Hong Kong Innovation Project

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On Reform of Hong Kong's Public Research Funding System

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1. Introduction

The Hong Kong government used to adopt a laissez-faire policy to promote economic development in Hong Kong, but since 1997 promotion of R&D and innovation has been given high priority on the policy agenda (Liu, 2008; ITC, 2004). In order to come to terms with the rising economic strength of Mainland China, some in Hong Kong, both from the private and public sectors, feel that Hong Kong needs to develop its own innovation and technology capabilities in a few fields to become an "innovation hub" in the region (Sharif and Baark, 2008). In so doing, Hong Kong may be able to capitalize on the manufacturing muscle in the mainland, the Pearl River Delta (PRD) in particular.

Against the above backdrop, the Applied Science and Technology Research Institute (ASTRI) was established in 2000 to conduct industry-oriented applied R&D, with Industrial Technology Research (ITR) in Taiwan and the Korean Advanced Institute of Science and Technology (KAIST) in Korea as its models. The Innovation and Technology Commission (ITC) was also established as the successor of CTI in 2000 to coordinate related policies to promote R&D and technological innovation in different sectors. Since then, R&D schemes and R&D projects funded by the ITC have grown in number (see Section 3). However, questions remain as to the extent to which more active innovation policies have produced significant positive results (Liu,

2008).

The central question of this paper is how the Hong Kong government can reshuffle its public research funding system and innovation governance in order to boost innovation. In general, innovation governance has become an increasingly important issue and a key challenge for OECD member countries. To address this issue, it requires developing the necessary institutional set-ups, procedures and practices for agenda setting and prioritisation, implementation and policy learning (OECD, 2005). Innovation governance involves many issues, but this paper focuses on the way the Hong Kong government, particularly the ITC, administrates R&D funding schemes and the ways in which the research institutes interact with the funding agencies.

2. A Snapshot of R&D in Hong Kong

This section highlights some stylized features of R&D in Hong Kong, though some more detailed analyses can be seen in the Appendix.

Hong Kong, despite being one of the high-performing East Asian economies, has not been very active in R&D and technological innovation. Its R&D expenditures in 2006 amounted to HK$ 11.95 billion (about US$ 1.54 billion), accounting for 0.81% of GDP. This percentage is relatively low by international standards, and lower than

its major neighbouring economies, Taiwan (2.58%) and Mainland China (1.42%). However, a positive trend was the growing momentum of the private (business) sector in R&D investment. The business sector accounted for 53% of the total R&D expenditure in 2006, and has overtaken the higher education sector to become the major R&D performing sector since 2005. On the other hand, the government sector, including the public R&D institutions, has played a minor role as an R&D performer, with its R&D share being as low as about 2.08% in 2006, though the government remains an important source of funds for R&D. Of note is the fact that despite a publicized commitment by the government to the stepping-up of R&D activities, the R&D expenditure invested by the government either fluctuates over time or at most grows at a modest rate.

A close look at R&D expenditure in the business sector by industry sector suggests a predominant role played by the service industry. Hong Kong-based enterprises with R&D activities were mainly clustered in two broadly-defined industry sectors, namely, (1) the wholesale, retail and import and export trades, restaurants and hotels sector; and (2) the financing, insurance, real estate and business services sector. These two sectors contributed 58% and 24% of the total R&D expenditure in the business sector respectively, followed by the manufacturing industry (6%). However, an additional part of R&D for manufacturing may be hidden

in the wholesale, retail and import and export trades, restaurants and hotels sector because R&D activities in this sector are predominantly performed by trading firms with sub-contract processing arrangements. As for the financing, insurance, real estate and business services sector, R&D activities undertaken by the constituent firms were mainly related to information technology. This peculiar feature mentioned above has much to do with de-linking of R&D and manufacturing locations. This issue has spurred some controversies related to public R&D funding, to which we shall return later.

