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Hong Kong

An examination of recent developments in Hong Kong's innovation system: 1990 to the present

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This paper provides a broad-based background to the major innovation-related organizations, policies and institutions that have shaped Hong Kong's innovative landscape over the past decade and a half and determined the trajectory of its innovation system. The examination reveals three key issues: First, the Asian Financial Crisis was the major catalyst for change in the development of Hong Kong's innovation system. Second, the ecology of Hong Kong's innovation system grew in an unprecedented manner following 1998. Finally, this growth in the elements of the system indicates promising directions in which to drive future in-depth research.

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THE INNOVATION SYSTEMS (IS) concept is widely used in Scandinavia and Western Europe, both in academic contexts and as a tool for policy-making.[1] Although the IS concept has been widely applied to economies in the industrialized world (see, for example, chapters in Nelson, 1993; chapters in Larédo and Mustar, 2001; Lemola, 1994; Vuori and Vuorinen, 1994; Edquist and Lundvall, 1993; Dalum, 1994; Capron and Meeusen, 2000; Goyer, 2001; Drejer, 2000), it is only recently being applied to industrializing economies (see, for example, Intarakumnerd *et al* (2002) on Thailand's innovation system; IDRC (1997) on China's innovation system; Cimoli (2000) for Mexico's innovation system). This line of study — applying the IS concept to industrializing economies — extends to the 'newly industrializing economies' (NIEs) of Korea, Taiwan and Singapore (Hou and Gee, 1993; Kim, 1993; Wong, 1996; 2003; Chung, 2001; Chang and Shih, 2004).

Conspicuous by its absence, however, is scholarship that attempts to understand Hong Kong's economy by explicitly employing the IS perspective as its primary analytical lens. This paper aims to fill this lacuna within innovation studies by applying the IS perspective to Hong Kong's innovation system.[2] It provides a broad-based background to the major innovation-related organizations, policies and institutions that have shaped Hong Kong's innovative landscape over the past decade and a half and determined the trajectory of its innovation system.

I relied on four data sources for the material contained in this paper. First, I examined the scholarly literature pertaining to the development of Hong Kong's innovation system and economy. Second, I performed an in-depth analysis of official

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Government documents, particularly the two seminal reports published by the Commission on Innovation and Technology (HKSAR, 1998; 1999) and the Hong Kong Chief Executive's annual policy addresses from 1997 to 2004. Third, I gathered information about the functions of Government departments from their official websites. Finally, but perhaps most importantly, I interviewed policy-makers within the Hong Kong Government and non-government individuals who advised the Government on innovation and technology policy-making.[3]

I have divided my review into two major chronological periods punctuated by a major break in 1998. The first period begins in 1990 and continues to the end of September 1998 and the second period begins in October 1998 and extends to June 2005.[4] Although 1997 was a milestone in Hong Kong's history because the territory's sovereignty returned from Great Britain to China on 30 June, another major event was sparked in the same year (literally at the same time as Hong Kong's handover): the Asian Financial Crisis.

The region-wide crisis burst the asset bubble that had underpinned much of Hong Kong's economy prior to 1997 and triggered the worst economic recession Hong Kong had ever experienced.[5] Furthermore, since 1997, economic reforms in mainland China, combined with China's admission into the World Trade Organization, have shaken Hong Kong's heavy reliance on its traditional capacity as a trading center.

The magnitude of these changes cannot be overemphasized: long accustomed to relatively high and stable levels of growth, Hong Kong quickly found itself facing quarter upon quarter of negative growth, deflation, and mushrooming unemployment levels.[6] As a result, beginning in the fall of 1997, the population at large was yearning palpably for strong leadership and a new vision to pull Hong Kong out of its economic difficulties (Tung, 1997; 1998; van der Kamp, 1999).

The sudden changes in the economic landscape spurred the Government to participate actively, even urgently, in the transformation of Hong Kong's economic and innovation system so that it could create a new role for itself and a new engine for economic growth that could extricate the economy from its ruinous predicament. In March 1998, the then-Chief Executive of Hong Kong, Tung Chee-Hwa set up a high-level committee — the Commission on Innovation and Technology (CIT) — of academics, industrialists, businessmen and government officials to provide advice on what institutional arrangements were needed to drive forward innovative and technological development.

Combined, the Commission's two reports — the first published in September 1998 and the second and final report in June 1999 — not only significantly altered Hong Kong's innovation system, but also indelibly determined its trajectory thereafter. In this way, 1998 represented a clear break from previous Government policies related to technology, science and innovation, and that is why I select 1998 as my chronological dividing line.

The remainder of this paper is structured as follows. I begin by reviewing important currents in the recent literature on innovation and technology development in Hong Kong, allowing me to better situate the present paper within the innovation systems field. I then describe Hong Kong's innovation system and innovation and technology policy-making, pre-1998 and post-1998. I end by evaluating Hong Kong's innovation system, based on the previous contents of the paper, and by suggesting directions for future research.

Situating this research

While the Hong Kong economy has been studied extensively, from both a macro and micro perspective, this paper's analysis of its innovation system is among the few to explicitly employ the IS conceptual approach to the 'Special Administrative Region' (for exceptions, see Sharif and Baark, 2005; 2007). Existing studies that examine innovation phenomena or issues related to innovation, science and technology development in Hong Kong — that is, that touch on at least one of the institutions, organizations or policies — can be categorized into three broad groupings loosely grouped according to how much attention they devote to an in-depth understanding of Hong Kong's innovation system.[7]

The first and broadest grouping comprises scholarship that studies Hong Kong's economic (and sometimes, although rarely, innovative) development in relation to, and typically grouped together with that of, other Asian NIEs. The most notable piece of scholarship in this group is the World Bank's 1993 publication, *The East Asian Miracle*. Academics have also written extensively on a variety of different aspects of these economies ranging from patenting, to productivity, the Chinese diaspora, the lack of any 'miracle', and the role of government.[8] In this category, only limited attention is paid to Hong Kong (accounts are dominated by the Korean and Taiwanese stories, followed by the Singaporean) and in the other cases to innovation, science and technology (for exceptions, note Dahlman, 1994; Lall, 1996).

