



Understanding the dynamism in Hong Kong's innovation environment

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Abstract

Purpose – The authors' intention is to demonstrate how adopting a more precise interpretation of the term "institution" as used in the innovation studies literature provides a better understanding of the dynamic nature of an innovation system. The paper therefore focuses less on organisations and other key actors in Hong Kong's innovation system and more on the laws, rules, procedures, business practices, etc. that facilitate and govern such activity.

Design/methodology/approach – The paper adopts the term "innovation environment" to denote the institutional setting within which innovative activity is carried out in Hong Kong and reviews key elements of the innovation environment to note trends towards innovation-oriented changes. Data and other descriptive information that informs the treatment of the innovation environment are based on interviews of diverse actors associated with Hong Kong's innovation system as well as research into an interdisciplinary body of literature.

Findings – The authors find that although there has been little evidence of substantial progress in the development of Hong Kong's innovation system, key elements of the innovation environment exhibit trends in the direction of a more robust use of innovation-related resources to drive economic growth in the territory.

Originality/value – Apart from its focus on Hong Kong's innovation system, the paper advances innovation studies by demonstrating that its methodology of examining the innovation environment – the institutional setting in which key organisational actors carry out innovative activity – reveals the dynamism of an innovation system that might not emerge from a focus on organisations and other key actors.

Keywords Hong Kong, Innovation

Paper type Conceptual paper

1. Introduction: dynamising the innovation environment

Work in innovation studies, a rapidly growing field in the social sciences, has spawned the innovation systems (IS) conceptual approach, a tool used by researchers and policymakers to analyse and optimize the contributions of innovations to economic growth and development. Introduced in the 1980s, the IS approach has been propagated through an international body of literature that documents its growing influence. Supranational bodies such as the Organisation for Economic Cooperation and Development (OECD), the European Union (EU), and the United Nations Conference on Trade and Development (UNCTAD) have integrated the IS conceptual approach into their analytical perspectives. Even the World Bank and the International Monetary



Fund have begun to employ it (Lundvall *et al.*, 2002, p. 214)[1]. Scholars and policymakers in Scandinavia and Western Europe have embraced the approach wholeheartedly, with Finland adopting it as a basic category in its science and technology policy, and Sweden legitimizing it in its own way by naming a new central government institution (an “*ämbetsverk*”) VINNOVA, or the “Systems of Innovation Authority”.

In the government domain, a shift in many public administrations from general science and technology policies to more targeted efforts to support innovation has been underway since the 1990s. We have already noted global bodies such as the OECD (OECD, 1996, 1997, 1999) and the EU, which inherited its IS orientation from the European Commission (1994, 1995, 1996), European Commission (2002), as well as Sweden’s VINNOVA. Other governmental organisations that have employed the IS approach include the National Technology Agency of Finland (2002), the Government of Canada (2002), the Government of New Zealand (2002), the UK Office of Science and Technology (2002), the Government of the People’s Republic of China (International Development Research Center, 1997), and, most recently, the Innovation and Technology Commission (ITC) in the Hong Kong Special Administrative Region Government (HKSAR, 2004).

For our purposes we shall characterise an innovation system as a set of organisations and institutions that (jointly and individually) bring about the development and diffusion of new technologies. The components of such a system provide a framework within which governments form and implement policies that affect the innovation process. As such, an innovation system forms a network of interconnected organisations and institutions that create, store, and transfer the knowledge, skills, and artifacts that define new technologies (adapted from Metcalfe, 1995 in OECD, 1999, p. 24). Because innovations emerge from such systems we must, in order to develop a comprehensive understanding of the innovation process, give due consideration to all component organisations and institutional factors.

Typically, however, such institutional factors are conceptualized in the literature as static elements of a given innovation system that are subject to change only over the very long-term. We provide an alternative framework in this paper, applying the IS conceptual approach in a way that acknowledges and tracks the changing nature of such institutions. To mark this departure from tradition, we adopt the term “innovation environment” in place of “institutions” to denote the institutional framework within which innovation system actors, through their operations and interactions, produce economically significant innovations. In this way we avoid any possible confusion between “institutions” and “organisations.” On our view, innovating organisations operate within an institutional environment – the innovation environment. More importantly, we show that, contrary to the traditional view of innovation system institutions (Baark and Sharif, 2006a,b; Sharif, 2006b), an innovation environment is dynamic. To clarify the conceptual framework that provides the novelty of our approach, we shall expound a bit further on the institution-organisation distinction.

In the IS literature, organisations that are created expressly to undertake or promote innovative activities are generally regarded as the primary actors in any given innovation system. In innovation studies in general and within the IS framework in particular, the firm serves as the most important organisation in producing innovation. Firms include not only companies that generate innovations but also their suppliers and venture capital organisations as well as customers and competitors. Governments

and universities also play key roles in IS. In Hong Kong, the government – embodied in public agencies that are responsible for innovation policy, competition policy, or regulation and initiate and finance research and development (R&D) expenditures and university programs – remains the main driver of innovation activity, although private sector participation has recently been increasing.

Here, we focus not on such organisations per se, but on the institutional elements that make up the innovation environment within which knowledge is created and used. As we have defined the innovation environment, it provides the framework within which the key actors play their roles and interact with one another. But in the IS literature, it has proved difficult to define “institution” in a way that avoids “fuzziness” or “conceptual ambiguity”. The term is used in different senses by different authors, sometimes denoting various kinds of organisations or “players” in the system (Nelson and Rosenberg, 1993), while at other times denoting the laws, rules, routines, and other “rules of the game” (Lundvall, 1992). Although considerable strides have been made in contributions to both theory and methodology in IS thinking, the term “institution” remains the subject of a debate that is far from reaching consensus (Sharif, 2006a). To be sure, some scholars have tried to encourage the field to converge on a uniform interpretation of institutions. Charles Edquist of Lund University in Sweden has argued strongly, for example, for distinguishing sharply between organisations and institutions (Edquist and Johnson, 1997) and has recently implemented this approach in a major research project comparing IS in small countries in Europe and Asia, which aimed at making the IS conceptual approach less “fuzzy” and “diffuse” (Edquist and Hommen, 2008). We hope that by clearly distinguishing what we call “institutions” from the traditional concept of “organisations” we have achieved some measure of clarity in this respect.

