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New trends in innovation strategy at Chinese universities in Hong Kong and Shenzhen

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Abstract: This paper assesses collaborative innovation activity undertaken by universities in Hong Kong and Shenzhen, China. The theoretical background references the systems of innovation approach and the triple helix model of university-industry-government interaction. The paper reviews Hong Kong's tertiary education system and the role of science and technology development in Shenzhen and Mainland China. Focusing on knowledge transfer between university research facilities, research institutes, industry, and government, the paper profiles key collaborative innovation programmes and documents an emerging trend in innovation strategy that utilises innovation collaboration to spawn startup businesses in China. Although we find no definite pattern of university-industry-government collaboration, we identify a range of specific competitive advantages associated with each of Hong Kong's universities that drive their innovation-related collaboration with institutions and firms in other sectors.

Keywords: innovation strategy; university cooperation; Hong Kong; Shenzhen.

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1 Introduction

Research focusing on industrialised countries suggests that linkages between research-oriented universities and private firms (D'Este and Patel, 2007) enhance competitiveness and drive economic growth and development. Universities also generate human capital in the form of highly skilled, technologically adept engineering and managerial talent, not to mention additional benefits achieved through knowledge spillovers. Research universities are thereby emerging as drivers of economic growth, in some instances providing the critical resources needed to establish dynamic industrial clusters in major metropolitan regions (Abdullateef, 2000; Appleseed Inc., 2003).

Until recently, individual private sector firms carried out most of the innovative activity in Shenzhen, the People's Republic of China (PRC), with universities playing a less prominent role. Lately, however, universities have been contributing much more actively to the PRC's innovation and innovative entrepreneurship. Several factors are contributing to this new trend, one of which is the more active role that Hong Kong's universities are now playing in its neighbour's economic life. Another factor is the increased blurring of economic and political boundaries between the two cities, resulting in cross-border flows of knowledge and technology as well as human and economic capital, which in turn influences university participation in innovative activity and university-industry-government dynamics.

Whereas Hong Kong-owned manufacturing companies located in Guangdong Province have been found consistently to be less active than their indigenous Guangdong counterparts in pursuing research, development, and innovative activities (cf., Huang and Sharif, 2009), the aforementioned emerging trend will undoubtedly see Shenzhen universities and university-based researchers becoming vigorous actors engaging in domestic as well as cross-border research and innovation joint ventures with actors in Hong Kong.

With a comparatively higher concentration of world-class universities and a culture of academic internationalism, Hong Kong's tertiary education sector owns a competitive edge in the transfer of science and technology (S&T) to Southern China's innovation system, enabling it to enhance innovation capacity in Shenzhen and Guangdong province. Hong Kong universities hoping to contribute to this transfer of cutting-edge S&T have recently established several research institutes in Shenzhen. These agents of technology transfer include the Chinese University of Hong Kong's Shenzhen Research Institute (CUHK SZRI) and its affiliation with the Shenzhen Institute of Advanced Technology

(SIAT), the City University of Hong Kong's Shenzhen Research Institute (CityU SRI), the Hong Kong University of Science and Technology's Shenzhen Research Institute (HKUST SRI), and the University of Hong Kong's Binhai Hospital (BH) and Shenzhen Institute of Research and Innovation (HKU SIRI). Their presence in Shenzhen supported the case study approach that informed the research design of this paper (see Section 3), in which we explore the contribution of major Hong Kong universities to the economic well-being of the Hong Kong–Shenzhen nexus. By targeting relevant cases of Hong Kong university expansion into Shenzhen, we demonstrate their contribution to a new trend in innovation strategy on the part of the Shenzhen government and Shenzhen-based research institutes.

The broad research question we pose in this study is: How do Hong Kong's research-oriented universities contribute – through their collaboration efforts – to the development of innovation-based industry in Shenzhen? In summary, our study finds no definite pattern of university-industry-government collaboration. Instead we identify specific competitive advantages in each of the universities under study that drive their innovation-related collaboration with institutions and firms in other sectors. Our study also suggests that Hong Kong's universities will forge the future developmental pathway for innovative activities in the Hong Kong–Shenzhen nexus in response to demand for knowledge on the part of Shenzhen's innovative industries. Our findings suggest that Hong Kong's academics will benefit from their culture of academic internationalisation and professionalism in transferring transformative research-related practices, culture, and ethics to Shenzhen.

In the remainder of the paper, Section 2 covers the theoretical background, Section 3 introduces the research method of this study, Section 4 surveys the current state of the tertiary education system in Hong Kong, Section 5 assesses the role of S&T development in China and Shenzhen, Section 6 describes current collaboration efforts between Hong Kong and Shenzhen universities, and Section 7 concludes by summarising the findings and acknowledging the study's limitations.

2 Theoretical background: the role of universities in powering innovation systems

Innovative activity typically depends on external resources and is therefore characterised as a 'collective achievement'. Scholarly work in innovation studies has focused on delineating 'systems of innovation' based on national, technological, industrial, or sectoral characteristics that capture this 'collective' aspect (Carlsson and Stankiewicz, 1991; Freeman et al., 1982; Hughes, 1983; Malerba, 2005).[1] Here we focus on a main component of any innovation system – academia – through the lens of the 'triple-helix model' of university-industry-government interaction (Etzkowitz and Leydesdorff, 1997).