The second grouping comprises contributions to the literature that are more directly relevant to Hong Kong, but that are written mostly, again, by economists (or that have a distinctly economics flavor). This scholarship addresses issues ranging from an examination of the role of government in Hong Kong's development, to a focus on specific industries or sectors (such as information technology or education), and the changing role Hong Kong has had (and continues) to play since the economic opening of mainland China in 1979.[9] Few pieces in this group of scholarship focus on contemporary innovation and technology development in Hong Kong from a broad, macro perspective as opposed to an industry-specific perspective (for exceptions, note Hobday, 1995; Chen, 1996).

The third and final grouping comprises research that is most pertinent in terms of fitting an 'innovation studies' mould. Although not all the literature in this grouping explicitly employs the 'innovation systems' perspective or terminology, each of the studies is closely related to the development of organizations, institutions and policies that can possibly promote or hinder the development of Hong Kong's innovation system. Scholarship in this group includes Kwong (1997); Enright *et al* (1997); Berger and Lester (1997); Parayil and Sreekumar (2004); Davies (1999); and Ostrov (2002).

Kwong (1997) examines the future of industry and technology, albeit from an economics perspective, and provides a framework for discussing issues such as the role of government in innovation and technology policy-making and the future of innovation and technology in Hong Kong. Kwong's major empirical contribution is to find that Hong Kong manufacturers in the decade from 1987–1997 have been most active in the transfer of technology to mainland China, whereas their technological capability has actually declined.

Enright *et al* (1997) aim to achieve a "deeper understanding of Hong Kong's economic system as well as the sources of competitive advantage and disadvantage that underlie and influence the performance of Hong Kong's industries in international markets" (Enright *et al*, 1997: vii). The authors conclude that Hong Kong's business networks remain its greatest asset for future development and that it can maintain competitiveness by focusing on clusters of activities related to services providing high-value activities for light manufacturing, trade or infrastructure.

Perhaps the most influential publication pertaining to innovation and technology was the *Made by Hong Kong* report edited by Suzanne Berger and Richard Lester (1997). This book focuses on the future of industry in Hong Kong. Berger and Lester's central conclusion is that there is a "future for Hong Kong as a world-class industrial power. To realize such an ambition, Hong Kong needs to strike out in a new direction as a leader in the production of new generations of products" (Berger and Lester 1997: xiii).

In their article, Parayil and Sreekumar (2004) argue that the mode of innovation in Hong Kong from the early 1950s to the mid-1990s was systemic in nature and conformed to a variant of the national innovation system model, while, since the mid-1990s, the mode of innovation has more closely conformed to the triple-helix model. Davies (1999) argues against the thesis contained in Berger and Lester (1997) — that high technology manufacturing in Hong Kong will prove to be a myth — because, Davies argues, Hong Kong's environment is poorly suited to innovation, in that the territory's firms would be unable to make a shift en masse towards a more 'high-tech' positioning. Ostrov (2002) examines a specific high-tech measure — the Cyberport venture — launched in 1999 and criticizes the Government epistemology on which it was based.

Note that nowhere in this literature do we find any in-depth or comprehensive reference to the development of Hong Kong's innovation system based on analysis of its constituent organizations, institutions and policies across the board. With most of these studies, Hong Kong's innovation system is either viewed as a 'given' (its development unworthy of in-depth examination) or it is treated superficially with negligible attention paid to the monumental changes that occurred in 1998. Perhaps the scholarship on this subject is limited because so little time has elapsed since 1998. Even Parayil and Sreekumar (2004) (a more recent addition to the literature in which the authors explicitly deploy the IS concept) characterize a period in Hong Kong's development (the 1950s to the 1990s) that fits the IS mode of thinking.

By contrast, this paper employs the IS perspective as the primary conceptual lens through which to examine the recent history of Hong Kong's innovation-related development. I employ this conceptual lens to discern major organizations, funding schemes and institutions that constitute Hong Kong's innovation system. Utilizing the IS perspective as one among others is helpful and effective (though not by any means a panacea) as it provides a framework within which I can identify, examine and evaluate the constituent elements of Hong Kong's innovation system as well as the system as a whole. In this way, my

By contrast to previous literature, this paper employs the innovation systems perspective as the primary conceptual lens through which to discern major organizations, funding schemes and institutions that constitute Hong Kong's innovation system

focus on Hong Kong contributes to the growing body of work that utilizes the IS perspective to study 'catching-up' or NIEs in East Asia and developing economies in South America.[10]

Finally, the focus on Hong Kong is important not only in terms of filling a gap in the empirical literature within innovation studies; but also because Hong Kong has, as of 1998, itself embarked on a new path in technology and innovation formulation. For this reason, I expect Hong Kong to be a prime venue for employing the IS analytical lens not only for my study but also for policy-makers formulating innovation-related policies, particularly during the post-1998 period.[11] The magnitude of Hong Kong's commitment to the continued development of its innovation system remains to be seen, but it will surely represent a significant change from the pre-1998 period, when innovation and technology, in terms of both scope and scale, languished at the periphery of the territory's priorities.

Pre-1998 institutions and policies[12]

Before the onset of the regional financial turmoil in 1997 and 1998, Hong Kong had enjoyed robust economic growth for over 40 years, punctuated only by short-term adjustments, mainly to external events. During this period of rapid growth, Hong Kong had established a substantial manufacturing network in the region to become a major regional center of trade, finance, transportation and communications, consolidating its traditional position as the primary entrepôt between China and the rest of the world.