In addition, there seems to be a mismatch between public R&D and private R&D, especially in terms of the strategic areas selected by the ITC for the R&D Centre Programme, including automotive parts & accessory systems, information & communications technologies, logistics & supply chain management enabling technologies, nanotechnology & advanced materials, textiles & clothing, and Chinese medicine. The R&D expenditure in the business sector predominately concentrates on information technology and electrical & electronic engineering technology, with these two areas contributing to 42.5% and 33.6% of the total private R&D respectively. On the other hand, for such areas as Chinese medicine and nanotechnology, the R&D investment of the private sector is negligible.

The business sector in Hong Kong is engaged substantially in R&D outsourcing. In 2007, a total of HK$3,223.7 million was spent by this sector in R&D outsourcing, with its size being more than half the total business R&D expenditure. The wholesale, retail and import and export trades, restaurants and hotels sector as a whole was not only involved substantially in R&D outsourcing but also spent 93.9% of the total expenditure for outsourced R&D activities (HK$ 2.44 billion) to parties outside Hong Kong. This type of R&D outsourcing also accounted for about 74.8% of the total expenditure for outsourced R&D activities by the finance, insurance, real estate and business services sector, the second largest R&D performing business sector. In terms of the geographical and organizational patterns of the performing parties of the outsourced R&D concerned, intra-corporate cross-border network, especially within the PRD Economic Zone, is the dominant type of R&D outsourcing adopted by the Hong Kong-based firms/establishments. This is consistent with the above-mentioned significance of Hong Kong-based trading firms with sub-contract processing arrangement in the wholesale, retail and import and export trades, restaurants and hotels sector.

3. Hong Kong Public R&D Funding

Since 1998, a few funding schemes have been set up under the auspices of the ITC to support different innovation activities, ranging from R&D (the Innovation and Technology Fund; ITF), technology ventures (the Applied Research Fund; ARF[1]), design (the DesignSmart Initiative), and patent application (the Patent Application Grant; PAG). Table 1 outlines some of the major funding schemes administrated by the ITC; among which the paper is particularly concerned with the ITF, as well as the innovation governance relationship between the ITC and its umbrella R&D institutes. Figure 1 portrays the structure of the ITC's funding schemes.

The Innovation and Technology Fund (ITF), launched in 1999 with an injection of HK$5 billion, aims to support projects that contribute to innovation and technology upgrading in the industry, as well as those essential for upgrading and developing the industry. The ITF can be considered as the flagship R&D initiative funded by the Hong Kong government not only because of the sheer size of its allocated budget but also due to the wider coverage of its funding structure. The ITF has four programmes, including Innovation and Technology Support Programme (ITSP), University-Industry Collaboration Programme (UICP), General Support Programme

[1]The investment period of the Applied Research Fund has expired in end March 2005 and the Fund has ceased making new investments.

(GSP), and Small Entrepreneur Research Assistance Programme (SERAP). Of particular relevance to the paper is the Innovation and Technology Support Programme (ITSP) because the lion's share of the research institutes' funding comes from this programme. In addition, according to the ITC (2008), the amount approved under the ITSP amounted to 83% of the whole ITF from its initiation until May 2008 (see also Table 2).

The ITC has adopted a new three-tier structure funding proposals under the ITSP since 2005. Tier 1 involves the establishment of R&D centres to undertake projects in their respective technology areas: including automotive parts and accessory systems; logistics and supply chain management enabling technologies; textile and clothing; nanotechnology and advanced materials; information and communications technologies (covering communications technologies, consumer electronics, integrated circuit design and opto-electronics) and Chinese medicine. Tier 2 involves the funding of project proposals submitted under the Guangdong-Hong Kong Technology Cooperation Funding Scheme (TCFS). Tier 3 involves the funding of more forward-looking and innovative applied R&D projects (www.itc.gov.hk).

The R&D Centres Programme resulted from the "New Strategy" released in 2005, which consisted of two key initiatives. The first one was to identify the strategic technological areas to be actively promoted by the government. The underlying

criteria for the selection of the focus areas include (1) existing research capabilities of universities and other research institutes; (2) Hong Kong companies' competitive advantages; (3) industrial needs, and (4) market potentials.

The second key initiative was to set up R&D centres in selected areas to conduct applied R&D and to facilitate technology transfer from universities and research institutes to the business sector. The underlying criteria were to support the further development of innovation and technology with emphasis on five key elements, i.e. focus, market relevance, industry participation, leverage on the Mainland, and better coordination among different elements of the innovation and technology programme. In total five R&D centres were established in 2006 to drive and coordinate R&D efforts in the designated technology areas.