In an innovation environment, innovation-related research and production activities are driven by various incentives and initiatives. Such environmental factors are, as we have noted, counted among the innovation-related “institutions” in the IS literature, and it is a natural extension of the concept of an institution that it denotes rules or laws that regulate relations between individuals, groups, and organisations, and extends to established practices, routines, norms, and sets of common habits. In this sense, such institutions – comprising the innovation environment – indeed constitute the “rules of the game”. In embracing that strain in the literature, in which the term “institution” is characterised in this way, we emphasise the great significance of these environmental conditions (even if it is sometimes difficult to pinpoint their precise role in determining the outcome of innovative activities).

We focus here exclusively on Hong King’s innovation system, highlighting emerging trends in key areas of Hong Kong’s innovation environment. On our account, understanding Hong Kong’s innovation environment – which shapes the behaviour of innovative actors – is the key to understanding its innovation system, a system that, we have found, is subject to relatively short-term changes that occur within a span of two to three years. We argue that by bringing such factors within the scope of IS research we make it possible to achieve a deeper and more accurate understanding of IS than has heretofore been possible. To that end we offer here a study of the dynamic elements in Hong Kong’s innovation environment, highlighting emerging trends and prospects for the future.

In our investigation of Hong Kong's innovation environment, we have relied on two sources of data. In order to achieve as complete a picture as possible of the innovation environment, we identified and interviewed individuals from as broad a spectrum of relevant segments of society as possible. These include technology policy advisors to the government who have offered technology policy recommendations (based on which the government has implemented innovation and technology policy), academics who have utilised the IS conceptual approach to study parts of Hong Kong's innovation system, consultants who have worked for the Hong Kong Government, Hong Kong Government bureaucrats who formulate or implement technology and innovation policy, and chief technical officers of local innovative companies. Second, in addition to interviewing key actors in the policymaking arena, we also undertook a systematic examination of the literature related to Hong Kong's innovation system. Because so little work under the banner of "innovation systems" pertaining to Hong Kong has been done – particularly work targeting its innovation environment – we researched material from a variety of fields including economics, business studies, industry-specific studies, education policy, and politics.

2. The emergent innovation environment in Hong Kong

Hong Kong's innovative organisations operate within an innovation environment comprising a policy and regulatory framework that is constrained to a considerable extent – but nevertheless a framework subject to change – by Hong Kong's social and economic structure. Moreover, it has been strongly influenced by the policies of "positive non-intervention" and free trade that had been followed by both the colonial British and the Hong Kong SAR governments until the late 1990s. This philosophy implied that under normal circumstances it is futile and damaging to the growth of an economy, particularly an open economy, for the government to attempt to plan the allocation of resources available to the private sector or to frustrate the operation of market forces. Since 1997, however, the Hong Kong SAR government has become increasingly involved in building the infrastructure and regulatory regime in order to promote competitiveness in the private sector, and commitment to "positive non-interventionism" has weakened somewhat since the advent of the new government in 1997 (recently Chief Executive Donald Tsang Yam-kuen abandoned the notion of "positive non-intervention" in favor of a new slogan: "small government, big market")[2].

In general, terms, the government's interest in maintaining an environment that has enhanced, rather than limited, the influence of global and local competition has driven explicit government policies and regulations. The promotion of technological innovation and creativity are seen as vital for a knowledge economy, and may require special initiatives and regulation to ensure its growth. In this paper, we show how key elements of this policy and regulatory framework are in fact changing and thereby differentially affecting Hong Kong's innovation system over time. We analyse the innovation environment by reference to its most important components, describing not only each component's role in innovative activities in Hong Kong, but also the changes that have occurred or can be anticipated to occur with respect to each one. This examination enables us to show the dynamic nature of the various environmental (or "institutional") factors and incentives that influence the innovation process in Hong Kong. We offer in Figure 1 below a capsule overview of the innovation environment in Hong Kong; the

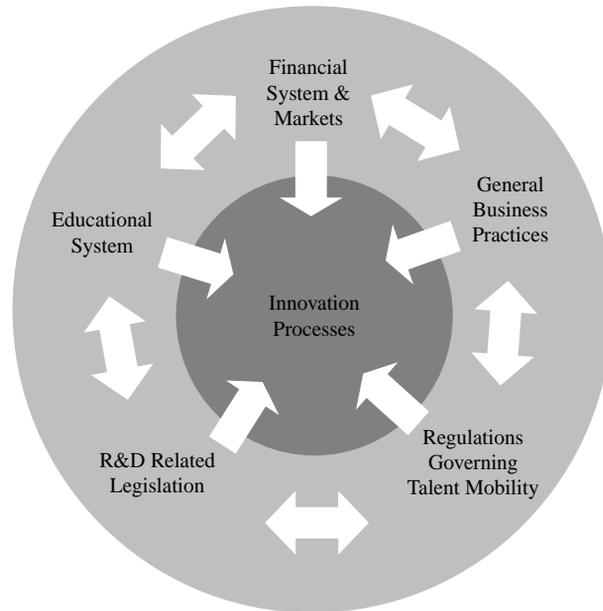


Figure 1.
Composition of
Hong Kong's innovation
environment

innovation environment as we have defined it consists of the “rules of the game” regulating knowledge flows and other interactions among key actors in the system. Figure 1, it should be noted, is presented mainly to identify the key areas in which institutional or environmental factors play a role. It cannot completely capture the interactivity and feedback-driven, looping flow of information that characterises the complex whole of an active innovation system.