Because of Hong Kong's economic success in competing primarily on the basis of cost, innovation was not seen historically to be important by the actors in Hong Kong's innovation system, including most notably the colonial Government. In fact, the roots of Hong Kong firms' manufacturing (during the period between the 1950s and 1970s) can be traced to the opportunistic exploitation of a geographic land-space by mainland Chinese immigrants, particularly textile barons from Shanghai (fleeing the communist regime), who transferred start-up capital and managerial expertise to the colony (Wong, 1988; Hollows, 1999).[13]

Technological sophistication had little to do with the establishment of manufacturing firms in Hong Kong. Over time, as Hong Kong's manufacturers faced limits to low-cost manufacturing, they found an escape route for their industries in the opening up of China from 1979 onwards (leading to cheaper land and labor resource costs). Unlike other newly industrialized East Asian economies, Hong Kong's entrepreneurs, because of their linguistic and cultural familiarity, could easily leverage the abundant labor and land resources in Guangdong (China) to offset the disadvantage of heightened labor costs, allowing them to continue their model of export-led growth without investments in R&D.

Concomitantly, a successful model of Chinese business was flourishing vigorously in Hong Kong while controlling a large manufacturing base in Guangdong province. This organizational model, featuring Chinese family businesses, superimposes a paternalistic management structure onto a network of social and economic relationships connecting firms of many sizes (Redding, 1990). In establishing and upgrading their organizational model, Hong Kong firms exploited their traditional strategies of imitation and 'followership', while emphasizing the development of organizational know-how rather than formal R&D for new product development.[14]

This historical legacy left its mark in terms of Hong Kong Government policy revolving around the principle of what was called 'positive non-intervention', or *laissez-faire*, taken to mean that the function of the Government is primarily that of creating the infrastructure to enable market opportunities to be exploited by entrepreneurs. While some view this attitude as a myth, it largely held true until 1998 with respect to Hong Kong's innovation system.[15] As a result, the structure of Hong Kong's innovation system prior to 1998 was relatively straightforward and can be divided into organizations that participated in the innovation system and the funding schemes that underpinned it. Some of these organizations still exist, while others were merged or renamed and their activities broadened.

Organizations

There were three groups of organization in Hong Kong prior to 1998: Government-sector, non-government sector (but publicly funded) and public-sector. They are described, along with their funding schemes, below (HKSAR, 1998: 45–50).

Government sector

- Trade and Industry Bureau (TIB)/Industry Department (ID) The TIB was responsible for overall Government policies on industrial technology support and development. It was assisted by the ID in policy implementation.
- Education and Manpower Bureau (EMB)/ University Grants Committee (UGC)/Research Grants Council (RGC) The EMB was, and still is, responsible for overall Government policies on tertiary education, employment and human resource development, including policies on academic research, technical education and industrial training. In the determination and application of the Government's funding for university education and research, it was assisted by the UGC and the RGC, both of which operate to this day. The UGC, set up in 1965, is an advisory committee responsible to the Government on the development and funding needs of higher-education institutions. The RGC, on the other hand, advises the Government, through the UGC, on the needs of the institutions of higher education.

Publicly funded non-government sector:

- Universities Through education and research, the universities build and develop the science and technology base of Hong Kong's economy. They are the single most important component in the innovation system. The higher-education sector in Hong Kong was expanded significantly in the 1990s: two local polytechnics and two colleges were granted university status between 1992 and 1994. The universities' R&D focus is mainly on basic research with some applied research. Today, eight universities are governed by the Universities Grant Council (UGC), of which three receive the lion's share of research funding from the Government.[16]
- Vocational Training Council (VTC) The VTC, established in 1982 and still running, is the primary vehicle in Hong Kong for providing technical education and industrial training at the craft and technician levels.
- Hong Kong Productivity Council (HKPC) Established in 1967, the remit of the HKPC is to promote increased productivity and the use of more efficient methods in industry through consultancy and training. As recently as 1998, it was the main technology support organization in Hong Kong. In 1997, the HKPC employed about 600 staff with an operating budget of HK$380 million. The Government finances about 45% of this budget and the remainder is met by income from services to clients.
- Hong Kong Industrial Technology Center Corporation (HKITCC) The HKITCC was set up by the Government in June 1993 to facilitate the promotion of technological innovation and the application of new technologies in Hong Kong's industries (HKITCC, 1996). The HKITCC operated a business incubation program aiming to nurture technology-based start-up firms by providing them with low-cost accommodation as well as some management, marketing, financial and technical assistance.
- Hong Kong Institute of Biotechnology (HKIB) The HKIB was founded in 1988 to act as the catalyst, and provide the essential infrastructure, for the emergence of a successful biotechnology industry in Hong Kong through the provision of R&D support, downstream development and an incubator facility for start-up biotechnology companies. Prior to 1998, the HKIB operated mainly on project-dependent funding from the Industrial Support Fund (see below under funding schemes), with additional private donations and income from clients.

Private sector

- Industrial, business and professional bodies Some industrial, business and prof.

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economic development, the CAIT filled the void that was left when the CIT was disbanded.

Although on paper the CAIT's brief seems to be thorough, it did not maintain the momentum put in place by the CIT's two reports. The CAIT met only once or twice a year from the time of its establishment, and many members were absent from each of those meetings. Crucially, the CAIT was unable to provide advice to the Government that significantly altered or improved on any of the CIT's recommendations.

In the light of this situation, a second body was convened by the Hong Kong Government in early 2004 to salvage some of the impetus that had been directed towards innovation and technology in 1998 and 1999. A Steering Committee on Innovation and Technology (SCIT) was established in January 2004 and met for the first time on 20 February of the same year.[21]

Although it is not explicitly mentioned in Government literature, the SCIT comes closest to the "high-level policy group to coordinate innovation policy" (recommended as the institutional arrangement in the CIT's second and final report (HKSAR, 1999)). The SCIT consists of some members from the CAIT, with other academics and industrialists.

Outcomes of CIT's recommendations

Despite delaying the formation of adequate policy vehicles to replace the void left by the CIT, several changes took place in terms of the organizational, institutional and policy structure of Hong Kong's innovation system, beginning in 1998. In the five years subsequent to the publication of the CIT's second and final report in 1999, the innovation and technology program is summarized by the Government to have encompassed the following elements (HKSAR, 2004: 3–14).