The six[2] R&D centres are administrated by different host organizations, including the Hong Kong Productivity Council (automotive parts and accessory systems), ASTRI (information and communications technologies), the University of Hong Kong, the Chinese University of Hong Kong and the Hong Kong University of Science and Technology (logistics and supply chain management enabling technologies), the Hong Kong University of Science and Technology (nanotechnology and advanced materials) the Hong Kong Polytechnic University (textile and clothing), and the Hong Kong

[2] The six R&D centres include an existing one, namely the Hong Kong Jockey Club Institute of Chinese Medicine Limited plus five new ones.

Jockey Club Institute of Chinese Medicine Limited (Chinese medicine). The designated functions for these centres include: (1) to conduct industry-oriented research; (2) to facilitate IP commercialisation; (3) to provide technology and market intelligence; (4) to provide a platform for exchange of IT/technology; and (5) to promote technology development, transfer and knowledge dissemination. However, according to our interviews in Hong Kong, at least some of them are more like project offices, with limited in-house R&D capacity and a limited number of staff members.

On top of that, ASTRI was established in 2000 to conduct industry-oriented applied R&D. ASTRI's research areas include photonics technologies, internet applications, wireless communications and IC design. Its operating strategy is to transfer the technologies developed from its R&D projects to industry through licensing arrangements, contract research arrangements and spinning-off new technology companies. ASTRI has a subsidiary company, the Hong Kong Jockey Club Institute of Chinese Medicine Limited (HKJCICM), which aims to promote and support the modernization and further development of Chinese medicine in Hong Kong. The Hong Kong Jockey Club Charities Trust, which owns 50% of HKJCICM, has pledged to donate HK$ 500 million to fund the R&D activities managed by the HKJCICM while ASTRI provides premises and supporting facilities to HKJCICM and funds its recurrent operating costs.

Table 2 provides information on the breakdown of the approved projects under ITF by programme and industrial sector. The ITSP is the major programme funded by the ITF, accounting for 53.75% of the approved projects and 83.5% of the approved amount respectively. The broadly-defined information and communications technologies area (including information technology and electrical & electronics, shown in Table 2) is the field that is most funded across programmes under the ITF, followed by the so-called foundation industries and biotechnology.

Table 3 goes further to show the funding indicators of the major funding schemes, of particular interest to the paper, under the auspices of the ITC. Over the period 2006-2008, among the schemes listed in Table 3, the ITSP has funded most projects. In terms of the R&D Centres Programme, out of the five R&D centres listed, the R&D Centre for Information and Communications Technologies right from 2006 has made a quick start and has funded a number of projects, while the rest of them only began to gain momentum from 2007 with a limited number of projects funded. Likewise, since its founding, the HKJCICM has funded only 17 projects in collaboration with local universities and Mainland institutions (ITC, Controlling Officer's Report, 2009).

The tables and figure below suggests that there is a mismatch between public R&D and private R&D, especially in terms of the strategic areas selected by the ITC for the R&D Centre Programme. As discussed above, R&D expenditure in the Hong Kong business sector predominately concentrates on information technology (including information system & technology, computer hardware technology, computer software technology and communication technology) and electrical & electronic engineering technology, with these two areas contributing 42.5% and 33.6% of the total private R&D respectively. This is equally true for the two major R&D investing sectors, namely the wholesale, retail and import and export trades, restaurants and hotels sector; and the finance, insurance, real estate and business services sector. On the other hand, for such areas as Chinese medicine and nanotechnology, R&D investment of the private sector is negligible. As a result, it is not surprising to see that the R&D Centre for Information and Communications Technologies has made a quick and significant progress in funding R&D projects.