To set the stage for addressing the elements of Hong Kong's innovation environment individually, we should mention several key developments in the history of Hong Kong's innovation system. On 1 November 1999, an HK\$5 billion Innovation and Technology Fund (ITF) was set up pursuant to the planning proposed in the Commission on Innovation and Technology's (CIT's) two reports (HKSAR, 1998, 1999). The ITF's remit was to finance projects that contribute to innovation or technology upgrading in industry as well as those that contribute to the industrial development. As of end March 2006, the ITF had supported 796 projects worth HK\$2.2 billion. As is suggested by the relatively small proportion of funds dispensed by the ITF in the five years following its establishment, it faced several limitations. First, the ITF's success in bringing new technologies to fruition was limited. Although the ITF sought to strengthen local research capabilities and encourage research spending by the business sector, it had invested only 44 per cent of its total funds (by monetary value) in projects between its launch in November 1999 and March 2006. According to the findings of a survey commissioned by the Innovation and Technology Commission, only 0.15 patents per project were granted. Second, the bottom-up approach of the funding scheme was not conducive to building significant focus or development clusters. With this approach, individual researchers or research groups initiated research projects based on their

interests and abilities. In practice, this led to the funding of projects with little regard for the strengths and needs of Hong Kong industry. Finally, individual projects were not integrated into an overall structure or scheme for the holistic development of Hong Kong's innovation system. As funds for projects were granted only on a case-by-case basis, there was no overarching theme or general coordination for an effective distribution of funds.

In attempting to address the issues related to the ITF, the government sought to revamp the innovation and technology programme with a new strategy that was published in a document entitled *Consultation Paper – New Strategy of Innovation and Technology Development*, released in June 2004 (HKSAR, 2004). This strategy, drawn up after extensive consultation with stakeholders, is based on several key principles: focus, market relevance, industry participation, the leveraging of Mainland China, and better coordination among the various elements of the innovation and technology programme. The key initiative of the new strategy, distinguishing it from the old, is its emphasis on identifying specific technology focus areas for future development. The objective in identifying technology focus areas is to ensure that the development of Hong Kong's innovation system aligns with its comparative advantages to create the greatest potential for meeting industry and market needs. Finally, the new strategy differs from the old in that it adopts a more market-driven, demand-led approach as opposed to the traditional supply-side approach that had predominated in the past.

Perhaps, more importantly, the new strategy led to the establishment of a range of new organisations in April 2006 – designated R&D centres – that should enhance the development and commercialisation of technologies for five shortlisted sectors of the economy. The establishment of these centres represents a strategic change in direction in innovation and technology policy. After a comprehensive review and public consultation in 2004, the government decided to adopt a new strategy to further promote applied R&D and technology upgrading in the industry. With a highly focused approach under the new strategy, the government established five R&D centres to conduct industry-oriented applied R&D in five technology areas and promote technology transfer to the relevant industries. These centres have initiated several platform research projects and individual applied research projects during their short time in existence, but it may be too early to accurately assess the impact that they will have on their respective industries.

The primary objective of the R&D centre Program is to strengthen collaborative applied research activities between industry and research organisations and, as a result, maximize the economic benefits of research outputs. Five R&D centres undertake industry-oriented research in the following industries: automotive parts and accessory systems, information and communication technologies, logistics and supply chain management enabling technologies, nanotechnology and advanced materials, textiles and clothing. The ITF has earmarked HK\$2.6 billion to support the establishment of the R&D centres and provide funding for projects over the first five years. Each of the five R&D centres aims to develop core competencies in its respective technology area and become a focal point of applied R&D and technology transfer in Hong Kong. In line with the market-driven, demand led approach that characterises the strategic change in direction in Hong Kong's innovation and technology policy, the R&D centres work closely with industry in drawing up their

R&D directions and technology development roadmaps, promoting technology transfer and facilitating commercialisation of R&D results.

3. Key elements in Hong Kong's innovation environment

In this section, we survey the key institutional elements in Hong Kong's innovation environment. By focusing on the environment rather than on innovation actors (including organisations), we are able to underscore the dynamism that characterises Hong Kong's innovation system today.

3.1 Financial system and markets

3.1.1 Banking. Obtaining requisite financing for innovation and technology ventures in Hong Kong has seemed always to be a difficult proposition. Small-to-medium-sized enterprises (SMEs), for example (including technology and innovation-related start-ups), rely heavily on personal savings in lieu of readily available business loans. Banks in Hong Kong do not explicitly differentiate between large and small firms or between innovation-related and non-innovation-related firms when considering requests for start-up financing: Lending policies across sectors are transparently similar. Nevertheless, in practice, large firms are typically better able to demonstrate creditworthiness. When judging the creditworthiness of potential customers, banks apply criteria comprising a familiar range of factors: financial strength, profitability, net worth, track record, management quality, relations and payment records with other banks, business prospects, business risks (such as the degree of concentration of suppliers and customers) and opinions from trade counterparties (Hong Kong Monetary Authority (HKMA) Quarterly Bulletin, August 2000). According to a survey conducted by the Hong Kong Monetary Authority, the availability of collateral was an important factor in determining loan decisions. Clearly, loans are not granted if would-be borrowers do not meet the required financial management standard.

Unfortunately, this situation has not changed significantly *vis-à-vis* bank financing for innovative start-ups, but a government-run initiative – the Small Entrepreneur Research Assistance Program (SERAP) – represents a fairly successful attempt to make “angel investment” available for the initial phase of a company's inception. Under SERAP, the Hong Kong Government provides an unsecured, non-interest bearing loan of as much as HK\$2 million, under the condition that the company itself matches the figure either in kind or in cash. As of 28 February 2007, there were 256 projects approved under SERAP totaling HK\$254.4 million.

