13 start-up companies were funded, totalling HK\$4 million. Ten of these 13 TSSSU awardees are commercializing HKU technologies, including eight new start-ups formed by our researchers, and two existing start-ups that received further funding. Two examples are highlighted below.

Comma Technology Limited

Inspired by the ideas of Apple Watch and Google glasses, Leon Kong, an HKU alumnus, and his team established a start-up, Comma Technology Ltd., which is focused on portable and wearable technology for logistics and manufacturing industries in order to provide enterprises with safe, efficient and friendly solutions for data collection, and to bring the innovation of “wearables” to the industry sectors. They have developed a smart pen, which captures only information essential to the operation at hand and feeds that back to a company's central system. Their smart glove has been tested in a warehouse where workers just had to pass their hand across the AutoID tags to collect and transmit information to the company's main system. The application of their technologies may also be extended to fields such as healthcare and retailing. The start-up placed highly in three major technology and innovation competitions in Mainland China, including a second-place finish against more than 1,780 competitors at the 7th Shenzhen Entrepreneurship and Innovation competition.



Living Tissues Company Limited



Dr Barbara Chan of the Department of Mechanical Engineering together with her two former PhD students have developed a new cartilage regeneration technology to grow cartilage tissues out of cells taken from one's body. The team has been working with orthopaedic surgeons over the years, manipulating stem cells from animal bone marrow with treatments and technologies to shape them into cartilage and bone. This technology would offer a novel solution to the treatment of cartilage related diseases, and patients could be benefited from shorter healing time because the replacement parts are fully biocompatible. Having developed four technology platforms and 10 patents to support this capability, Dr Chan's team has established a start-up, Living Tissues Co. Ltd., to advance it to the next stage. This start-up was awarded the 2015 Red Herring Asia Top 100 Award, which honors companies that deliver potentially strong technology and innovation in Asia, Europe and the Americas.

DreamCatchers

DreamCatchers, HKU's entrepreneurship series launched in 2015, continues to provide a platform to inspire innovation and entrepreneurship.

The **DreamCatchers X PMQ Startup Salon** was organized with PMQ in October 2015, where over 300 students, alumni and HKU friends joined the panel discussion and PMQ tour and enjoyed music performance. Four speakers who are start-up founders or advertising professionals shared their experience on how to turn ideas into promising businesses and how to make good use of marketing, branding, design and creativity to create opportunities for products.



The **HKU DreamCatchers 100K** was launched in early 2016 to provide seed fund for young entrepreneurs to kick off their businesses. Each winning team will be awarded a \$100K seed fund in August. There were over 140 applications and 20 teams

were shortlisted after 5-minute pitch rounds. Their business ideas cover various areas like catering, biomedical, social innovation, hardware, etc. Each team has been assigned a mentor from start-ups or the industry. They will have their final pitch before the judges and audience to compete for ten \$100K awards.

The **DreamCatchers MedTech Hackathon 2016**, co-organised with Hong Kong Science and Technology Parks Corporation (HKSTP), was a one-week event in June for participants to come up with prototypes of healthcare solutions to address the unmet medical needs in the world. Ten students from Stanford University, 30 students from Hong Kong universities and young professionals from HKSTP attended lectures on business models as well as prototyping skills and patents, and visited Queen Mary Hospital, Tung Wah Hospital and Grantham Hospital to observe clinicians' work and to explore unmet needs in a hospital setting. They worked in teams for creative solutions to tackle problems like engaging caregivers of post-discharge stroke patients to improve patient access and adherence to rehabilitation, preventing falls in community, minimising infection and monitoring fluid status for peritoneal dialysis patients in order to reduce hospital visits, etc. The teams presented their prototypes to judges and audience at the final pitch on June 30, 2016.