Table 1 Description of the Major Funding Schemes under the Auspices of the ITC

Scheme	Description	Notes
The Innovation and Technology Fund (ITF)	■ Launched in November 1999 with an injection of HK$5 billion. ■ To support projects that contribute to innovation and technology upgrading in industry, as well as those essential to the upgrading and development of industry ■ Four programmes under the ITF ◆ Innovation and Technology Support Programme ◆ University-Industry Collaboration Programme ◆ General Support Programme ◆ Small Entrepreneur Research Assistance Programme.	■ As at the end of January 2009, a total of 3,101 applications received requesting HK$15.7 billion funding; among them, 1,285 (HK$3.8 billion) approved. ■ Most of the funded projects related to information technology (30%); electrical and electronics (24%); and manufacturing technology (15%)
The Applied Research Fund (ARF)	■ A government-owned venture capital fund to support local technology ventures with commercial potential, with a capital of HK$750 million ■ Administered by the Applied Research Council (ARC), a private company wholly owned by the Government	■ As at the end of January 2009, 24 investments with funding of HK$392 million made ■ The investment period of the Applied Research Fund has expired in end March 2005 and the Fund has ceased making new investments.
The DesignSmart Initiative	■ Launched in June 2004, with HK$250 million ■ To strengthen government support for design and innovation, and to promote wider use of design and innovation in industries to help them move up the value chain ■ Two main elements: Financing a design support programme and setting up the InnoCentre as a one-stop shop for a design cluster	■ As at the end of January 2009, a total of 302 applications received; among them, 202 (HK$106.5 million) approved