- Innovation and Technology Fund (ITF) A HK$5 billion ITF was set up on 1 November 1999 in accordance with the planning proposed in the CIT's first report. This initiative, to finance projects in order to strengthen research capabilities in Hong Kong and increase research spending on R&D projects in the business sector, was the single most important initiative in terms of both financial clout and impact on innovation-related activity in Hong Kong. As of the end of March 2004, the ITF had supported 562 projects worth HK$1.53 billion (HKSAR 2004: 3).

  As the relatively small proportion of funds dispensed by the ITF in the five years following its establishment suggests, several problems were associated with the Fund. First, the ITF's success in bringing new technologies to fruition was limited: it funded (by monetary value) only 30% of the projects from its overall pool from its launch in November 1999 through June 2004.[22]

  Second, the ITF was based on a bottom-up approach that was not conducive to building significant focus and clusters. According to this method, individual researchers or research groups initiated research projects based on their interests and abilities. In practice, this led to funding projects with little regard for the strengths that Hong Kong as a whole was/is able to provide.

  Finally, individual projects were not integrated into an overall structure or scheme for the development of Hong Kong's innovation system. As funds for projects were granted on a case-by-case basis, there was no overarching theme or general coordination in their distribution.

The initiative of the Innovation and Technology Fund to finance projects in order to strengthen research capabilities in Hong Kong and increase research spending on R&D projects in the business sector, was the single most important initiative

- Applied Research Fund (ARF) Private venture capital firms were engaged to manage the ARF from 1998 onwards: they assessed the technical and commercial viability of proposed technology ventures and determined the terms of the ARF's investment in any given company. As a result of continued losses (for example, a loss of 48% on its investment for the year ending March 2004), the ARF ceased to make new investments from March 2005 onwards, after its contractual period expired. Upon the cessation of the ARF, there was a balance of HK$400 million in the ARF (from an initial start-up sum of HK$750 million) which was transferred to the ITF.
- Applied Science and Technology Research Institute (ASTRI) ASTRI was established in January 2000 to perform 'mid-stream' R&D for transfer to industry in Hong Kong with a view to elevating the technological level of industry and stimulating the growth of technology-based industry. ASTRI also brings together industry and university R&D assets, thereby acting as a spawning ground for technology entrepreneurs. Aside from the university sector, ASTRI today intends to become the single largest dedicated performer of R&D and innovative activity in Hong Kong.
- The Hong Kong Science and Technology Parks Corporation (HKSTPC) The HKSTPC was set up in May 2001 to provide a range of services catering to the needs of industry at various stages, ranging from nurturing technology start-ups through the incubation program, to providing premises and services in the Science Park for

applied R&D activities, and providing land in industrial estates for production.[23]

- Innovation and Technology Commission (ITC) The ITC was established on 1 July 2000 as part of the revamping of the Government's bureaucratic structure, with the mission of spearheading Hong Kong's drive to become a knowledge-based economy. The old Industry Department's (ID) functions, in so far as they pertained to innovation and technology, continued under the auspices of the ITC.
- Hong Kong Design Center (HKDC) Recognizing the importance of design to business activity, as a strategic value-added tool that can enhance competitiveness¸ the Government set up the HKDC in 2001 to serve as a link between businesses and designers of all disciplines.
- Cyberport One of the most maligned innovation-related organizations, conceived of in 1999 and completed in 2002, is the Hong Kong Cyberport project. It is a major infrastructure project providing state-of-the-art information technology, telecommunications and digital media facilities with a view to creating a cluster of information technology companies and facilitating development of new technologies, applications, services and content. The giant HK$14 billion project was designed as a pocket-sized Silicon Valley.

  It was heavily criticized because the deal to tender the construction was an opaque closed-door arrangement between the Hong Kong Government and a local businessman who is the son of Hong Kong's wealthiest individual. Furthermore, critics have questioned whether Cyberport, as a commercial venture, is in fact a high-technology project or just another real estate investment in disguise. Finally, the Cyberport venture indicates that the Government was, then at least, very much following in the path of its historical mode of *laissez-faire* planning with the assumption that it needed only to provide good infrastructure and investment incentives (like land) to foster a culture of innovation (Baark and So, 2006).
- Hong Kong Productivity Council (HKPC) Pursuant to a consultancy study on its role completed in February 2002, combined with the establishment of ASTRI, the HKPC repositioned its service focus to provide integrated support to innovative and growth-oriented Hong Kong firms across the value chain. After assuming a role in the 1990s as an agent for providing technical support to Hong Kong's light industries, the HKPC today places greater emphasis on the diffusion and use of innovations among Hong Kong's service sectors. Apart from the service sectors, its principal focus is on manufacturing, but with an eye on their service-related activities. The main geographical focus now is Hong Kong and the Pearl River Delta region.
- Building up human capital Despite a shrinking gross domestic product (GDP) for three years from 1999 onwards, public expenditure increased. In the financial year 2001–2002, 4.2% of Hong Kong's GDP was spent on education. In the financial years 2002–2003 and 2003–2004, the percentages were 4.4% and 4.7%, respectively.[24] About a third of this expenditure went to tertiary education leading to an increase in the number of university graduates.

  Also related to the CIT's recommendations regarding the building up of human capital, the Government adopted an Admission Scheme for Mainland Talents and Professionals in 2003 (a successor to a similar scheme launched in 2001).[25]
- Changes to the institutional framework Prior to 1997, intellectual property rights were protected in Hong Kong, mainly following the British model. Only trademarks were subject to local legislation in Hong Kong, while patent rights, designs and copyrights depended greatly on acts of Parliament in UK Copyrights legislation. With the transfer of sovereignty to China on 1 July 1997, Hong Kong localized its patent law and since has introduced its own patent system.[26]

  Also, towards the end of 1999, a second, alternative, board on the Hong Kong Stock Exchange known as the Hong Kong Growth Enterprise Market (GEM) was established. The idea behind GEM is to offer a venue for innovative and high-growth companies to seek equity funding despite having a short history and short record of profitability. This removal of a major entry barrier enables growth enterprises to capitalize on available opportunities by raising expansion capital under a well-established market and regulatory infrastructure. As the GEM's website states: "GEM complements and supports the HKSAR Government's initiative to promote the development of technology industries in Hong Kong".[27]

The way forward

In attempting to address problems that have resulted from the implementation of changes to its innovation system, particularly regarding the ITF, the Government sought to revamp the existing innovation and technology program with a new strategy in a Consultation Paper released in June 2004 (HKSAR, 2004). This strategy was based on the principles of focus, market relevance, industry participation, leveraging mainland China and better coordination among different elements of the innovation and technology program.