3.1.2 Venture capital. With capital under management amounting to US\$30 billion (accounting for about 30 per cent of the total capital pool in the region), Hong Kong is the largest venture capital centre in Asia (as of June 2005, there were 173 Hong Kong-based funds). Hong Kong had, as of June 2005, a pool of 603 venture capital professionals, the second largest such group in Asia after Japan's (*Asian Venture Capital Journal*, 2005). Hong Kong is, however, distinctively an administrative hub serving the region: In 2000, 91 per cent of all funds under management by venture capital firms originated outside Hong Kong, and the bulk of these funds financed companies in the region, principally in Mainland China. Given the comparative lack of development of Mainland China's capital market, most venture funds pursue their exit strategies outside Mainland China, mainly through Hong Kong's main board and

the growth enterprise market (GEM), as well as the US's Nasdaq exchange. Thus, Hong Kong serves more as a regional centre than as an actual, primary investment target for venture capitalists (VCs). Salient features of the local private venture capital industry are presented in Table I.

3.1.3 Applied research fund. In 1993, the government also set up its own venture capital fund, with total funding of HK\$750 million. The ARF provided venture capital for technological ventures or R&D activities undertaken by local firms that demonstrated commercial potential. Any company that was able to obtain financing from the ARF was entitled to retain all intellectual property (IP) rights arising from its project. Since November 1998, private venture capital firms have been engaged in managing the ARF[3]. After a review conducted at end 2004, it was concluded that the original objective of the ARF, i.e. to foster the development of technology-based ventures and R&D projects with commercial potential, could be better spearheaded under the new strategic framework for innovation and technology development, and there was little justification in continuing to make new investments under the ARF model in parallel. The Applied Research Council (ARC – a private company set up by the government to control and administer the ARF) has accordingly ceased making new investments since March 2005, but will continue to oversee existing investments and their exit.

3.1.4 Growth enterprise market. The innovation and technology environment in Hong Kong witnessed a major development towards the end of 1999 with the establishment of a second, alternative, board on the Hong Kong Stock Exchange known as the Hong Kong GEM. The GEM is meant to offer a channel through which innovative and high-growth companies with short histories and little or no proven record of profitability can seek equity funding. Removing traditional entry barriers enables growth enterprises to capitalise on new opportunities by raising expansion capital under a well-established market and regulatory infrastructure. As the GEM's Website states, the "GEM complements and supports the HKSAR government's initiative to promote the development of technology industries in Hong Kong"[4].

In the seven years since the GEM was set up, it has enjoyed some significant achievements: Over HK\$45 billion in equity funds raised; listing more than 220 new companies[5]; graduating 12 GEM companies to the Main Board (as of end 2005). Despite the comparatively more relaxed listing requirements for the GEM as compared with those of the Hong Kong Stock Exchange Main Board (Table II), the GEM's problems have often outstripped its achievements. It has been criticised widely for bending listing rules, attracting spin-offs from Hong Kong's property companies rather than from innovation and technology-related start ups, maintaining low liquidity levels, losing its competitive edge to Mainland exchanges, and causing many

	1996	1998	2000	2002	2004	June 2005
Number of venture capital funds	101	129	192	176	177	173
Estimated number of venture capital professionals	370	494	662	N.A.	606	603
Capital under management (US\$ million)	8,729	15,442	24,128	26,660	27,530	30,014

Source: *Asian Venture Capital Journal*, various issues (1996-2005)

Table I.
Hong Kong private
venture capital industry,
1996 to June 2005

Requirement	GEM	Main Board
Revenue, profit and cash flow	None	HK\$50 million profits: HK\$20 million in last year and HK\$30 million in preceding two years OR HK\$2 billion capitalisation plus at least HK\$500 million revenue in last year plus positive cash flow from operations of at least HK\$100 million in last three years OR HK\$4 billion market capitalisation plus revenue of at least HK\$500 million last year
Minimum market capitalisation	HK\$30 million	HK\$50 million
Public float	25 per cent (dropping to the higher of HK\$1 billion or 20 per cent)	25 per cent (dropping to 15 per cent if market capitalisation exceeds HK\$10 billion)
Management continuity and issuer purpose	Two years (or one year if firm is sufficiently large) in one focused active business pursuit	Three years
Spread of holders	At least 100 persons or 200 persons if the one-year active business pursuit restriction is used	Less than 50 per cent of public float in hand of three largest share holders
Lockup period	Six months	Six months
Target investor	Minimum transactions HK\$50,000; subject to "buyer beware" warning	All retail and wholesale
Financial reporting	Annual audited and semiannual and quarterly un-audited reports	Annual audited and semiannual un-audited reports
Additional self-governing appointees	Needs sponsor and compliance advisor for two years following listing	Needs sponsor but role ends with listing (H-shares sponsor continuing for three years)

Table II.
Listing requirements and trading differences between the GEM and the main board of the Hong Kong stock exchange (as of March 2006)

Source: Au *et al.* (2006, p. 42)

shareholders to lose most of their investments. The GEM index return is approximately one-ninth of its value at inception.

In order to make the GEM more attractive, the Hong Kong Stock Exchange has proposed a number of changes that, if adopted, will be implemented in 2008. These changes are representative of the dynamism present in the financial markets in general in Hong Kong, and the financial markets for innovative start-ups in particular. Two of the major changes are that firms must have at least HK\$100 million market capitalisation, and firms must have achieved at least HK\$20 million of cash flow in the two years prior to their applications. While the proposed changes will help improve the quality of the listed firms, there is concern that the requirements of bigger market capitalisation and a high cash flow for firms to be listed on the GEM would defeat its original purpose, namely to allow emerging enterprises to raise funds more easily. Furthermore, start-up firms may face serious difficulties in meeting the proposed requirements[6].