Cyberport University Partnership Programme (CUPP)

CUPP is a FinTech-focused elite entrepreneurship programme launched in 2015 by Hong Kong Cyberport Management Company Limited, in collaboration with Stanford Graduate School of Business (GSB), for local university students to unleash their potential, gain insights into the global market, and receive world-class training and mentorship. Project teams nominated by partnering local universities visited notable start-ups at Silicon Valley and joined a one-week entrepreneurship boot camp at Stanford GSB in late September 2015. HKU had six teams selected to join this new programme. Eighteen teams from five local universities presented their business prototypes on the CUPP Demo Day during the "Global Entrepreneurship Week China – Hong Kong" at Cyberport on November 17, 2015. Three of the ten teams that won the cash prize of HK\$100,000 each and interview opportunities for the Cyberport Incubation Programme were from HKU.

4. Turning Knowledge into Action

Impact Project Funding Scheme

The University continued to use the KT funding to run the Impact Project Funding Scheme in 2015/16, which has become an important enabler for our academic staff to benefit the broader community with their expert knowledge. In the reporting year, 74 proposals were received, of which 61 were supported (list at http://www.ke.hku.hk/newsletter/issue9/newsinbrief_6C). Two examples are highlighted below.

Heat Stress on Hong Kong Construction Sites – the Impact of New Guidelines on Workers’ Health & Safety

In this project Professor Steve Rowlinson of the Department of Real Estate and Construction studied the impact of the revised heat stress guidelines for construction workers that were developed based on research done by him under a research contract for the Hong Kong Construction Industry Council. Through site inspections, survey, interviews and focus group discussions with construction workers and supervisory and managerial personnel in the industry, the project revealed that the general heat mitigation hardware as recommended by the revised guidelines has been adopted. Besides, provision of general basic health check for construction workers has become more common among large main contractors and SME contractors alike. The project has raised the awareness of construction workers and frontline supervisory staff on the importance of implementation of heat stress mitigation measures. Some institutionalised difficulties in the implementation of some of the measures in the revised guidelines have also been identified, which will be useful in informing further discussion of the larger issues in the industry in future.

Cultivating a Generation of I-Smart Kids: Applying Quality-of-(Real)-Life Theory to Internet Addiction Prevention

Professor Cecilia Cheng’s team in the Department of Psychology designed, promoted, implemented, and evaluated an Internet addiction preventive intervention programme that served 3,289 local primary school students. Participating students learned about the healthy and safe use of the Internet, the etiology, symptoms and consequences of Internet addiction, and ways to prevent it. They were encouraged to solve problems and regulate emotions by healthier means instead of relying on the Internet. Besides, training, consultation and programme materials were offered to the teachers and school executives of 15 participating schools so that they could organize their own programmes in future and incorporate elements of healthy use of the Internet in their school-based Healthy School Policy.

Student KE Projects

The KT funding was used to support 23 student KE projects in the reporting year. The University also makes use of other funds to encourage students to undertake community projects, for example, the Service 100 Fund and the We Are With You Project Scheme that are administered by the Centre of Development and Resources for Students. Two examples are highlighted below.

Stay Hearty, Stay Healthy

This exhibition on cardiovascular health organised by medical students was held in October to November 2015 in various venues in the community. It attracted many members of the public to attend the health seminars and discuss with our medical students about common

misunderstanding of cardiovascular health. There were also question and answer sessions with medical professionals after each health seminar. About 900 people joined their health check and counseling sessions during the six days of the exhibition.

We Are With You Project: Water Community Student Ambassador Programme

The project aims to preserve and promote the cultural heritage of the Southern District with the general public. Having received training on oral history and cultural tourism to learn about the cultural heritage of the water community, HKU students shared their knowledge with the general public via various activities, such as guided exhibitions and cultural tours. 50 cultural tours were held for 774 participants, and 14 interactive workshops were held for 462 participants.