Table 1 PRC's R&D expenditure by performing sector as a percentage of GDP and in million US$, 2006–2010

	% of GDP	*Expenditure in million USD$ (growth rate*)*	*% of GDP*	*Expenditure in million USD$ (growth rate*)*	*% of GDP*	*Expenditure in million USD$ (growth rate*)*	*% of GDP*	*Expenditure in million USD$ (growth rate*)*	*% of GDP*	*Expenditure in million USD$ (growth rate*)*
Year/sector	*2006*		*2007*		*2008*		*2009*		*2010*	
BERD	1.99%	61,602.87 (N/A)	1.01%	74,045.86 (+ 20.20%)	1.08%	88.502.69 (+ 19.52%)	1.25%	112,874.68 (+ 27.54%)	1.30%	131,410.67 (+ 16.42%)
HERD	0.13%	7,988.78 (N/A)	0.12%	8,688.24 (+ 8.76%)	0.12%	10,211.07 (+ 17.53%)	0.14%	12,438.23 (+ 21.81%)	0.15%	15,136.80 (+ 21.70%)
GOVERD	0.27%	17,077.80 (N/A)	0.27%	19,702.18 (+15.37%)	0.27%	22,092.89 (+ 12.13%)	0.32%	28,834.46 (+ 30.51%)	0.32%	32,433.20 (+ 12.48%)
Total (GERD)	1.39%	86,669.45 (N/A)	1.40%	102,436.28 (+ 18.19%)	1.47%	120,806.64 (+ 17.93%)	1.70%	154,147.36 (+ 27.60%)	1.77%	178,980.66 (+ 16.11%)

Notes: BERD: Business Expenditure on Research and Development
HERD: Higher Education Expenditure on Research and Development
GOVERD: Government Expenditure on Research and Development
GERD: Gross Domestic Expenditure on Research and Development
*Growth rate is calculated based on data from the abovementioned source

Source: 'Main Science and Technology Indicators' in OECD Science, Technology and R&D Statistics, OECD. http://www.oecd-ilibrary.org/science-and-technology/data/oecd-science-technology-and-r-d-statistics/main-science-and-technology-indicators_data-00182-en (accessed 4 July 2012)

Wu (2005) assesses the relative importance of universities within both the systems of innovation framework and the triple helix model, suggesting that the USA, Japan, and continental Europe offer three distinct innovation models. In the USA, universities greatly expanded their research efforts following World War II and since then have engaged in applied research aimed at boosting industrial performance with new technologies. Thus the US university research sector has been a major player in the growth of the American innovation system. For its part the federal government has introduced new mechanisms to link universities to industry (Brown and O'Brien, 1980) and fund economically productive research and teaching (Mowery and Rosenberg, 1993).

A new era in the USA was ushered in with the passage in 1980 of the Stevenson-Wydler Technology Innovation Act and the Bayh-Dole University and Small Business Patent Act, facilitating the transfer of publicly funded intellectual property (IP) to industrial firms (Feldman and Francis, 2003). Lately researchers have found it easier to license technology created in their own labs and found startup companies, while universities have worked more closely with industry, thereby diffusing innovations more easily throughout the system. As a result, patenting grew sevenfold between 1976 and 1998, with licensing revenues from IP sales growing rapidly as well (Owen-Smith et al., 2002).

In Japan and Europe parallel developments have spawned an emerging 'entrepreneurial' university model (Etzkowitz et al., 2000). Japan has emphasised long-term research initiatives with commercial potential (Etzkowitz et al., 2000; Kodama, 2005), while Europeans have sought to match university research projects with suitable firms to deliver tangible commercial outcomes more quickly (Malik et al., 2011; Owen-Smith et al., 2002). In the process, as Etzkowitz et al. (2000) argue, universities worldwide are increasingly shifting from the traditional educational missions of teaching and research to a more complex model that includes actively supporting the competitive development of local and regional economies. As a result, universities increasingly play a critical role in innovation systems, participating in a triple-helix nexus involving closer interaction with government institutions and private industry. Ideally, regional or worldwide innovation systems will enable major university research facilities to collaborate with industrial facilities wherever they operate.

Wong et al. (2007) argue that, to establish a knowledge-based economic framework under the new entrepreneurial model, Hong Kong will need local companies to acquire capabilities that are atypical in newly industrialising economies, where local enterprises "tend to be laggards, rather than leaders, in engaging in technology development and innovation activities" [Wong et al., (2007), p.942]. From the vantage point of Hong Kong's universities, therefore, it thus makes all the more sense to collaborate with Mainland institutions – particularly those based in Shenzhen – utilising them as springboards into collaboration with private enterprises in Guangdong, becoming leaders in technological development and innovation activities.

Xue (2008) argues that the strength of China's universities and national innovation system are closely linked insofar as industry supplies almost half of all research funding for PRC universities. Furthermore, China increasingly emphasises the role of its burgeoning university-owned enterprises in tertiary education strategic development.

The entrepreneurial university model (some say that spawning entrepreneurs is the 'third mission' of universities) finds perhaps stronger support in Shenzhen than in Hong Kong, for several reasons. First, high technology industries such as biotechnology and

information technology have experienced stronger growth in Shenzhen than in Hong Kong. This offers university-based research professors, post-graduate students, and university administrators greater potential to exploit commercial applications of advanced scientific research. Second, the Chinese government utilises universities more robustly than ever to support regional development. Investments in research and development (R&D) have increased substantially since at least 2006 (Table 1), and as recently as the promulgation of China's latest five-year plan (2011–2015).[2] Third, the growth of technology-based industries in Shenzhen has spurred stronger demand for new knowledge and technologies there and across Guangdong than in Hong Kong. This demand for knowledge and technology is the key driver of greater links between local Shenzhen universities and companies. Insofar as firms increasingly engage with universities to obtain external knowledge, such a demand-side factor should continue to drive greater collaboration between Hong Kong's increasingly entrepreneurial universities and their Shenzhen counterparts and research institutes [Malik and Wei (2011), explore how external partnerships, particularly with universities, customers, and key suppliers, have helped Chinese SMEs become more innovative].[3]

Finally, government regulation and policies have created key institutional – as well as financial – incentives for cooperation between universities in Hong Kong and Shenzhen. Since the 1990s, Hong Kong universities have been encouraged to patent and license technologies from public funding, supported by funding schemes for research cooperation and financial support for new technology-based ventures and new infrastructure (such as science parks). Indeed, Hong Kong has increasingly provided such support in recent years, providing an important incentive for direct collaboration (Sharif, 2006). Furthermore, in 1997 the Chinese Ministry of Science and Technology established the National Basic Research Program of China, more commonly known as the '973 Program', designed to fund basic research and key scientific endeavours to drive national economic and social development. The Programme offers unprecedented funding opportunities for researchers affiliated with Hong Kong universities and also provides prestige to Hong Kong-based researchers.