The key initiative of the new strategy, and the way in which it differs from the old, is its emphasis on identifying a number of technology focus areas for future development to be supported by the ITF's resources. The idea here is to ensure that Hong Kong moulds its innovation system to target areas in which it has comparative advantages and the greatest potential for meeting industry and market needs.

Nine focus areas were chosen in January 2005 as key areas for technology development. Five of these (Chinese medicine; communication technologies; consumer electronics; integrated circuit design and opto-electronics) are under the responsibility of ASTRI.[28] These five areas serve as ASTRI's research priorities as laid out in its latest five-year plan, published in early 2005.

For the remaining four areas, various organizations within Hong Kong's innovation system have been invited to set up R&D centers. They include the Hong Kong Productivity Council, which is designed to create an R&D center in automotive parts and accessory systems; the Hong Kong Polytechnic University set up as an R&D center in the area of textiles and clothing; the Hong Kong University of Science and Technology (another of the research-oriented higher-education institutions in Hong Kong) set up as an R&D center in nanotechnology; and the final research area, in technologies that enable logistics and supply chain management, will have an R&D center hosted by an organization after a competitive bidding process is completed.[29]

The new strategy differs from the old in that it adopts a more market-driven, demand-led approach as opposed to a predominantly supply-side approach.[30]

Evaluation of Hong Kong's innovation system

This paper has highlighted 1998 as a particularly important milestone in the development of Hong Kong's innovation system. Even though 1997 is commonly identified as a watershed year in Hong Kong's development, it is not the return of sovereignty of Hong Kong to China as such that led the Government to participate more actively in the development of Hong Kong's innovation system. Rather it was the Asian Financial Crisis that triggered the impetus for real and lasting change.

As a result, we can identify five significant changes in Hong Kong's innovation system marking the contrast between the system pre-1998 and post-1998. First, in terms of decision-making, funding in the pre-1998 innovation system was provided by the Industrial and Services Support Funds (ISF and SSF) on an *ad hoc* basis. Today, available funding is greater and consolidated under the umbrella of the Innovation and Technology Fund (ITF).

Second, the number of actors and elements constituting Hong Kong's innovation system has increased markedly since 1998. In particular, important organizations such as ASTRI are now positioned to an influenctial role in performing innovative activity and linking industry to the latest technological developments.

Third, policy-making has changed because of the increased commitment posted by the Government beginning in 1998 and 1999. Whereas there was little commitment to the development of the innovation system pre-1998, post-1998 has witnessed a stronger desire from the Government to strengthen the overall system. Unfortunately, this burst of activity in the late 1990s quickly faded and is only now being resurrected through the Innovation and Technology Commission's (ITC) New Strategy, launched in 2005.

Fourth, on a related point, the ITC's New Strategy hints at policy-learning from Government officials. Having identified problems with the previous innovation and technology policies, the Government is now taking active measures not to repeat the same mistakes.

Finally, and perhaps most significantly, whereas previously there was little integration of innovation and technology policy measures with events unfolding on the mainland, there is now increasing integration on that front with southern China. Collaboration with the Guangdong Provincial Department of Science and Technology and Hong Kong's ITC is now beginning to grow substantially, compared with the pre-1998 period.[31] Similarly, the Hong Kong Productivity Council has shifted its focus to include the Pearl River Delta region in addition to solely Hong Kong companies.

In spite of these changes, however, we could still say that Hong Kong's innovation system is, in a word, underdeveloped. Despite its being a small territory, the diversity and institutional range of Hong Kong's innovation system compares poorly with those of other small countries such as Singapore, where, before 1990, the policy focus had been on promoting technology deployment, while after 1990 the Government shifted its attention to raising the indigenous R&D profile of local Singaporean companies through various long-term strategies and plans. This is no doubt a legacy of Hong Kong's historical role as a trade hub, coupled with traditionally (pre-1998) low levels of Government intervention.

In evaluating measures designed to intervene in Hong Kong's innovation system, the most obvious point to be made is how conspicuously 'late' the policies have been in their introduction. Not until 1998 did Hong Kong develop any kind of formal, coordinated innovation policy. Even then, the policies and organizations did not immediately gel, necessitating gradual adjustments over the past several years. Against any comparison benchmark — such as Organization for Economic Cooperation and Development (OECD) countries, or Asian NIEs or countries/territories of a similar size — Hong Kong stands out as among the last to recognize the value of innovation and the gains to be made from an efficiently working innovation system.[32]

In Hong Kong's case, this delay may have been especially detrimental to the overall innovation system because of the speed and intensity with which China (the one economy on which Hong Kong uniquely depends for its economic livelihood) has been opening in terms of economics, innovation and finance, since 1979. In particular, cooperation

among the cities and regions constituting the Yangtze River Delta (YRD) region have led to suggestions that the entire Pearl River Delta region will be unable to keep up with innovation and technology development in the YRD.