3.1.5 Tax system. Hong Kong's tax system constitutes an important element in the innovation environment, in virtue of two key features. First, low corporate taxes and

Hong Kong's simple tax structure are attractive to all businesses and entrepreneurs. Second, the current tax regulations in Hong Kong allow businesses to deduct the costs associated with R&D as regular business expenditures. The potential of tax policy to promote innovation in Hong Kong is however not as robust as it could be. Low taxes are good in themselves, but Hong Kong provides no additional incentives for innovative activities beyond those that apply to all businesses. Similarly, tax deductions for R&D activities are no greater than those offered for regular business expenditures. Current policy notwithstanding, the Hong Kong Government is looking to move forward – over the past two years it has been seriously considering whether and how it should introduce tax incentives for firms that undertake R&D related expenditures. Various interested organisations as well as high-technology corporations have been pushing hard for the government to implement such changes, leading to active consideration on the part of local policymakers.

The institutional framework for obtaining capital for innovation in Hong Kong is thus characterised simultaneously by some traditional elements such as bank loans, which are still very difficult to obtain for high technology ventures, and some emerging sources of funding such as venture capital. These avenues for financial support have not been able to fundamentally remove funding constraints as the primary barrier to innovation in Hong Kong. This is partly because the institutions for financial support are linked to the short-term and trade-oriented perspective that persists in the general business practices that we analyse below.

3.2 General business practices

Family-run enterprises comprise the majority of Hong Kong's SMEs. Such firms feature considerable overlap between ownership and management, centralised decision making, high levels of family orientation (nepotism), the widespread use of personal networks, great flexibility and adaptability to changing market conditions, an emphasis on pragmatism over legalism and dependence on internal sources (as opposed to institutional, external sources) to raise funds, and, finally, lack of trust and cooperation outside family-based networks (Redding, 1990). Although Hong Kong firms are known for their entrepreneurial spirit, these firms are also highly oriented to short-term survival strategies and consequently show little inclination to pursue or appreciation of the benefits of long-term R&D investments. Our interview respondents indicated that, in general, these firms typically possess an opportunistic, low-risk-and-quick-profit mentality that is not conducive to long-term investments in innovative activity.

To date the HKSAR Government has not yet undertaken a regulatory initiative that may significantly influence general business practices in Hong Kong favourably, namely the adoption of legislation to discourage anti-competitive practices. However, on 6 November 2006 the government did launch a three-month public consultation on competition policy to engage the public, seeking views and opinions regarding the way forward for a competition policy to be adopted in Hong Kong. The discussion document, asking 20 questions, examines whether a new competition law should also include the regulation of market structures, including monopolies and mergers and acquisitions.

Another feature of general business practices in Hong Kong with the potential to affect the innovation environment is sophisticated consumer demand. Sophisticated

consumer demand should be an important driver for innovative products and services. One thesis is that firms primarily benefit from sophisticated consumer demand in domestic markets, while an alternative view is that export-oriented firms can build on sophisticated consumer demand in foreign markets. Regardless of the market in question, the more sophisticated are consumers, the more innovation they demand from manufacturers in products and services. Consumer demand can therefore be a driving force, compelling companies to undertake R&D and innovation activities.

The picture in Hong Kong in this regard is, however, mixed. Given the relatively small size of the local consumer market, Hong Kong firms are distinctly outward-looking and are characterised by the dual features of:

- A high degree of adaptability, which includes the capacity to absorb knowledge and technology from global sources in order to synthesise knowledge into new productive configurations.
- The ability to learn from their customers and markets.

In practice, this means that the level of R&D and innovation adopted by Hong Kong firms is closely tied to the level of sophistication that characterises their customers. Depending upon where their customers fall along the spectrum of consumer sophistication, Hong Kong firms will undertake higher or lower levels of R&D and innovation accordingly[7]. There is an emergent trend in which Hong Kong firms are increasingly forced to undertake higher levels of R&D based on the growing sophistication of their customers.

While many Hong Kong-based industrial firms have excelled in providing “original equipment manufacture” services to overseas customers, they frequently find themselves needing to undertake R&D in order to supply “original design manufacture” in order to stay competitive. As consumer markets in Europe and North America are increasingly focused on product quality and product differentiation, Hong Kong suppliers are thus gradually facing the prospect of either moving up the value-added chain or missing out on cheaper suppliers altogether. A case in point is the watch industry, which has been forced to increase R&D in order to keep up with demand for better watch movements.

3.3 Regulations governing talent mobility

Hong Kong has the fewest number of full-time-equivalent science and engineering researchers per million inhabitants when compared with other developed Asian countries such as Japan, Korea, Taiwan and Singapore. Add to this is the short-term focus of traditional business strategy pursued by local enterprises and the result is a general climate of opportunistic behaviour indulged in by both employees and employers alike. Such behaviour makes it difficult to build long-term capabilities through the retention of high-quality human resources. This problem is exacerbated by the relatively small size of Hong Kong’s tertiary education system, which has only been gradually expanded in the last two decades.