3 Methodology

This paper's context-based case study approach shapes its research design, as we conceptualise Hong Kong and Shenzhen as two *cases* with distinct innovation and university systems. We analysed relevant policy documents and interviewed key actors – such as technology transfer officers, vice-presidents for R&D, representatives from the R&D arms, and relevant deans – at HKU, CUHK, and HKUST.[4] We also investigated Shenzhen Municipal Government development plans to uncover the systemic demand for knowledge, especially in the strategic fields of

1 biology [Shenzhen Biology and Industrial Revitalisation Development Plan (2009–2015)]

2 the internet [Shenzhen Internet and Industrial Revitalisation Development Plan (2009–2015)]

3 new energy [Shenzhen New Energy and Industrial Revitalisation Development Plan (2009–2015)].

Relevant and updated data were collected from Hong Kong's University Grants Committee (UGC) to examine contextual factors affecting Hong Kong's university system, and this data informs comparative case studies of the four abovementioned focal institutions – the CUHK SZRI in affiliation with the SIAT, the CityU SRI, the HKUST SRI, and the HKU SIRI and BH.

Documents from the concerned research institutes and academic units, some of which are available via their official websites and others via the universities' annual reports, were studied to compare and contrast the strategies and actions involved in implementing the 'third mission' and in consequence the outcomes for the Hong Kong–Shenzhen innovation nexus. Again, these were supplemented by data obtained from selected interviews with key university representatives. Throughout the data collection process, we paid particular attention to institutional organisation under the triple-helix model and incentives for academics to engage in such knowledge transfer from higher education institutions in Hong Kong to innovative industries in Shenzhen.

4 The state of the tertiary education sector in Hong Kong

Today, eight Hong Kong universities are governed by the UGC, of which three – HKU, CUHK, and HKUST—receive the lion's share of Government research funding (University Grants Committee, 2012). Tertiary education accounted for approximately one-third of Hong Kong's public expenditure on education in 2010/2011, approximately 3.6% of GDP, which is close to the OECD average. However, Hong Kong's gross domestic expenditure on research and development (GERD) remains lower than the OECD GERD/GDP average (0.73% versus 2.34%; see Table 2). Therefore, although Hong Kong universities conduct R&D at rates that are comparable to those of advanced economies, other sectors (notably business and government) remain significantly weaker (Sharif, 2010). Thus Hong Kong universities seek opportunities to partner with businesses and public and private research institutes and organisations in Shenzhen city and the Pearl River Delta (PRD) region more generally.

Table 2 International comparison of higher education expenditure on R&D, 2008

COUNTRY	*HERD/GDP (%)*	*GERD/GDP (%)*
Finland	0.64	3.72
Singapore	0.54	2.61
Netherlands	0.67	1.76
Japan	0.43[a]	3.44
OECD average	*0.40*	*2.34*
Hong Kong	0.40	0.73
Ireland	0.39	1.45
Korea	0.38	3.36
Taiwan	0.34	2.77
People's Republic of China	0.13	1.54

Notes: [a]2007 Figure
HERD: Higher Education Expenditure on Research and Development
GERD: Gross Domestic Expenditure on Research and Development

Source: OECD (2010) and HKSAR Census and Statistics Department (2011)

Table 3 Classification of UGC-funded universities within Hong Kong's innovation system

University of Hong Kong
Established: 1912
Faculties: Architecture, Arts, Business and Economics, Dentistry, Education, Engineering, Law, Medicine, Science, Social Sciences, Graduate School, Professional and Continuing Education
Areas of Emphasis: Research-based teaching, basic and applied research
Chinese University of Hong Kong
Established: 1963
Faculties: Arts, Business Administration, Education, Engineering, Law, Medicine, Science, Social Science, Graduate School, Continuing and Professional Studies
Areas of Emphasis: Research-based teaching, basic and applied research
Hong Kong University of Science and Technology
Established: 1991
Faculties: Science, Engineering, Business and Management, Humanities and Social Science, Lifelong Learning
Areas of Emphasis: Research-based teaching, basic and applied research
Hong Kong Polytechnic University
Established: 1994 (1972)
Faculties: Applied Science and Textiles, Business, Construction and Environment, Engineering, Health and Social Sciences, Humanities, Design, Hotel and Tourism Management, Professional and Continuing Education
Areas of Emphasis: Advanced teaching, applied research
City University of Hong Kong
Established: 1994 (1984)
Faculties: Business, Creative Media, Energy and Environment, Liberal Arts and Social Sciences, Law, Science and Engineering, Graduate Studies, Continuing and Professional Education
Areas of Emphasis: Advanced teaching, applied research
Hong Kong Baptist University
Established: 1994 (1956)
Faculties: Arts, Business, Chinese Medicine, Communication, Science, Social Sciences, Visual Arts, Graduate School
Areas of Emphasis: Liberal arts teaching, research
Lingnan University
Established: 1999 (1967)
Faculties: Arts, Business, Social Sciences, Further Education
Areas of Emphasis: Liberal arts teaching, research
Hong Kong Institute of Education
Established: 1994 (1939–82)
Faculties: Languages, Arts and Sciences, Educational Studies, Languages, Graduate School, Continuing and Professional Education
Areas of Emphasis: Teacher training

Notes: Dates without parentheses refer to the year in which the current institutional status was attained; dates in parentheses refer to the year in which the institution was founded.

The Hong Kong Government has funded a substantial proportion of the higher education research and development (HERD) expenditure by heavily subsidising university research through the UGC, the Research Grants Council (RGC), and the Education Bureau (EDB). The EDB monitors the tertiary education policy framework, yet universities enjoy considerable institutional autonomy when implementing policies. The UGC and the RGC assist the Government in allocating education and research funding. Until recently, over 65% of the eight UGC-funded universities' total income came from government subventions. This figure has dropped steadily since 2003/2004 suggesting that, although it remains high at above 50%, the role of government education subsidies is declining.

By feeding the human capital base with technologically savvy personnel and conducting academic and contract research, universities constitute the single most important element in Hong Kong's innovation system. Indeed, the higher education sector has, relatively recently, expanded significantly, with two local polytechnics and two colleges attaining university status between 1992 and 1994.