5. Knowledge Access

The HKU Scholars Hub (hub.hku.hk/), a unique one-stop online platform for searching our experts, has been very successful in making HKU researchers, their research and expertise highly visible. The view counts of the HKU Researcher Pages from outside HKU have increased from 2.3 million in 2014/15 to over 4.9 million in 2015/16.

QUANTITATIVE INDICATORS

Given the broad definition of KE of the University, our performance indicators are not limited to the UGC required metrics, but also other indicators that are highly relevant to the University's KE efforts. Two tables on the UGC and HKU performance indicators respectively are at [Annex II](#).

LOOKING AHEAD

The University's new strategic document, i.e., HKU Vision 2016-2025, captures the University's ambition to be Asia's leading global university, building on past achievements through the established pillars of teaching and learning, research, and KE. It centres around the (3+1)Is: *internationalisation*, *innovation* and *interdisciplinarity*, which converge to create *impact*. We aim to play a leading role in driving innovation to be the key to Hong Kong's future. For example, HKU is a partner and Professor Guanhua Chen of HKU is one of the three founders of the Hong Kong X-Tech Startup Platform and X Technology Foundation. Launched on July 19, 2016, the Platform is expected to support 120 early-stage projects and 50 angel projects in the next four years. The University is also in the process of establishing a new Centre for Innovation and Entrepreneurship.

The HKU Vision 2016-2025 provides a framework underpinning and guiding the HKU KE strategy 2016-19, which focuses on four strategic priorities, i.e., Enhancing Capabilities and Capacity for Realising and Corroborating Impactful Research, Broadening Knowledge Access and Community Engagement, Strengthening and Sustaining Partnerships, and Nurturing Innovation and Entrepreneurship. Details are set out in our Initial Statement for KE for 2016-19 submitted to the UGC on July 22, 2016.

The University of Hong Kong
July 29, 2016

THE UNIVERSITY OF HONG KONG**IMPACT CASE HISTORY****Title of case study:****Dental development: An Aid to Give Identities and to Inform General Health****1. Summary**

Dr Hai Ming Wong and a team of PhD and BDS students in the Faculty of Dentistry have applied dental age assessment to address the social issue of unregistered births in the region. The lack of a registered identity can make it difficult for children to get an education and medical treatment and may leave them vulnerable to abuse. The team has brought dental age assessment and oral health education programmes to two villages in India, where nearly 60 per cent of births are unregistered. Their public awareness programme has reached about 500 families in rural areas of India, and about 150 undocumented children in rural welfare homes had their age estimated through their efforts. They have established a charity, the D.O.B. (Date of Birth) Foundation, the first of its kind in the world to promote accurate birth records. In addition, about 200 dentists and forensic practitioners in India and Hong Kong have been trained in dental age assessment. They have also transferred knowledge of dental development and oral health care to teachers of primary schools and orphanages in rural areas of Guangxi, China. The team was awarded the inaugural Knowledge Exchange (KE) Excellence Award of HKU this year.

2. Underpinning research

The timing of all stages of tooth development follows a sequential and organised pattern, so the developing dentition can be used as a maturity indicator. Dental age relates more closely to chronological age than other physical or psychological attributes, so an individual's age can be assessed from dental development more accurately. For example, variation of estimated age from skeletal tissues is around 1 to 2 years, whereas age estimated from dental maturity can be accurate with a range of only 6 months. Dr Hai Ming Wong of the Faculty of Dentistry has conducted research to identify factors that affect dental development to further improve the accuracy of the method for age estimation.

While there has been much research on tooth development among Western populations, this has been lacking for Chinese populations. Dr Wong led a research project to establish a reference data set (RDS) for a southern Chinese population for the age range from 3 to 22 years based on the defined developmental stages of each permanent tooth using dental panoramic tomographs collected in Hong Kong, and to validate the established southern Chinese RDS and the age estimation method internally using the two-fold cross-validation technique, and externally with a southern Chinese sample. The research team further investigated the applicability of the established southern Chinese RDS and the age estimation method to a northern Chinese sample. The established dataset is the world's first dental age assessment dataset for southern Chinese. This realistic, valid and reliable method of age estimation that was developed based on clearly defined criteria of tooth development stages and mathematical techniques can be used by any researchers and related authorities in civil, legal, criminal and forensic applications around the world to estimate age accurately. This information, for example, can help to identify children in natural disasters such as earthquakes, or help orphans.