Related to this phenomenon are difficulties in integrating labour markets in Hong Kong and Mainland China. In spite of growing recognition that talent from Mainland China is capable of complementing Hong Kong’s needs, the pace and depth of integration fall short of optimal levels. Concerted efforts to attract Mainland expertise have been seen only since 2000, and existing measures have met with mixed success. A recent initiative is the Admission Scheme for Mainland Talents and

Professionals, and it has resulted in a flow of talent from Mainland China to Hong Kong. For the years 2004 and 2005, respectively, 4,370 and 4,665 professionals and talented people entered Hong Kong to find employment. The number of Mainland students studying at universities in Hong Kong has also increased (for 2003-2004, 1,528 Mainland students were granted student visas for degree courses in Hong Kong, while for 2004-2005, the number rose to 3,214). With effect from 1 August 2001, degree- or above-degree-level Mainland students graduating from UGC-funded institutions in 1990 or beyond who have job offers may be allowed to re-enter Hong Kong for employment. With this policy the goal is to retain outstanding Mainland students to work in Hong Kong so as to increase Hong Kong's competitiveness. As of 31 March 2005, 409 Mainland Chinese students had been admitted under this arrangement. This immigration policy may help firms and research organisations acquire new expertise that will in time contribute to Hong Kong's innovation development programme. Nevertheless, only a small percentage of Mainland students trained in Hong Kong have stayed.

In other words, Hong Kong has been conspicuously inefficient in leveraging the resources invested in non-local students and reaping the benefits of such a strategy. In its latest attempt to remove another barrier to incoming talent, the Quality Migrant Admission Scheme (QMAS) was launched in June 2006. In order to attract high-quality migrants from Mainland China and overseas to settle and work in Hong Kong, the QMAS eliminates the requirement that professional talent must obtain an offer of employment and be granted a working visa before coming to Hong Kong. A recent newspaper article reported that only 238 out of an annual quota of 1,000 persons to be admitted under the QMAS had been filled[8].

In contrast to the apparent inability to leverage the resources invested in non-local students, Hong Kong firms have been adept at actively hiring Mainland Chinese talent in Mainland China branches of Hong Kong firms. By 2001, approximately 60,000 Hong Kong-owned firms in Guangdong province employed at least 11 million people (Federation of Hong Kong Industries, 2003). Furthermore, over the period of 1979-2004, Hong Kong was the largest contributor of foreign direct investment (FDI) to Guangdong (US\$99.6 billion worth of FDI came from Hong Kong, representing 66.2 per cent of total cumulative FDI inflows to Guangdong; Guangdong Statistical Yearbook, 2005). In light of these statistics, the hiring of Mainland Chinese talent in Mainland China (by Hong Kong-owned firms) is by no means an insignificant trend; rather it confirms the impression that Hong Kong firms are flexible and quick to adapt to changes – in this case circumventing the local regulations governing the mobility of Mainland Chinese talent.

In the long run, it is the educational system that should provide the mainstay of trained talent for innovation in Hong Kong. Even here, the institutions are undergoing change, with the government seeking to impart a new culture of creativity and entrepreneurship support, and with a range of initiatives designed to improve university-industry linkages.

3.4 Educational system

Currently conditions in Hong Kong's educational system are not favourable for encouraging local innovation and technology development. Broadly, Hong Kong's educational system is configured in a way that favours the appropriation of existing

knowledge rather than the exploratory and creative search for new knowledge. Rote learning methods practiced at the secondary level may help students prepare themselves to perform well in exams, but it means that the curriculum rarely ventures beyond the narrow confines of the subjects being taught and tested. The learning experience in Hong Kong therefore leaves students less adept than they need to be at applying knowledge, solving problems creatively by tapping into a wide range of disciplines, and responding to novel situations with spontaneity. Students as a consequence fall short in developing creative skills or in integrating interdisciplinary approaches that lead to innovation. Nevertheless, even if Hong Kong's educational system discourages creativity, it does produce students with outstanding capability in mathematics and science – foundational subjects for advanced development of scientific and engineering knowledge. Consider that, according to the Trends in International Mathematics and Science Study (TIMSS) conducted by the US government in 2003, the average score of Hong Kong's fourth and eighth grade students ranked top four in the world (Highlights from the Trends in International Math and Science Study: TIMSS (Mullis *et al.*, 2003)). If Hong Kong's students could learn to apply these skills more creatively, they might usher in a new era of innovation.

In an attempt to improve levels of creativity among local students, the Education Commission responded in 2000 with education reform proposals intended to encourage the development of skills and virtues such as critical and exploratory thinking, innovating and adapting to change, self-confidence, team spirit, social skills, and moral and civic values and behaviours (HKSAR Education Commission, 2000, 2001, 2002-2004). In conjunction with this initiative, changes are proposed for the make-up of secondary and tertiary sectors (shortening the length of the former while lengthening the latter to provide for a more well-rounded education in which students acquire skills applicable to innovation and technology development).

Career incentives offered by major universities in Hong Kong might also influence the processes through which R&D outputs and technology transfers find their way to industry. For example, to ensure that they recruit and promote the most talented and eminent scientists, the three predominantly research-centred universities – Hong Kong University, Chinese University of Hong Kong, and Hong Kong University of Science and Technology (HKUST) – have adopted procedures that promote faculty on the basis of publication of scientific papers together with teaching evaluations. This has raised the academic profile of higher education in Hong Kong, but it provides little incentive for faculty members to collaborate with or contribute expertise to industry.

In terms of contribution to industry, licensing of technologies to firms is one (but a fairly common) mechanism by which academic research can be translated into industrial growth, as are consultancy arrangements, in addition to joint or contract R&D. However, concrete data on these technology transfer mechanisms as well as data on spin-offs and start-ups is either patchy or incomplete. Importantly, however, there are two government-sponsored programs – the University-Industry Collaboration Programme (UICP) and the R&D centre program – which have recently started to contribute to the translation of academic research into industrial growth. The UICP aims to stimulate private sector interest in R&D through leveraging the knowledge and resources of universities, while the objective of the R&D Centre Program is to strengthen collaborative applied research activities between industry and research organizations.

UICP projects explicitly make cooperation between universities and industry a major objective.