With 17 degree-granting organisations – eight of which are funded by the UGC (see Table 3) – Hong Kong now provides 14,600 first-year first-degree places to approximately 18% of the 17-to-20-year-olds in the population. The oldest of the eight universities, HKU and CUHK, have the longest traditions of serving the Hong Kong community through the breadth of their training programmes and the size of their student bodies. In spite of its comparatively young age, HKUST has developed a healthy reputation, although it covers a much narrower range of specialisations than HKU or CUHK. HKPU and City University were polytechnics that originally provided training in engineering subjects, and since upgrading to university status in 1994 they have maintained the tradition of cooperating with important Hong Kong manufacturing and service sectors, including the textiles, electronics, and tourism industries.

5 National promotion of S&T in China and Shenzhen's role

In March 2006, China launched its *National Mid- and Long-Term Science and Technology Development Plan for 2006–2020*. The Plan represents the ambition of sustaining economic growth and social development through homegrown innovation and increased government-led R&D investments. Its quantitative targets for China's innovation performance include raising the ratio of gross expenditures on R&D to GDP to 2.5% by 2020. The Plan envisages

a technological progress contributing to 60% of economic growth

b increases in business expenditures in R&D doubling those in technology transfer (as dependence on foreign technology drops below 30%)

c increases in the number of invention patents granted to Chinese citizens and the citation of international scientific papers so that both rank among the world's top five.

Shenzhen has been targeted with a strategic role in the plan, positioning it uniquely within China's overall developmental map. The city is envisioned as a technological hub for both Southern China and the entire country, motivating the further development of Hong Kong/Shenzhen academic research relationships due in no small part to the strength

of Hong Kong's universities in conducting cutting-edge basic research in the natural sciences.

For its part, the Shenzhen government has identified three strategic fields in which it hopes to advance the nation's technological and innovative capacity:

a the internet[5]

b biology[6]

c new energy.[7]

Investments in these areas include RMB10.5 billion (1.69 billion US dollars) from 2009 to 2015 (Shenzhen Municipal Government, 2009a, 2009b, 2009c). At the same time, the Shenzhen Municipal Government also set out aggressively on the 'innovation route' by participating in drafting relevant plans which have since been enacted, including:

1 PRD Region Reform and Development Plan (2008–2020). This plan promotes private investment and exports as drivers of economic growth, aiming to achieve uniform development across the PRD and deepening the integration of economic development between the PRD and Hong Kong and Macau. This includes deepening S&T cooperation between Guangdong, Hong Kong, and Macau, and establishing joint-innovation zones and innovation communities to strengthen cooperation between industry, universities and research academies.

2 Overall Plan of Shenzhen as a National Innovation City (2008–2015). In the short run (two to three years), this initiative aims to incubate SMEs which focus on innovation-related activities and, in the longer run (five years), establish graduate schools and universities to provide the region with internationally competitive human resources. The initiative will also bring together human resources from universities in Hong Kong and Shenzhen to work cooperatively in further boosting innovation.

3 The Master Plan of the Shenzhen Modern Industrial System (2009–2015). The goal of this initiative is to develop high-tech service industries while utilising the strength of Hong Kong's and Shenzhen's universities. These plans are currently in various stages of implementation.

6 Deepening collaboration between Shenzhen's and Hong Kong's universities and research institutes

The new innovation strategy pursued by Shenzhen's universities and research institutes is heralded by deeper and broader collaboration with Hong Kong's universities. As the aforementioned innovation strategies forge ahead, new innovation ventures proliferate, creating new opportunities not only for knowledge-based entrepreneurial activities but more relevantly for developing universities in Shenzhen with strong knowledge bases, a trend that has been facilitated by the closer collaboration we have observed between Shenzhen universities and research institutes and major universities in Hong Kong.

Since the early 2000s, Hong Kong's universities have, to their credit, identified the gap they are able to fill and have typically been the initiators of collaborative efforts with Shenzhen's universities. To be sure, these efforts have been lubricated by generous

incentives from the Shenzhen government and the eagerness of Hong Kong's universities to transfer S&T in the rapidly growing Shenzhen market (The University of Hong Kong, 2011). One manifestation of this closer collaboration is the joint establishment, following Hong Kong's return of sovereignty to Mainland China, of the National Natural Science Foundation of China (NSFC)/RGC Joint Research Scheme. The Scheme was established to enhance Hong Kong–Mainland research collaboration among universities and research enterprises, the growth of which is reflected in the doubling of applications to the Scheme from 148 in 2000 to 294 in 2011. The RGC increased the total funding grant from HK$10 million (US$1.29 million) in 2000 to HK$17 million (US$2.19 million) in 2011, with HK$21 million (US$2.71 million) earmarked for 2012/2013. In 2012, the RGC and the NSFC decided to expand the Scheme by funding successful projects for up to four years (one more than the previous three-year limit).

Notable examples of these collaborative efforts include the abovementioned CUHK SZRI and the SIAT, the CityU SRI, the HKUST SRI, and the HKU SIRI, which serve as nodes attracting innovation collaboration between Hong Kong and Mainland China as well as with international partners.

6.1 CUHK SZRI and SIAT

In March 2009, CUHK gained support from the Shenzhen Municipal Government to establish the CUHK SZRI amidst the intense industrial development of the PRD region at the turn of the 21st century. The institute is wholly owned by CUHK and aims to facilitate the involvement of university researchers in key laboratories, spin-off companies, training opportunities, and technology transfer. CUHK sees the SZRI initiative as a signal milestone in Hong Kong–Shenzhen collaboration which enhances Shenzhen's competitiveness amidst the rise of China's capital cities (The Chinese University of Hong Kong, 2010). The institute enables CUHK to advance collaboration with the Shenzhen Municipal Government, particularly through world-class laboratories and engagement with important state research, in turn complementing the PRC development plan for economic reengineering of the PRD. University researchers are thereby afforded unprecedented opportunities for technology application in industry that is unavailable in Hong Kong.