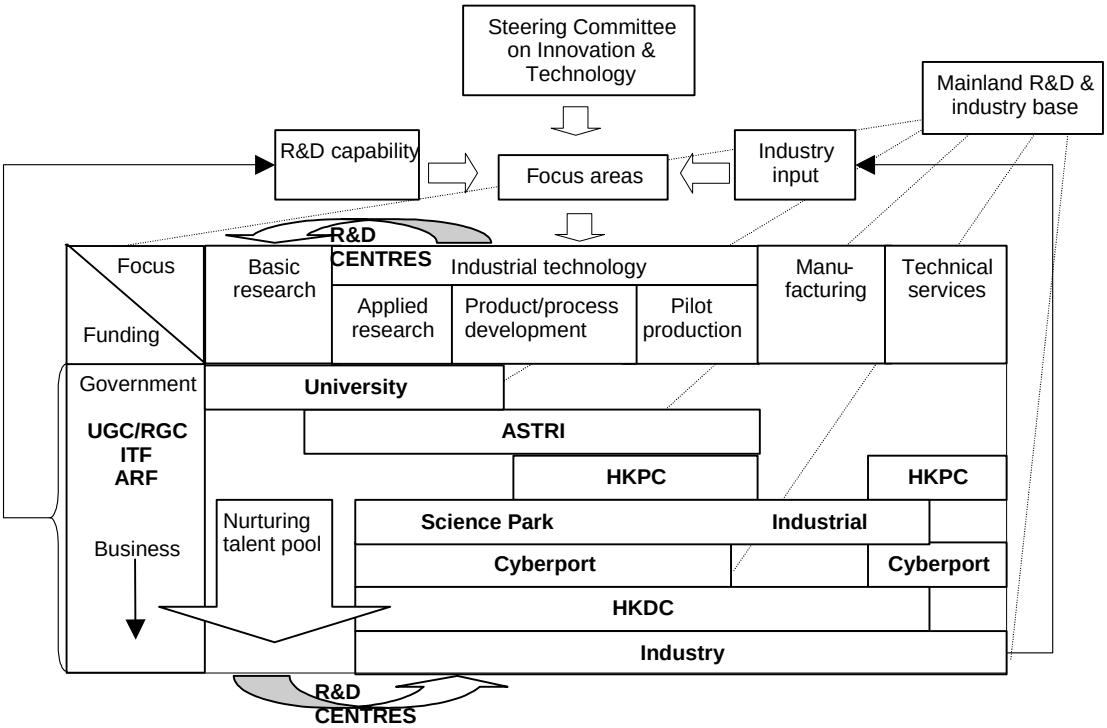
Lateness in tackling and introducing innovation policy and subsequently weak implementation has fragmented many initiatives, especially in the first few years following the publication of the CIT's two reports. This however is slowly beginning to change. In facilitating this change, Hong Kong could possibly, therefore, benefit from an approach to its innovation system whereby policy and funding initiatives are better coordinated and understood in terms of a larger conceptualizing framework, that is, via the innovation systems (IS) approach. Indeed, the IS conceptual approach was also embraced by policymakers in Hong Kong in 2004 (HKSAR, 2004: 15–18) as indicated in a recent Consultation Paper. In that Paper, Hong Kong's innovation system was depicted as shown in Figure 1.

Several key questions arise from Figure 1, the most striking of which is the lack of emphasis on firms. This is especially noteworthy in Hong Kong's case because of the central role of small and medium-sized firms in Hong Kong's corporate landscape.[33] Not only is there the thick, downward pointing arrow (the origins of which are unclear) pointing to the 'Industry' bar (presumably denoting firms), but the location of 'Industry' right at the bottom of the figure suggests a peripheral role (unlike the principal position of firms in the IS diagram from the OECD (1999: 23) in which they are positioned at the heart of an innovation system schema).

It may be that the role of firms is marginal because of the low levels of innovative activity that they generate. Nevertheless, the key idea of bringing firms into the center of the innovation system is still missing in the diagram (as is the acknowledgement of innovative activity that predominantly occurs in large firms in Hong Kong at present).[34]

Movement towards adopting a systems-of-innovation approach by the Hong Kong Government must, however, be tempered by the observation that the development of greater coordination and integration among the constituent elements of Hong Kong is in its infancy. There is a long way to go. For example, too little scholarship attempts to understand the aggregate innovation system currently in Hong Kong. This may be partly because of the piecemeal nature of the Government's own innovation policies. Take, as an example, the Applied Research Fund. As recently as June 2004, it was conceived as an important element of Hong Kong's innovation system (see Figure 1). Shortly thereafter, however, in March 2005, it ceased to operate.

This paper represents an effort to redress that balance by using the IS framework as a descriptive tool to enumerate the set of institutions, organizations and funding mechanisms that contribute to the development and diffusion of technologies that enable growth. It is hoped that such a survey paper will open



UGC- University Grants Committee
RGC- Research Grants Council
ITF - Innov and Technology Fund
ARF - Applied Research Fund
ASTRI - Applied Science and Technology Research Institute
HKPC - Hong Kong Productivity Council
HKDC - Hong Kong Design Centre

Figure 1. Hong Kong's innovation system
Source: HKSAR (2004: 18)

the door to additional scholarship that undertakes deeper analysis of the way Hong Kong's innovation system is presently evolving, particularly in relation to developments in southern China.

Future research paths

What this paper has shown is that, in Hong Kong, funding mechanisms that provide incentives for the development and diffusion of new technologies, followed by organizations, are more important than the institutions that comprise the innovation system. Moreover, the institutional framework of Hong Kong's innovation system has been altered less than the constituent organizations and funding mechanisms.

This paper has highlighted some of the more influential organizations in the Hong Kong innovation system. This identification has underscored the importance of studying, in particular, the Innovation and Technology Fund (ITF), including its inception, development and the factors that have influenced it post-launch. Given the recent significance assumed by the Applied Science and Technology Research Institute (ASTRI) in terms of developing five technology focus areas, it is also worth studying this organization in greater depth, as it promises to remain one of the largest organizational actors in Hong Kong's innovation system.

It would be instructive to study the now-abolished ARF, a pre-1998 funding scheme to which a substantial sum of money was allocated. An additional study target is the Government agency, the Innovation and Technology Commission (ITC), which has coordinated innovation-related policy over the past several years. It has proved itself to be the primary Governmental actor and it is worth investigating the manner in which policy decisions are arrived at, consultations conducted and conclusions reached.[35]

Another understudied theme is that of university–industry links in Hong Kong. This area of the innovation system has changed over the past decade, yet there is no scholarship that attempts to explicate in detail the nature and intensity of such links. Such scholarship is urgently required if Hong Kong is to fully exploit the competencies of its relatively strong education sector.