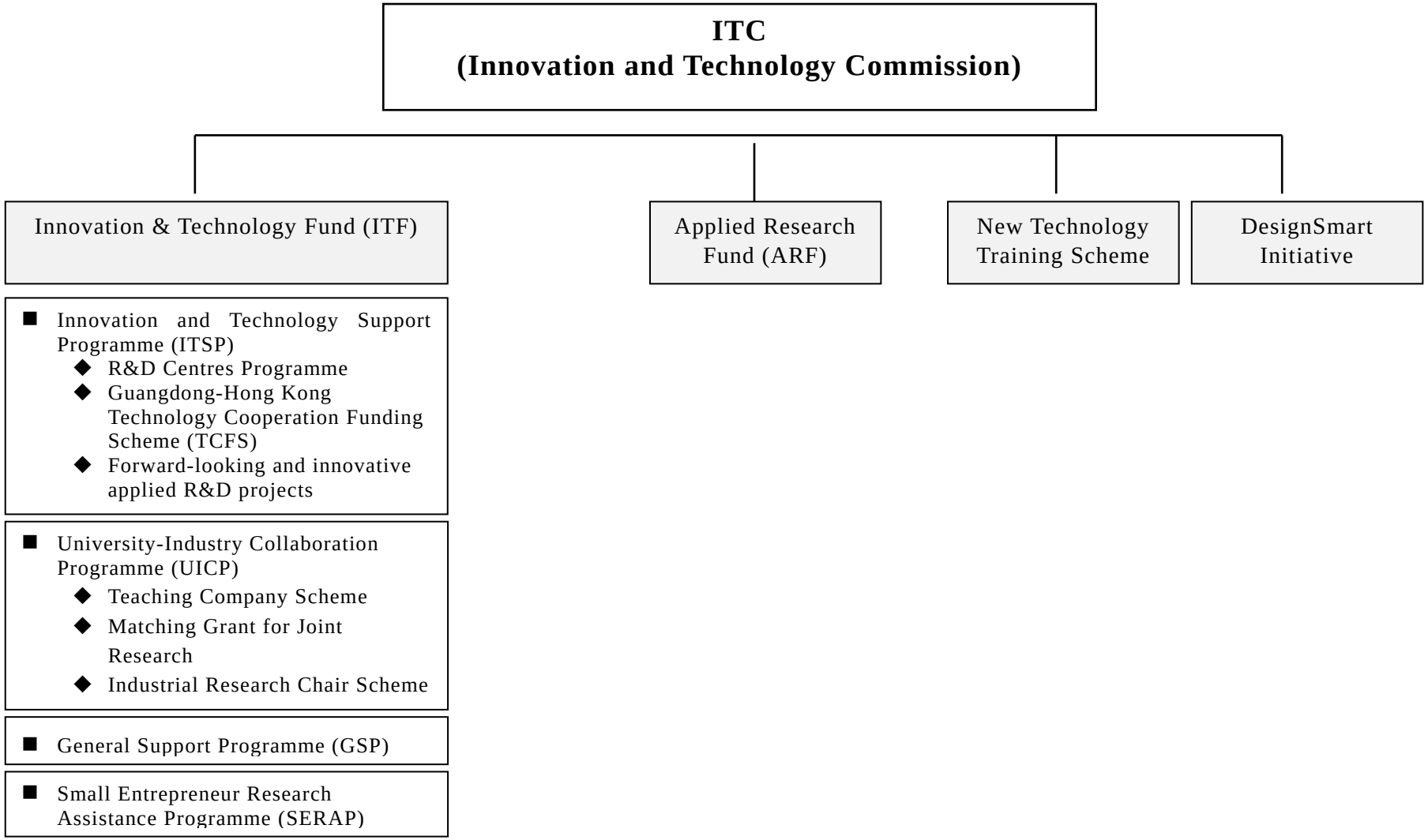


Figure 1 Structure of the Funding Schemes Administrated by the ITC

Table 2 Innovation and Technology Fund: Distribution of Approved Projects among Different Industrial Sectors (as at 30/9/2008)

	Programme									
	Innovation and Technology Support Programme		General Support Programme		University-Industry Collaboration Programme		Small Entrepreneur Research Assistance Programme		Total	
Industrial Sector	No	$mn	No	$mn	No	$mn	No	$mn	No	$mn
Biotechnology	77	236.3	5	2.8	37	62.9	23	22.6	142	324.4
Electrical and Electronics	225	1,120.3	3	2.8	37	31.6	74	76.1	339	1,230.9
Environmental	19	44.2	1	1	8	19.6	12	12.5	40	77.3
Information Technology	139	709	8	9.6	42	49.1	139	144.2	328	912.1
Foundation Industries	135	667.4	4	3.2	46	27.9	13	12.6	198	711.0
Textiles/Clothing/Footwear	55	223.5	1	0.4	5	3.3	4	3.2	65	230.4
General (Cross Sectors)	3	37.7	84	92.9	-	-	1	0.9	88	131.5
Others	6	20.9	10	17.0	-	-	10	8.3	26	46.1
Total	659	3059.3	116	129.7	175	194.3	276	280.4	1226	3663.7

Note: There may be a slight discrepancy between the sum of individual items and the total as shown in the tables owing to rounding.

Source:http://www.itf.gov.hk/eng/statistics/StatTable104View.asp?StatTypeId=104&StatId=517&StatCaption=Distribution+of+Approved+Projects+among+Different+Industrial+Sectors.

Table 3 Funding Indicators of the Major Funding Schemes under the Auspices of the ITC, 2006-2008

Indicators	2007 (Actual)	2008 (Actual)	**2009 (Estimate)**
ITSPΨ			
applications received and processed	137	192	**360#**
projects funded and being monitored	116	137	**172#**
TCFS			
applications received and processed	51	71	**61**
projects funded and being monitored	90	101	**111**
R&D centres' projectsϕ			
Automotive Parts and Accessory Systems R&D Centre			
new projects	9	12	**11**
projects funded and being monitored	9	21	**32**
Hong Kong R&D Centre for Information and Communications Technologies			
new projects	35	45	**62**
projects funded and being monitored	51	94	**124**
Hong Kong R&D Centre for Logistics and Supply Chain Management Enabling Technologies			
new projects	8	9	**14**
projects funded and being monitored	8	17	**31**
Nano and Advanced Materials Institute			
new projects	5	10	**31**
projects funded and being monitored	5	15	**46**
Hong Kong Research Institute of Textiles and Apparel			
new projects	13	15	**25**
projects funded and being monitored	13	28	**52**
ASTRI projects funded and being monitored^	25	9	**1**
PAG			
applications received and processed	131	103	**103**
projects funded	79	63	**63**

Ψ The figures do not include applications submitted by or projects undertaken by the five R&D centres and the ASTRI, which are reported under the indicators "R&D centres' projects" and "ASTRI projects funded and being monitored".

\# The projected increases are due to the planned additional calls for entry for ITSP in 2009.