In addition, SZRI will respond to demand for continuing education by offering professional development and training programmes and non-degree courses, especially in the fields of engineering, management, and hygiene. Such a teaching and training mission is designed to breed talent and update expert knowledge for various blossoming industries in the city, the greater PRD region, and across the nation.

Even before the SZRI was established, CUHK became engaged in Chinese science and innovation when SIAT was set up in 2006. Housing 500 permanent staff paid through a national grant, SIAT is a collaborative research institute involving CUHK, the Chinese Academy of Sciences (CAS), and the Shenzhen Municipal Government with its research orientation towards the emerging new energy, digital city, low-cost healthcare, and service robotics industries. In 2009, SIAT became the first national research institute in China to collaborate with a non-Mainland partner.

More than 30 CUHK professors engage in SIAT research, applying science to technology advancement. University professors also manage the Institute of Biomedical and Health Engineering, the Institute of Advanced Computing and Digital Engineering, the Shenzhen Institute of Advanced Integration Technology, and the SIAT board.

Driving new industry output of over 1 billion RMB (0.16 US billion dollars), SIAT has thus far established industry partnerships with more than 153 firms, embracing Huawei, Midea, and CIMC amongst others. It is also one of the top filers of patent applications amongst Guangdong research organisations. Patent filing data serves to indicate both current innovative activity and future innovations (when patents are actually granted, utilised, and further improved). As it takes, on average, four-and-a-half years to be granted an invention patent in China, patent filing statistics are more revealing than actual patents granted given that the patenting boom in China is less than a decade old. Nevertheless, in 2009, 149 patents were acquired by SIAT, of which about two-fifths were transferred to industry. SIAT-based productivity is conducive to driving innovation-related growth in Shenzhen and the PRD.

6.2 CityU SRI

CityU established CityU SRI in 2001, and CityU Research Institute (Shenzhen) Ltd. in 2002. Located in the Gaoxin District in Shenzhen, CityU SRI is the Mainland extension of CityU's applied research, incubation, and professional education programme. The institute comprises five award-winning research centres, including

a the Biotechnology and Health Centre

b the Centre for Prognostics and System Health Management

c the Futian–CityU Mangrove R&D Centre

d the Future Networking Centre

e the Information and Communication Technologies Centre.

Over a decade's time, SRI has received funding from the PRC, Guangdong province, and Hong Kong for the State Key Laboratory of Millimetre Waves and the State Key Laboratory in Marine Pollution, the national 863 Programme, prominent S&T projects in Guangdong province, the Key Laboratory of Biochip Research in Shenzhen, and the Shenzhen–Hong Kong Innovation Circle Programme.

6.3 HKUST SRI

HKUST has exemplified the Chinese university innovation strategy since the turn of the 21st century. The first HKUST-Shenzhen initiative was launched in 1999 when HKUST signed a joint venture agreement with Peking University (PKU) and the Shenzhen Municipal Government to establish the PKU-HKUST Shenzhen–Hong Kong Institution.

The PKU-HKUST Shenzhen–Hong Kong Institution claims to be the most significant collaborative base utilised by PKU and HKUST outside their respective campuses. Employing Shenzhen as an interconnecting platform, research laboratories, high technology incubation companies, and training programmes were put in place by researchers and professionals affiliated with the two institutions. While the Shenzhen PKU-HKUST Medical Center was set up with the launching of the PKU/HKUST MD+PhD dual degree programme in 2001, in the same year HKUST participated in the Shenzhen Virtual University Park by establishing the HKUST SRI,[8] and was amongst the first cohort of 38 universities (including PKU and Tsinghua University) to occupy space at the facility. The Shenzhen Research Institute functions as the local HKUST liaison

office in Shenzhen, undertaking project management and student recruitment in Mainland China.

Education, at both the undergraduate and postgraduate levels, is essential for human resource cultivation. HKUST was the first higher education institution to acquire PRC approval of direct recruitment of undergraduate students in the Mainland, which was obtained through the Hong Kong and Macau Affairs Office of the State Council of China in 2000. Whereas Mainland students constitute a considerable proportion of the HKUST student population, the university has over the years produced many engineering, science, and technology graduates who return to China and contribute to its rising innovation system and economy. The globally renowned HKUST MBA programme commenced accepting students in Shenzhen in 2002.

It is worth noting important examples of graduates who serve to illustrate HKUST's impact:

1 Professor Kang Feiyu graduated with his PhD in mechanical engineering from HKUST in 1997 and is today Dean of the Graduate School at Shenzhen, Tsinghua University. An expert in carbon materials, Kang founded the New Carbon Materials Laboratory with funding from the Key Laboratory for Advanced Materials of the Ministry of Education and Tsinghua University. Kang is the named inventor on 20 nationally issued patents and two US-issued patents. During his tenure as Executive Deputy Dean at Tsinghua's School of Continuing Education from 2003–05, Kang initiated a pioneering free distance-learning platform for the underprivileged, with the school having established distance-learning stations in over 100 underdeveloped provinces in Mainland China. Through this 'Virtual University' programme, millions of people living in the underprivileged provinces can benefit from the university's quality educational resources.

2 Frank Wang graduated with both his bachelor's and master's degrees (both in electrical engineering) from HKUST in 2006 and 2011, respectively, and is currently CEO and CTO of DJI Innovations and founder of iFlight Technology. Wang developed an unmanned miniature helicopter that has been used for surveying and monitoring high-altitude environments, and facilitated the protection of highland ecology, setting a milestone in the history of unmanned aviation when the helicopter was used to take an aerial scan of Sichuan after the massive earthquake there in May 2008. The scan helped authorities assess the extent of the damage and draw up rebuilding and rehabilitation plans.

3 David Xiao graduated with his PhD in electrical engineering from HKUST in 2002 and in 2006 helped establish and is now the managing director of Advanced Photoelectronic Technology Ltd. Xiao has worked with other HKUST alumni engineers, and they have, together, been involved in filing patents for important innovations.