In Hong Kong, funding mechanisms that provide incentives for the development and diffusion of new technologies, followed by organizations, are more important than the institutions that comprise the innovation system

A final but important point to note, following the examination contained in this paper, is the degree to which the linear or pipeline model of innovation pervades Government policy-making. This model is given in the annexes of both seminal CIT reports and appears to form the central mental model for technological development. The ASTRI, and many of the other organizations that dominate Hong Kong's innovative landscape (such as the Hong Kong Institute of Biotechnology), have been set up according to a linear mode of thinking.

The linear model has been proved vastly inadequate by Kline and Rosenberg (1986) and others (Lundvall 1985); it represents a very narrow subset of all possible models for promoting innovations, especially in Hong Kong, which has generally low levels of R&D investment but high levels of entrepreneurial activity. Furthermore, it is questionable whether Hong Kong's regional economic system can benefit more from greater investment in the generation of new knowledge than from investments in the exploitation of existing knowledge. It will therefore be in Hong Kong's interest to discard the linear model of innovation in favor of a more interactive approach if it is truly to reorganize and strengthen its innovation system.

Notes

1. Finland was the first country to adopt the concept of innovation system (IS) as a basic category of its science and technology policy, and Sweden has given the concept legitimate status in its own way by naming a new central Government institution (an *ämbetsverk*) VINNOVA, or the Systems of Innovation Authority.
2. Although Hong Kong is unequivocally a geographical and political part of the People's Republic of China (as a Special Administrative Region (SAR) — one country), economically and constitutionally it is sufficiently distinct to be considered, from a conceptual standpoint, an 'independent' innovation system (two systems), solely for analytical purposes. Therefore, any and all references to 'Hong Kong' or 'HKSAR' in this paper denote, in full, 'The Hong Kong Special Administrative Region of the People's Republic of China'.
3. In total, I interviewed ten individuals in Hong Kong from June 2004 to August 2004, including former or current Government consultants, members of Governmental advisory boards and innovation and technology-related Government officials. In this way, my interview sample embodies a representative cross-section of views pertaining to innovation and technology policy-making in Hong Kong. All my interviews were arranged in advance, conducted without significant interruptions and lasted between one and a quarter and four hours. The interviews were semi-structured and I developed guides to help direct conversation. These guides, provided in advance to my interviewees, did not necessarily articulate exactly the questions that I would ask or the order in which I would raise particular issues, but rather provided an outline of themes that I wanted to cover during the course of the interview. To make up for the absence of an audio recording of my interviews, I took copious hand-written notes.
4. I do not attempt to study the very early history of Hong Kong's innovation system. For the early history see, for example, Tsui-Auch (1998).
5. The asset bubble in the late 1990s was characterized by: a) unsustainably high property prices; b) a rapid rate of increase in prices; and c) high transaction volumes. The transaction prices of apartments had risen to a level where high-end property prices (of 'grade-A' luxury residential apartments and offices) were among the highest in the world

and were rising by an average of 10% every three to four months. Furthermore, transactions involving such properties were at a record level.