As of 31 March 2007, there were 164 projects approved under the UICP with a total funding amount of HK\$186.3 million (Table III). Each of these projects was approved on the basis of the participation of an industrial firm in a collaborative arrangement with a university. UICP support is given as a grant, subject to a cash contribution by the company amounting to no less than 50 per cent of the project cost. No independent evaluation has yet been carried out for the effectiveness of this program in mobilizing private sector involvement and the benefits accrued to the private sector. As Table III shows the majority of projects under the UICP program fall into the information technology area, manufacturing technology, and electrical and electronics.

3.5 R&D related legislation

The HKSAR Government has not enacted formal and direct laws that affect R&D in the territory. This is consistent with the already noted principle of “big market, small government” and free trade. The members of the Finance Committee of the Legislative Council (LegCo) scrutinise and approve public expenditure proposals put forward by the government. Therefore, its functions are critical to legislative efforts that support R&D initiatives. Such legislative approval has been required for R&D-related projects that exceed a budget of HK\$15 million. For instance, the establishment of ASTRI in 2000 and the R&D centres in 2006 had been scrutinised by the Finance Committee. As R&D-related projects are required to pass through this legislative approval process, their success has perhaps depended too much upon LegCo’s usually conservative attitude towards R&D and innovation-related initiatives. At the same time, however, not all R&D projects are required to pass through this legislative approval process. The ITC has the authority to disburse funds for individual R&D projects that do not exceed HK\$15 million.

Hong Kong also features formal legislation that protects already existing innovations. For example, the Intellectual Property Department fosters local awareness of the importance of intellectual property rights and respecting the rights of others[9]. The government’s support for patent applications is administered and assisted by the ITC, while the enforcement of intellectual property rights falls to the Customs and Excise Department. Legal provisions for protection of intellectual property rights are clear and transparent enough as written. Hong Kong has recently featured a number of

Technology area	Number of projects (per cent)	HK\$ millions (per cent)
Information technology	42 (26)	49.1 (26)
Electrical and electronics	34 (20)	31.2 (17)
Manufacturing technology	34 (20)	20.8 (11)
Biotechnology	19 (12)	30.5 (16)
Chinese medicine	15 (9)	26.9 (15)
Materials science	11 (7)	6.7 (4)
Environmental technology	8 (5)	19.6 (10)
Nanotechnology	1 (0.6)	1.5 (1)
Total	164	186.3

Source: ITF website: www.itf.gov.hk; accessed 24 April 2007

Table III.
Sectoral distribution of
approved projects under
the University-Industry
Collaboration Program
(UICP) as of 31 March
2007

high-profile legal cases in which the government has successfully prosecuted some internet users accused of infringing copyrights. These cases have certainly enhanced the impression that the protection of intellectual property is a high priority for the government.

The context of intellectual property protection is only partly defined by laws and regulations. More importantly, it is linked to the general business practices and, ultimately, to the ability of the educational system to foster respect for creativity. It is likely that key changes in these components of the institutional environment will be more effective in bringing about a culture of innovation in Hong Kong.

4. Discussion and conclusions

Hong Kong is an affluent and open society in which information flows freely. It boasts a simple tax structure that keeps taxes low and practices strict adherence to the rule of law. With a multi-lingual and multi-cultural work force, Hong Kong easily accommodates both private and public organisations that seek international contacts. Such a background has given Hong Kong businesspeople a Mainland China focus, and this is an added advantage for conducting business there. Hong Kong also has a reputation for quality, an essential trait for a marketing channel through which new products are introduced. Although these conditions are not directly related to innovation-led development as such, they help support business engaged in innovation generally.

In this paper, we have shown how a dynamic interpretation of the concept of the “innovation environment” provides a more useful analytical tool for identifying the status of and changes in the relevant policies, rules, and norms that have the greatest potential to affect innovative organisations in Hong Kong. For instance, as an international financial centre, Hong Kong boasts a large and fluid stock market. There are some 300 venture capitalists currently stationed in Hong Kong, serving both Mainland China and Hong Kong businesses. The legal system and intellectual property regulations provide protection to businesses. Furthermore, increased government support has been welcomed.

Through this analysis of Hong Kong’s innovation environment, we have been able to identify some emergent trends that promise the development of new innovation-related strengths. Perhaps, some of the most significant trends we can identify involve environmental changes that address the culture of the general public by encouraging an acknowledgement of the need for innovation. Removing Hong Kong’s traditional short-term mentality would make it easier to promote innovations. Hong Kong students have rightly been characterised as short-term oriented and lacking commitment to the greater good. Students often choose subjects that promise higher salaries on graduation, as business programmes have always been the most popular choices. Parents do not discourage this behaviour and, in fact, many parents would even push their second-generation children to study the traditionally more lucrative money-making professions, such as medicine and law. The public and private sectors alike also tend to focus their attention on quick returns when they evaluate projects. It appears that this short-term mentality is so ingrained in society that education reform is needed to rectify the situation. With the availability of highly specialised business methods that continue to generate quick returns, Hong Kong firms are reluctant to switch to innovation-oriented business models due to the higher

opportunity costs involved. This prevailing attitude severely hampers efforts to promote technology-based industries.

Hong Kong needs a strong educational infrastructure to develop research and innovation-oriented personnel, not a system that rewards primarily memorisation rather than critical or creative thinking. Students in Hong Kong specialise much too early in their careers; the key seems to be to educate more people more broadly. This calls for a change in structure, from primary school through to the universities. More programmes that promote science and technology should be put in place to spark interest in innovation throughout the student population. Many graduates from engineering schools are also “virtual” engineers, without enough practical experience to be really useful to Hong Kong firms. Frequently, they do not enjoy sufficiently many opportunities to engage in practical engineering work in Hong Kong, but can find such experience only in the Pearl River Delta (PRD) region on the Mainland.