6.4 HKU BH and SIRI

6.4.1 Binhai Hospital

BH, also known as The University of Hong Kong–Shenzhen (Teaching) Hospital, is a medical project financed by the Shenzhen Municipal Government with substantial clinical and management support from HKU, in particular through its well-established

Faculty of Medicine. This is one of 101 Shenzhen government–funded medical projects costing a total of 19.5 billion RMB (3.1 billion US dollars) from 2005 to 2010. BH is a teaching hospital featuring a synergetic combination of clinical trials, scientific research, and education, making scientific research and medical education part of its mission. Providing world-standard engineering designs and facilities as well as medical administration, BH aims to respond to China's rising public need for high-quality medical services, especially given its young migrant population and unique geopolitical position.

BH envisions setting up a professional model for China's healthcare system by integrating the world-class facilities and equipment provided by the Shenzhen Municipal Government with the professional culture of the HKU expert team. Utilising a construction area of 352,000 square metres, 2000 patient beds will be accommodated, 60% of which will be set aside for the public. A fixed rate of 500 RMB (79 US dollars) per day, comprising bed cost, medicine, operations, and medical consultation fees will be charged to patients covered by the public healthcare system. Between 6000 and 10,000 outpatients will be served daily. BH specialises in organ transplants and cancer treatment and includes departments dedicated to tumour therapy, orthopaedics, cardiovascular treatment, and reproductive medicine. BH enhances access to and the quality of Chinese healthcare and medical services.

It is worth noting that, to address corruption, which is widespread across China (White, 1996) and impedes effective medical care (Yang et al., 1991), one key theme of the BH endeavour is engagement with the culture of hospital management. Given the comparatively more effective and seasoned HKU medical practices, the university assumes the role of management – in particular appointing the head of the hospital – on top of offering support for medical care, R&D, and education. With a view to discouraging doctors from engaging in corruption, respectably high salaries are provided. A quality assurance framework will be devised, including setting standards for international accreditation. Leveraging its reputation as a resource, the hospital emphasises a sense of mission, responsibility, and urgency among medical doctors and the general workforce, seeking to inculcate an ethical spirit across the organisation.

By transferring knowledge, practices, and medical professionals across the Hong Kong–Shenzhen border, the BH project enhances scientific and technological healthcare innovations in Shenzhen. Taking advantage of HKU's institutional competitive edge in medical science as well as its institutional networks with the Shenzhen Municipal Government, the call for healthcare innovations from Shenzhen incentivises HKU academic departments and academic researchers to engage in this joint venture, contributing additional value to the social and cultural innovations required to make healthcare delivery a success in Shenzhen.

6.4.2 HKU SIRI

Incorporated in March 2011, SIRI was an extension of HKU research in Mainland China, in particular transferring knowledge and technology to the Mainland and promoting incubation of Chinese industry. Administratively, HKU SIRI facilitates applications made by HKU researchers for Mainland research grants, including the National Key Basic Research Development Programme (the 973 Programme), the Science, Industry, Trade and Information Technology Commission of Shenzhen Municipality, and the National Natural Science Funds. There are plans to build a research base in Shenzhen

pending approval by the Shenzhen Municipal Government. Currently, laboratories established at HKU SIRI include the Bio-Materials Research Centre, the E-business Technology Institute, the Smart-Grid Research Centre, and the Water Environment Research Programme. There are three HKU SIRI projects under the 973 Programme:

a investigation of brain mechanisms underlying Chinese language processing and the neurogenetic basis for language disorders (Department of Linguistics)

b Power System Planning and Operation with Large-Scale Wind Integration (Department of Electrical and Electronic Engineering)

c Aeroacoustics and Advanced Noise Control for Large Passenger Aircraft (Department of Mechanical Engineering).

7 Conclusions

In exploring new trends in Hong Kong university involvement in Shenzhen's innovation system, this preliminary study finds no definite pattern of institutional organisation that accords with the triple-helix model of academic engagement in knowledge transfer from Hong Kong universities to innovative industries in Shenzhen. Generally, however, Hong Kong's institutional competitive edge and networks of universities facilitate and incentivise their engagement in Hong Kong–Shenzhen innovative activities through their academic departments and researchers. Apart from the common pattern of transferring knowledge in the biomedical and biotechnology fields, the focal institutions engage individually in specific areas in accordance with their respective competitive advantages. Examples include involvement in robotics and automation by CUHK SZRI, information and communication technology by CityU SRI, business administration by HKUST SRI, and e-business technology by HKU SIRI.

Given the culture and practices of Hong Kong academia, this paper proposes that the future developmental pathway for innovative activities in the Hong Kong–Shenzhen nexus will not follow a top-down model. Rather, Hong Kong's universities will respond to demand for knowledge by Shenzhen's innovative industries in accordance with their respective institutional/faculty networks and institutional competitive edges. Meso-level factors will shape the institutional organisation of academic engagement in knowledge transfer under the triple-helix model.

The case of Hong Kong–Shenzhen innovation collaboration deserves attention not only because of its dynamic presence in Southern China, but also because of both cities' special status relative to the PRC. As Guangdong, led by these two cities, assumes a new role in the global marketplace, Hong Kong and Shenzhen can lead the way for other rapidly growing Chinese regions and economic zones (such as the PRD and the Yangtze River Delta). Given the relatively advanced status of the Chinese economy, Hong Kong and Shenzhen are under intense pressure to shift towards a knowledge-based economy in order to survive – and thrive – economically.

Unprecedented investment in innovation-driven economic activity in Mainland China provides substantial incentives for Hong Kong–based researchers to transfer scientific knowledge, providing technological and engineering solutions for China's growing innovation system. Benefitting from a culture of academic internationalism and professionalism (Postiglione and Tang, 2008), Hong Kong scientists should lead in

transforming the practices, culture, and ethics of the Mainland research workplace. The unique strategies and pathways adopted by individual Hong Kong universities – as this paper finds – reflect the institutional autonomy that is cherished in the Hong Kong higher education sector.

Notwithstanding the lack of a clear triple-helix pattern of institutional organisation in the Hong Kong–Shenzen nexus, policies and practices conducive to fostering a new research culture that is liberal and accessible to scientists from diverse backgrounds should enable Hong Kong's academic researchers to contribute more robustly to China's innovation system, and more importantly motivate non-citizens and expatriate scholars to engage in Mainland innovation endeavours.