6. It was the first time most people in Hong Kong had ever experienced such deep-seated economic turmoil. At an individual level, those who had invested in either the stock or property markets saw their asset values slashed, often to a state of 'negative equity', in which the outstanding loans payable on their assets exceeded the assets' market value.
7. This review is meant to be helpful in pointing to the niche the present paper fills with respect to tracing and tracking the recent development of Hong Kong's innovation system; the review is not an exhaustive or in-depth exploration of all scholarship ever written on the subject of Hong Kong's economic success or development.
8. See, for example, Vogel (1991); Krugman (1994); Cardoza (1999); Carney and Gedajlovic (2000); Mahmood and Singh (2003); Redding (1990); Amsden (2001); Dahlman (1994); Uchida and Cook (2005); Lall (1996); Lall and Urata (2003); Mody and World Bank (1997); Stiglitz and Yusuf (2001); Simon (1995); Young (1995); and the Australia Department of Foreign Affairs and Trade (1995).
9. In this category we can fit: Ash (2003); Chiu and Wong (2001); Mok (2005); Tao and Wong (2002); Sung and Wong (2000); Tang (1999); Cheng and Wu (1998); Clayton (2000); Wan and Weisman (1999); Wan (1998); Federation of Hong Kong Industries (2003); Meyer (2000); Pun and Lee (2002); Hamilton (1999); Chen *et al* (1991); Tsui-Auch (1998); Chen (1996); Hobday (1995: chapter 7); Hollows (1999); Martinsons (1998); Sit (2004); Enright *et al* (2003); Yu and Robertson (2000); and Jessop and Sum (2000).
10. Witness, for example, the voluminous contributions to two major recent international conferences on innovation systems held in Rio de Janeiro, Brazil and Beijing, China, in 2003 and 2004, respectively.
11. Indeed, the analysis contained in this paper coincides closely with the first official use of the innovation systems perspective in Hong Kong by the Hong Kong Government in the summer of 2004 in a Consultancy Paper (HKSAR, 2004).
12. With respect to the definition of the terms 'organizations' and 'institutions', I employ Edquist's (2005) classification. In Edquist and Johnson (1997: 46–47), the authors state, "organizations are formal structures that are consciously created and have an explicit purpose". In other words, organizations can be understood to be players or actors. These players and actors can even be individuals, but the literature most commonly refers to them as organizations. The most important organization within an innovation system is considered to be the firm, as firms appear at the heart of the standard innovation systems schematic (for an example of such a schematic, see OECD, 1999: 23). Firms include suppliers, customers or competitors of other companies and venture capital organizations (Edquist 2001: 5). Other important organizations within innovation systems are public innovation policy agents, that is, public agencies responsible for innovation policy, competition policy or regulation. Depending on the innovation system in question, universities can also be a major organizational component. Institutions, on the other hand, are "sets of common habits, norms, routines, established practices, rules or laws that regulate the relations and interactions between individuals, groups, and organizations" (Edquist and Johnson, 1997: 46). In other words, institutions are the 'rules of the game'. Examples of institutions that are important within a system of innovation are patent laws and rules and norms that influence relations between universities and firms (Edquist 2005: 188). Understandably, institutions can differ considerably across innovation systems (patent laws, for example, differ across countries).
13. These Shanghai industrialists concentrated on low-cost manufacturing in the labor-intensive textile and clothing industries and turned to the British trading houses in Hong Kong, which had established links with international export markets (Tsui-Auch, 1998: 9).
14. The bulk of R&D expenditure by private firms in Hong Kong is devoted to redesigning and improving products and to making them easier and cheaper to produce. In other words, process innovation has often taken precedence over product innovation in Hong Kong's industries.
15. The idea that Hong Kong is a *laissez-faire* society is arguably a myth because the Hong Kong Government has always controlled many crucial parts of the economy, including land supply, housing policy and exchange rates. In particular relation to the land supply in Hong Kong, there has never been unrestricted allocation of resources because the local Government has always monopolized the supply and sale of land in the territory.
16. These three are The University of Hong Kong, The Chinese University of Hong Kong and The Hong Kong University of Science and Technology.
17. Examples of such bodies include the Hong Kong Garment Manufacturers Association Limited, Hong Kong Medical and Healthcare Device Manufacturers Association, Hong Kong Electronics Industry Association Limited.
18. Under this arrangement, the ISF was required to compete for resources annually in the Government's central allocation exercise and any provision not spent at the end of a financial year lapsed.
19. Such an institute (modeled on the Taiwanese equivalent of the Industrial Technology Research Institute (ITRI)) was necessary, the Commission argued, because: a) the gap between basic and applied research was too wide to be bridged by strengthening the capability of the universities and industry alone; b) the organizational infrastructure in place at the time (1997/1998) — the Hong Kong Productivity Council — did not possess the expertise to conduct midstream R&D; c) the proposed institute would bring together relevant research resources in the universities and industry; and d) virtually all industrialized economies have recognized the need for such applied research institutes as part of their technological infrastructure (for example, the Korean Advanced Institute of Science and Technology and 13 industry-specific research institutes and centers in Singapore).
20. The CAIT comprises 17 members, 15 of whom are non-official members from the business and academic sectors, locally and overseas. Two Government officials — the Secretary for Commerce, Industry and Technology and the Commissioner for Innovation and Technology — are official members of the CAIT.
21. Even though the Steering Committee on Innovation and Technology (SCIT) was set up in 2004, the Council of Advisors on Innovation and Technology (CAIT) still remains, but meets even less frequently than it did before the establishment of the SCIT. Furthermore, members of the CAIT have characterized their role as one of 'overseeing' and providing 'high-level guidance' to the SCIT.
22. According to the findings of a survey commissioned by the Innovation and Technology Commission, only 0.15 patents per project were granted.
23. The HKSTPC was formed by merging the former Hong Kong Industrial Estates Corporation, the Hong Kong Industrial Technology Center Corporation (HKITCC) and the Provisional Hong Kong Science Park Company Limited.
24. An expenditure of 4.7% of GDP for education puts Hong Kong in the average level among high-income economies.
25. The 2003 scheme (still in place today) seeks to improve the conditions for this special class of immigrants from mainland China, such as allowing them to bring their families to Hong Kong.
26. The Hong Kong Patents Ordinance came into force on 22 June 1997. It provides for the establishment of an independent patents regime and the granting of both standard and short-term patents.
27. From <http://www.hkgem.com/aboutgem/e_default.htm>, last accessed 13 July 2005.
28. The R&D area of Chinese medicine is strictly the responsibility of the Hong Kong Jockey Club Institute of Chinese Medicine (HKJCICM), which is a subsidiary of ASTRI.
29. Each of these R&D centers has an initial term of operation of five years and will play an independent role in fostering coordination among R&D institutions and cooperation with industry partners.
30. Accordingly, the ITF has adopted a new, three-tier funding model. Tier one comprises comprehensive and continuous support of the nine chosen technology areas. Tier two offers funding for the remaining four focus areas that were initially identified in the Consultation Paper but were not selected for the setting up of R&D centers (these include: advanced manufacturing technologies; digital entertainment; display technologies; and medical diagnostics and devices). Finally, tier three provides funding for innovative projects that fall outside the auspices of all 13 technology areas identified in the 2004 Consultation Paper.

31. In 2004, for instance, Hong Kong's ITC and the Guangdong Provincial Department of Science and Technology organized a major conference in Guangzhou to introduce Hong Kong's new strategy for innovation and technology development to enterprises in the Pearl River Delta (PRD) region.
32. Compare this with Singapore, for example, where, before 1990, the policy focus had been on promoting technology deployment while, after 1990, the Government shifted its attention to raising the indigenous R&D profile of local Singaporean companies through various long-term strategies and plans.
33. Hong Kong's business landscape is dominated by small and medium-sized enterprises (SMEs). In Hong Kong, SMEs are defined as non-manufacturing enterprises with fewer than 50 employees and manufacturing enterprises with fewer than 100 employees. In September 2004, there were about 282,000 SMEs in Hong Kong. They accounted for over 98% of the total establishments. The majority of Hong Kong's SMEs are family-run enterprises, with a high degree of overlap between ownership and management; centralized decision making; high level of family orientation (nepotism); the widespread use of personal networks; high degree of flexibility and adaptability to changing market conditions; emphasis on pragmatism over legalism; and dependence on internal sources (as opposed to institutional, external sources) for raising finance.
34. In contrast to small and medium-sized firms, large firms, which constitute 2% of total establishments in Hong Kong, undertake the largest amount of innovation expenditure (in dollar terms).
35. Although the ITC is the key Governmental actor in terms of innovation-related policy formulation and implementation, its role within the wider Hong Kong Governmental system is arguably minor.

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