We also note, however, that Hong Kong’s universities are increasingly playing a more direct role in stimulating economic growth by conducting targeted research to support industry, generating readily commercialised new technology, contributing technology and personnel to high-tech spin-offs, and fostering an entrepreneurial spirit within the ranks of their graduates. These trends among Hong Kong’s universities orientation have assumed global dimensions. Such a trend is consistent with what Etzkowitz *et al.* (2000) have argued in that there is a broader shift among universities worldwide to adopt a more complex entrepreneurial model, one that stresses the commercialisation of knowledge and the fueling of private enterprise in local and regional economies.

Currently, five out of Hong Kong’s eight public tertiary institutions are organizing efforts to promote an entrepreneurial university model. We can illustrate these efforts with reference to the “Entrepreneurship Program” at HKUST. Incubated companies at HKUST are provided with serviced and furnished space at modest cost, with access to university facilities and resources including central office support, and to an Advisory Committee that assists them with business development. HKUST also introduces Entrepreneurship Program companies to or matches them up with potential investors in order to sell their technologies or to secure funding. If a faculty member starts or joins a company that requires identifiable or patented IP, the company must obtain a license from HKUST. This will be negotiated on a case-by-case basis, and the university can be paid by some combination of an up-front fee, deferred royalties, or equity ownership in the company. If, on the other hand, a faculty member starts or joins a company using expert knowledge, ideas, concepts, and market insight, but does not require HKUST to file patent material or otherwise document any IP, the university requires no royalty payment or equity ownership in the company.

Aside from the Entrepreneurship Program, there are other entrepreneurial initiatives at HKUST, including an entrepreneurship seminar series, a high-technology entrepreneurship course for senior engineering students, and also a dual-degree technology and management program. The high-technology entrepreneurship training course is a three-credit course for entrepreneurially minded final year engineering and business school students who are interested in starting business in the Greater China region. Lectures and seminars on high-tech entrepreneurship, hands-on start-up exercise in a workshop environment, and practicing under the guidance of departmental faculty and industry consultants are all features of the course.

The dual-degree technology management program was first offered in 2003-2004, and 30-40 students have enrolled in the program annually. Students who successfully complete the program receive a joint Bachelor of Engineering and Bachelor of Business Administration degree.

Against the backdrop of such issues, Hong Kong features unique opportunities that are the envy of lesser economies. In particular, for example, there are opportunities to collaborate with Mainland Chinese firms, for both R&D and marketing purposes. As the PRD develops, Hong Kong may play an integral role, and the Hong Kong Government may focus its attention on helping organisations integrate in the PRD. Doing so will help Hong Kong to maintain a balance in the supply of and demand for resources – human resources and technical capabilities – and market opportunities, leveraging both Mainland China’s and Hong Kong’s strengths to stay ahead of the competition. Activities promoting information exchange with Mainland institutes/entities can provide avenues through which to establish collaborations. At the governmental level, under the mandate of the eleventh five-year plan, the local government in Guangdong is willing to promote R&D and innovation activities in the region, opening up opportunities that might have been possible otherwise only in Hong Kong[10].

Fortunately there is evidence based on our analysis of Hong Kong’s innovation environment to indicate the advent of a trend towards the exploitation of these opportunities (either directly or indirectly) on the part Hong Kong organisations/firms. In one sense, then, we see a mutual shaping of organisations within the innovation environment and the innovation environment itself, whereby the two components – organisations and the innovation environment – are shaping and being shaped by one another. This mutual influence underscores the dynamism of the innovation environment.

We have been able to detect these trends primarily because we have employed a new conceptual framework for the study of Hong Kong’s innovation system. By focusing less on organisations and other major actors in Hong Kong and more on the institutional setting in which innovation takes place – the innovation environment – we hope to have opened up new avenues for empirical research and analysis within the field of innovation studies. Through this new lens we can see how established organisations are beginning to embrace new models of business and technology development that promise to leverage the resources of the innovation system to promote economic growth and development in a rapidly changing global environment.

Notes

1. Lundvall *et al.* (2002, p. 214) claim that the United States National Academy of Sciences has also recently added the IS concept to its vocabulary and now uses it as a framework for analysing science and technology policy in the USA.
2. See “‘Big market, small government’ key” By Chief Executive Donald Tsang. Retrieved on 31 August, 2007 from www.news.gov.hk/en/category/ontherecord/060919/html/060919en11001.htm
3. These private venture capital firms assessed the technical and commercial viability of proposed technology ventures and determined the terms of the ARF’s investment in any given company. Suitable investment proposals were publicly vetted.
4. GEM Website. Retrieved on 13 July, 2006 from: www.hkgem.com/aboutgem/e_default.htm

5. Retrieved on 23 April, 2007 from Chapter 1 of: www.hkgem.com/research/listingmatters/e_consult-200601.pdf
6. The likelihood of these changes being implemented, according to our government respondents, is apparently high.
7. These conclusions are based on the views expressed by Chief Technical Officers of leading technology firms in Hong Kong.
8. See Joshua But, "Lack of publicity blamed for poor response to quality migrant scheme" *South China Morning Post* 30 August 2007.
9. See information on IPR in "Protecting Intellectual Property Rights in Hong Kong". Retrieved on 22 October, 2006. From www.hongkong.org/ehongkong22/property.htm
10. This integration may also open avenues to study the southern China regional innovation system employing the "open innovation" concept. The manner in which Hong Kong integrates external knowledge networks into its own innovation system and develops sustainable competitive advantages and a knowledge economy. Viewing technological and innovative developments through the "open innovation" lens can further aid in our understanding and means for addressing current innovation challenges facing Hong Kong's innovation environment, discussed in this paper. Indeed, such a path of study can help form a clear research agenda for the future.

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Further reading

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