One key limitation of this exploratory paper is that it offers only a snapshot – instead of tracing the developmental trajectory or trend – of the diverse relationships between Hong Kong universities in Shenzhen's innovative industries, according to institutional-specific competitive advantages and networks of academic departments and individual researchers. Additionally, in the absence of long-term government policies in Hong Kong's higher education sector, there is no significant top-down effect on this developmental trajectory. The changing landscape of Hong Kong university engagement with Shenzhen's innovation activities is in part mediated by academics who forge networks with industrial partners, but employment mobility of academics across various universities in Hong Kong is not uncommon. We suggest that longitudinal studies of the focal institutions/academic units are needed to inform studies of the developmental trajectory of this aspect of Hong Kong–Shenzhen collaboration.

This paper is also somewhat limited regarding the explanatory concepts that informed our research. Again, future developmental pathways for innovative activities in the Hong Kong–Shenzhen nexus seem unlikely to follow a top-down model. Rather, meso-level factors will shape the institutional organisation of academic engagement in knowledge transfer within the triple-helix model. In this sense, adding grounded concepts associated with the policy innovation of 'one country two systems' to the analysis as well as social networking with Chinese characteristics (i.e., *guanxi*) as a factor would add sophistication to the triple-helix model and enhance its explanatory power regarding innovation activities in Chinese contexts.

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References

Abdullateef, E. (2000) 'Developing knowledge and creativity: asset tracking as a strategy centerpiece', *Journal of Arts Management, Law, and Society*, Vol. 30, No. 3, pp.174–192.

Appleseed Inc. (2003) *Engines of Economic Growth: The Impact of Boston's Eight Research Universities on the Metropolitan Boston Area*, Author, Boston.

Brown, G.E. and O'Brien, T. (1980) 'University-industry links: government as blacksmith', *Technovation*, Vol. 1, No. 2, pp.85–95.

Carlsson, B. and Stankiewicz, R. (1991) 'On the nature, function and composition of technological systems', *Journal of Evolutionary Economics*, Vol. 1, No. 2, pp.93–118.

D'Este, P. and Patel, P. (2007) 'University-industry linkages in the UK: what are the factors underlying the variety of interactions with industry?', *Research Policy*, Vol. 36 No. 9, pp.1295–1313.

Etzkowitz, H. and Leydesdorff, L.A. (1997) *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations*, Pinter, London, New York.

Etzkowitz, H., Webster, A., Gebhardt, C. and Terra, B. (2000) 'The future of the university and the university of the future: evolution of ivory tower to entrepreneurial paradigm', *Research Policy*, Vol. 20, No. 2, pp.313–330.

Feldman, M. and Francis, J.L. (2003) 'Fortune favors the prepared region: the case of entrepreneurship and the capitol region biotechnology cluster', *European Planning Studies*, Vol. 11, No. 7, pp.765–788.

Freeman, C., Clark, J. and Soete, S. (1982) *Unemployment and Technical Innovation: A Study of Long Waves and Economic Development*, Pinter Publishers, London

HKSAR Census and Statistics Department (2011) *Hong Kong as a Knowledge-based Economy: A Statistical Perspective (2011 Edition)*, Hong Kong Special Administrative Region Government, Hong Kong.

Huang, C. and Sharif, S. (2009) 'Manufacturing dynamics and spillovers: the case of Guangdong Province and Hong Kong, Macau, and Taiwan (HKMT)', *Research Policy*, Vol. 38, No. 5, pp.813–828.

Hughes, T.P. (1983) *Networks of Power: Electrification in Western Society, 1880–1930*, Johns Hopkins University Press, Baltimore.

Kodama, T. (2005) 'An intermediary and absorptive capacity to facilitate university-industry linkage: based on an empirical analysis for TAMA in Japan', in *Universities as Drivers of Urban Economies in Asia*, pp.1224–1240, Washington, D.C., Development Economics Research Group of the World Bank and the Social Science Research Council.

Malerba, F. (2005) 'Sectoral systems: how and why innovation differs across sectors', in Fagerberg, J., Mowery, D. and Nelson, R. (Eds.): *Oxford Handbook of Innovation*, pp.380–406, Oxford University Press, Oxford.

Malik, K. and Wei, J. (2011) 'How external partnering enhances innovation: evidence from Chinese technology-based SMEs', *Technology Analysis & Strategic Management*, Vol. 23, No. 4, pp.401–413.

Malik, K., Georghiou, L. and Grieve, B. (2011) 'Developing new technology platforms for new business models: Sygenta's partnership with the University of Manchester', *Research Technology Management*, Vol. 54, No. 1, pp.24–31.

Mowery, D.C. and Rosenberg, N. (1993) 'The U.S. national innovation system', in Nelson, R.R. (Ed.): *National Innovation Systems: A Comparative Analysis*, pp.29–75, Oxford University Press, New York.

OECD (2010) *Main Science and Technology Indicators (MSTI)*, Edition 2 [online] http://www.oecd-ilibrary.org/science-and-technology/main-science-and-technology-indicators/volume-2010/issue-2_msti-v2010-2-en-fr (accessed 29 June 2012).

Owen-Smith, J., Riccaboni, W.W., Pammolli, M. and Powell, F. (2002) 'A comparison of US and European university-industry relations in the life sciences', *Management Science*, Vol. 48, No. 1, pp.24–43.

Postiglione, G.A. and Tang, H.H. (2008) 'A preliminary review of the Hong Kong changing academic profession data', in RIHE (Ed.): *The Changing Academic Profession in International Comparative and Quantitative Perspectives*, pp.227–249, RIHE, Hiroshima University, Hiroshima.

Sharif, N. (2006) 'An examination of recent developments in Hong Kong's innovation system: 1990 to the present', *Science and Public Policy*, Vol. 33, No. 7, pp.505–518.

Sharif, N. (2010) 'Rhetoric of innovation policymaking in Hong Kong using the innovation systems conceptual approach', *Science, Technology and Human Values*, Vol. 35, No. 3, pp.408–434.