Dr Wong's current research focuses on the applicability of the southern Chinese RDS and the age estimation method to the southeast Asian population groups such as Vietnam, Thailand, Cambodia, and the Philippines.

3. References to the research

Key peer-reviewed publications:

Jayaraman J., Wong H.M., King N.M., Roberts G.J.; Development of a Reference Data Set (RDS) for dental age estimation (DAE) and testing of this with a separate Validation Set (VS) in a southern Chinese population. *Journal of Forensic and Legal Medicine*, 2016, Jul 12, 43: 26-33.

Jayaraman J., Roberts G.J., Wong H.M., McDonald F., King N.M.; Ages of legal importance: Implications in relation to birth registration and age assessment practices. *Medicine, Science and the Law*, 2016, 56(1), 77-82.

Wong H.M., Peng S.M., Wen Y.F., McGrath C.P.; A population survey of early factors associated with permanent tooth emergence: findings from a prospective cohort study. *Community Dentistry and Oral Epidemiology*, 2016, doi: 10.1111/cdoe.12236.

Jayaraman J., Wong H.M., King N.M., Roberts G.J.; Secular trends in the maturation of permanent teeth in five-year-old children. *American Journal of Human Biology*, 2013, 25, 329-334.

Jayaraman J., Roberts G.J., King N.M. and Wong H.M.; Dental age assessment of southern Chinese using the United Kingdom Caucasian reference dataset. *Forensic Science International*, 2012, 216, 68-72.

Jayaraman J., Roberts G.J., King N.M. and Wong H.M.; Dental age assessment: are Demirjian's standards appropriate for southern Chinese children? *Journal of Forensic Odontostomatology*, 2011, 29(2), 22-28.

Selected external grant funding:

Dental age assessment in Southeast Asians: Is the reference data set of southern Chinese applicable? (17126115)

Funding Scheme: General Research Fund

Principal Investigator: Dr Hai Ming WONG

Period of the Grant: January 1, 2016 – December 31, 2018

Amount Awarded: HK\$656,166

Dental age assessment: Development and validation of a reference data set for the southern Chinese and its application to the northern Chinese (17122914)

Funding Scheme: General Research Fund

Principal Investigator: Dr Hai Ming WONG

Period of the Grant: January 1, 2015 – June 30, 2017

Amount Awarded: HK\$470,700

Child risk factors for delayed eruption of permanent teeth (HKU 781112M)

Funding Scheme: General Research Fund

Principal Investigator: Dr Hai Ming WONG

Period of the Grant: January 1, 2013 – December 31, 2015

Amount Awarded: HK\$524,356

4. Details of the impact or benefit

About one-third of births in the world are unregistered, according to UNICEF. In India, nearly 60% of the births are unregistered. Official statistics are unavailable for China. According to a report by UNICEF, in 19 countries including China, 26% to 60% of children, less than 5 years old, were not registered. In a world where governments and other providers of public services increasingly demand proof of identity, the lack of a registered identity can make it difficult for children to get an education and medical treatment and may leave them vulnerable to abuse.

Dr Wong led a team of PhD and BDS students in the Faculty of Dentistry to conduct a series of knowledge exchange (KE) programmes to apply dental age assessment to address the social issue of unregistered births in the region. With the help of NGOs in India and Mainland China, they used multiple methods to achieve the project aims, through dental age assessment, oral examinations/anthropometric assessments and follow-ups, in-depth consultations, and personalized oral and general health instructions.