Shenzhen Municipal Government (2009a) *Shenzhen Biology and Industrial Revitalisation Development Plan (2009–2015)*, Shenzhen Municipal Government, Shenzhen.

Shenzhen Municipal Government (2009b) *Shenzhen Internet and Industrial Revitalisation Development Plan (2009–2015)*, Shenzhen Municipal Government, Shenzhen

Shenzhen Municipal Government (2009c) *Shenzhen New Energy and Industrial Revitalisation Development Plan (2009–2015)*, Shenzhen Municipal Government, Shenzhen.

The Chinese University of Hong Kong (2010) [online] http://www.szdo.cuhk.edu.hk/en-GB/research/introduction (accessed 29 December 2012).

The University of Hong Kong (2011) [online] http://www.hku.hk/press/news_detail_6696.html (accessed 29 December 2012).

University Grants Committee (2012) [online] http://cdcf.ugc.edu.hk/cdcf/searchStatisticReport.do (accessed 29 June 2012).

White, G. (1996) 'Corruption and market reform in China', *IDS Bulletin*, Vol. 27, No. 2, pp.40–47.

Wong, P.K., Yuen-Ping, H. and Singh, A. (2007) 'Towards an 'entrepreneurial university' model to support knowledge-based economic development: the case of the National University of Singapore', *World Development*, Vol. 35, No. 6, pp.941–958.

Wu, W. (2005) *Dynamic Cities and Creative Clusters*, World Bank Policy Research Working Papers WPS 3509, The World Bank, Washington, DC.

Xue, L. (2008) 'China's evolving national innovation system – the role of universities', in Vessuri, H. and Teichler, U. (Eds.): *Universities as Centres of Research and Knowledge Creation: An Endangered Species?*, pp.47–58, Sense Publishers, Rotterdam.

Yang, P.L. Lin, V. and Lawson, J. (1991) 'Health policy reform in the People's Republic of China', *International Journal of Health Services*, Vol. 21, No. 3, pp.481–491.

Notes

1 Within such a 'collective' or 'system' other relevant factors include institutions (laws, regulations, rules, routines, norms, habits, etc.), the political process, the public research infrastructure (universities, research institutes, support from public sources, etc.), financial institutions, skills (the labour force), and so forth.

2 China's latest five-year plan (2011–2015) will add more scientists and engineers, establish hi-tech industrial parks, encourage venture capital investment, better protect intellectual property rights, and build a more innovation-oriented nation, in part through collaboration with Hong Kong universities.

3 See, for example, Malik and Wei (2011), who examine the extent to which collaboration with universities has become a common practice of external partnering among China's small and medium-sized enterprises seeking to become more innovative and competitive.

4 In these positions, we interviewed six individuals in Hong Kong from January 2008 to December 2008, and also from March 2011 to December 2011. We wanted our sample frame to embody a representative cross-section of views pertaining to the universities' collaboration efforts in Shenzhen. All of our interviews were arranged in advance, conducted without significant interruptions and lasted between 45 minutes and two hours. The interviews were semi-structured based on guidelines we developed to create an outline of themes to address during the course of an interview. The interviews were not audio-recorded; in place of recordings, hand-written notes were taken.

5 Shenzhen, whose early start gave it a highly developed Internet industry, was the first Chinese national model city for e-commerce [Shenzhen Municipal Government, (2009a), p.1]. Shenzhen's Internet penetration rate (over 60% of the city population) is the highest in China.

In 2008, the industry generated 16 billion RMB (2.57 billion US dollars), which accounts for 11.5% of national GDP. IT companies with such household names as Tencent, A8 Digital Music Holdings Limited, and Xunlei (a software enterprise) are based in Shenzhen.

6 Shenzhen, home to 61 enterprises with sales income of more than 100 million RMB (16.05 million US dollars) and six with over 1 billion RMB (0.16 billion US dollars) in sales [Shenzhen Municipal Government, (2009b), p.1], leads China in bio-medical equipment and bio-pharmaceuticals. Mindray, a bio-medical equipment company, invested 120 million RMB (19.26 million US dollars) in its Shenzhen base, the largest such investment in China. Shenzhen also attracted two of the largest foreign bio-pharmaceutical projects, the Sanofi Pasteur influenza vaccine and the Glaxo Neptune influenza vaccine. Exports of Shenzhen bio-medical products grew substantially at a yearly rate of 49.4% from 2004 through 2007, marketing to the USA, the European Union, Japan, and 140 other countries. Shenzhen-based enterprises have been listed on the New York and London stock markets. The bio-medical equipment companies Siemens and Philips also set up branch offices in Shenzhen. The city produced the first complete Asian genome map and the world's first gene therapy drug. 'Made in Shenzhen' is now a brand name for high quality bio-medical products. The Chinese government acknowledges that Shenzhen's competitive edge is due to its access to biotechnology R&D in Hong Kong [Shenzhen Municipal Government, (2009b), p.2].

7 In 2008, the output value of the new energy industry amounted to about 30 billion RMB (4.81 billion US dollars). Shenzhen houses the first large commercial nuclear power plant in China as well as the first modern waste incineration power plant. The city also invented the first plug-in dual-mode electric vehicles and is a national model city for renewable (solar) energy in housing and urban construction. The Shenzhen Municipal Government plans to invest in solar energy (including solar integrated photovoltaic – BIPV – and solar-LED optoelectronic products), nuclear energy, wind energy, biomass (comprising waste incineration power generation, waste incineration grates, and other biofuels), energy storage power stations, and new energy vehicles [Shenzhen Municipal Government, (2009c), p.4].

8 Milestone achievements of the Shenzhen PKU-HKUST Medical Center include establishing the Biomedical Institute in 2004, receipt of RMB500,000 (80,245 US dollars) research funding from the Shenzhen–Hong Kong Innovation Zone Fund in 2006, and the opening of the Medical Center's teaching and research building in 2007. Strategic multidisciplinary areas of the Institute embrace cell biology, clinical trials, immunology, molecular medicine and reproductive medicine with a view to creating synergy between biomedical research and clinical medicine.