Dr Wong's team brought dental age assessment and oral health education programmes to two villages in India. Their public awareness campaigns on the importance of birth registration have reached 500 families. They used different languages, for example, Tamil, a language used in South India, in their educational materials. Oral health information and oral health education was provided to 200 less privileged children in Chennai, India. About 150 undocumented children in rural welfare homes had their age estimated through their efforts and got their age certificates.

Students also visited an orphanage in Mainland China to conduct programmes on age estimation and oral health education. Knowledge of dental development and oral health care has been transferred to teachers of primary schools and orphanages in rural areas inhabited by minorities to benefit more children.

In addition, the team wanted to train the trainers in order to sustain the project efforts. They provided training in dental age assessment to about 200 dentists and forensic practitioners in India and Hong Kong.

The team has established a charity, the D.O.B. (Date of Birth) Foundation, the first of its kind in the world, to promote accurate birth records. They have also advocated to the United Nations Framework Convention on Climate Change to tackle the global issue concerning climate change displaced people, especially the small islanders, using dental age assessment.

Their KE work has also enabled them to join forces and build capacity with dental organisations and relief agencies in India, Mainland China and Hong Kong.

5. References to the corroboration of impact or benefit

- The project was extensively covered by the media in India as well as newspapers in Hong Kong, for example:

‘Dental test can give near precise estimate – Expert’ – Med India Network for Health
www.medindia.net/health-press-release/Dental-Test-Can-Give-Near-Precise-Birth-Date-Expert-209073-1.htm

‘Teenage Woes? No more lying through the teeth’ – The Times of India
www.timesofindia.indiatimes.com/city/chennai/Teenage-woes-No-more-lying-through-the-teeth/articleshow/36409816.cms

‘Dental Age Assessment for Delhi Gang Rape Suspect’ – Indian Television interview
www.youtube.com/watch?v=4toI5XiKVB4

- Establishment of the world’s first charity to promote accurate birth records, D.O.B. (Date of Birth) Foundation: www.dob-foundation.org/

Quantitative Indicators

Table 1

Performance Indicators Laid Down by UGC	2015/16 ^{Note 1}
Number of patents filed in the year (with breakdown by country and type)	129 ^{Note 2}
Number of patents granted in the year (with breakdown by country and type)	60 ^{Note 3}
Number of licenses granted (with breakdown by type)	86
Income (on cash basis) generated from intellectual property rights ^{Note 4}	\$20,428,000
Expenditure involved in generating income from intellectual property rights ^{Note 5}	\$6,663,000
Number of economically active spin-off companies (with breakdown by type) ^{Note 6}	11 ^{Note 7}
Net income generated (or net loss arising) from spin-off companies ^{Note 8}	(\$819,000)
Number of collaborative researches, and income thereby generated ^{Note 9}	
- no. of projects	21
- income generated	\$21,582,000
Number of contract researches (other than those included in “collaborative researches” above), and income thereby generated ^{Note 10}	
- no. of projects	882
- income generated	\$291,068,000
Number of consultancies, and income thereby generated ^{Note 11}	
- no. of projects	906
- income generated	\$38,861,000
Total of collaborative researches, contract researches and consultancies ^{Note 12}	
- no. of projects	1,809
- income generated	\$351,511,000
Number of student contact hours in short courses or e-learning programmes specially tailored to meet business or CPD needs ^{Note 13}	108,639
Number of equipment and facilities service agreements, and income thereby generated	
- no. of agreements	14
- income generated	\$695,000

Performance Indicators Laid Down by UGC	2015/16 ^{Note 1}
Income received from Continuing Professional Development (CPD) courses ^{Note 14}	\$7,004,000
Number of public lectures/symposiums and speeches to a community audience ^{Note 15}	1,490
Number of performances and exhibitions of creative works by staff or students ^{Note 15}	116
Number of staff engaged as members of external advisory bodies including professional, industry, government, statutory or non-statutory bodies	609

Notes:

1. Income/expenditure figures in HKD were rounded to the nearest thousand.
2. The number of inventions involved is 101.
3. The number of inventions involved is 41.
4. The practice of the Technology Transfer Office (TTO) in previous years was to use accrual basis instead of cash basis to report income generated from intellectual property rights (IPR) in line with the principal accounting policies per audited accounts of Versitech, HKU's wholly owned technology transfer company. Starting from the 2015/16 KE annual report, such income will be reported on cash basis in accordance with the UGC's definition.
5. In the previous years, TTO only reported the expenditure associated with revenue-generating IPR in a reporting year. Starting from the 2015/16 KE annual report, the costs incurred in protecting all IPR in the reporting year will be reported, without limiting only to those patents that were successful in generating income.
6. For commercialization, the University through Versitech takes a dual approach of spin-off and licensing.
7. In addition to spin-off companies, start-ups that are commercialising HKU technologies and funded by the Technology Start-up Support Scheme for Universities at HKU (TSSSU@HKU) have been included.
8. Versitech is a minority shareholder in the spin-off companies. It is difficult to predict the companies' sales/turnover due to the volatile business environment. Only the net income (or net loss) of those companies with equity held by Versitech was reported because being the equity holder Versitech could obtain the financial information from those companies.
9. ITF projects with industrial sponsorship and other collaborative projects with at least two partners (one of which being a government or public body) were included.
10. Contract research projects commissioned by external organizations, and projects supported by funding schemes that allow non-higher education institutions to apply, including ITF projects without industrial sponsorship, Public Policy Research projects, and projects funded by the Food and Health Bureau, the SK Yee Foundation, Construction Industry Council, and Standing Committee on Language Education and Research (SCOLAR), were included.
11. Consultancy projects commissioned by external organizations to Versitech were also included.
12. It is considered more appropriate to target the increase in collaborative researches, contract researches and consultancies together rather than separately because it is sometimes not easy to classify projects into these categories.
13. Taught postgraduate programmes were not included.
14. Expenditures including overheads were deducted. Net income from taught postgraduate programmes was not included.
15. Community, cultural and KE-related events organized by the University and those delivered by academic staff at the invitation of external organizations were included.

Table 2

Other Performance Indicators of HKU	2015/16
No. of external advisory bodies membership held by HKU staff	2,928
Number of placement/internships ^{Note 1}	5,816
Number of books and other media for non-academic audiences ^{Note 2}	331
Number of mentors from outside HKU for HKU students ^{Note 1}	1,165 ^{Note 3}
Number of knowledge transfer websites ^{Note 4}	205
Number of postgraduate theses on open access ^{Note 4}	24,593
Download count of postgraduate theses to addresses outside HKU ^{Note 4}	955,305
Number of publications on open access ^{Note 4}	17,562
Download count of publications to addresses outside HKU ^{Note 4}	781,103
Number of positive media impact related to knowledge transfer coverage, including print, on-line and electronic media ^{Note 5}	18,463 ^{Note 6}
Number of staff available for media contact ^{Note 4}	674
Number of appointments of external members to HKU advisory boards, committees or panels ^{Note 1}	443

Notes:

1. As HKU sees KE as a two-way process, these three indicators refer to the University's efforts to learn from the community.
2. Includes books, book chapters, textbooks, handbooks, public policy reports, and DVDs etc., published mainly for non-academic audiences by HKU staff, but excludes all research publications and patents.
3. The number of mentors relating to academic programmes has been excluded, hence the smaller number.
4. These six indicators refer to the University's efforts in making knowledge accessible to society.
5. The number was obtained through the media impact project using an online news platform covering mainly local newspapers and magazines, and some multimedia outlets and websites to pool daily news reports concerning HKU that are KE-related.
6. It was observed that there was a decrease in news with comments/opinion of our staff concerning political reform and the impact of social movements on the economy of Hong Kong in the reporting year.