ϕ All projects (including TCFS projects and feasibility studies) undertaken and/or monitored by R&D centres are included.

^ The figures do not include projects undertaken by the ICT R&D Centre hosted by the ASTRI, which are reported under the indicator "R&D centres' projects". Since 2007, all new ASTRI projects are undertaken by the ICT R&D Centre.

Source: *Government's 2009-10 Draft Estimates provided by ITC.*

4. Innovation Governance of Hong Kong Public R&D Funding

A central theme to the paper is the governance of Hong Kong's public R&D funding, which this section intends to address.

Public R&D Investment and Portfolio

It is widely perceived that R&D investment and R&D intensity in Hong Kong is quite low by international standards and compared to its peer economies, with its R&D intensity being as low as 0.81%. As a matter of fact, despite a publicized commitment by the government to the stepping-up of R&D activities, the R&D expenditure invested by the government did not grow until 2005, and even afterwards with a modest annual growth rate less than 8%. If Hong Kong's R&D investment keeps moving at the same pace or cannot manage to catch up with its neighbouring economies for years to come, Hong Kong will not become an innovation hub in the region.

As a matter of fact, China's R&D intensity reached 1.42% of GDP in 2006 and the Chinese government intends to increase R&D intensity to reach 2% of GDP by 2010. A closer look at the regional level within China, for such localities as Beijing and Shanghai, their R&D intensity in 2005 reached levels as high as 5.5% and 2.3% respectively; and even Guangdong had an R&D intensity of 1.1% (Blue Book of

China's Regional Development, 2007, p.12). Not to mention, its peer economies in Asia, like Taiwan and Singapore both have set a goal to raise R&D intensity to the 3% level by 2010.

More problematic is the way in which the government has spent the R&D expenditure. In our view, the resource allocation of public R&D in Hong Kong is intrinsically short-term. Although with strategic focuses, the R&D initiatives funded by the Hong Kong government are by and large short-term-oriented, dispersed and of reactive type focused on the individual programme-specific level. Hong Kong's public R&D lacks a long-term orientation and integrated R&D and innovation initiatives, or "innovation policy" in a broad sense. For example, although ASTRI is positioned to conduct applied R&D, due to the low innovation capabilities of traditional electronics SMEs in the Pearl River Delta, ASTRI has to develop technologies to an almost product-ready level, so that the recipient companies can apply the technologies developed directly to their production processes (Liu, 2008, p.5). Even ASTRI, the flagship research institute, admittedly is mainly doing development work, not genuinely forward-looking research because of the short time spans of the projects. In addition, not all of the R&D centres supported by the ITSP are truly engaged in R&D activities, with some of them functioning simply as a project office. As a result, the R&D Centres Programme remains a reactive source of

funding, even though the R&D centres currently have five years of funding.

In contrast, an important lesson from the OECD member countries has taught us that “Budgetary practices often promote short-term thinking and in some cases undermine strategic, long-term policy making” (OECD, 2005, p.8). As a result, efforts have been made in OECD countries to reduce fragmentation and to create critical mass and excellence in the public research sector. Initiatives in this area include ensuring or strengthening block grant funding mechanisms to support longer-term research, especially in catching-up economies, or renewing support for infrastructure and research equipment in more advanced countries (OECD, 2008, p.59).

Taking Finland as an example, the Finnish government has stepped up the model of centres of excellence by supporting a few Strategic Centres for Science, Technology and Innovation (otherwise known as SHOK). SHOKs provide a new way of coordinating dispersed research resources to meet targets that are important for Finnish businesses and society. In the individual strategic centres, companies, universities and research institutes will work together to formulate a jointly-agreed research plan. The plan will aim to meet the application needs for practical application by member companies within a 5-10-year period. In addition to shareholders and public funding organisations will commit themselves to providing funding for the centres in the long term. Another good example is Singapore’s “holistic” approach to

the development of a leading centre of excellence in biotechnology, which does not just involve funding initiatives but requires a good combination of vertical programmes and horizontal programmes for the strategic areas (Vonortas, 2008).

To go a step further, if Hong Kong is to become an innovation hub in the region, in a few selected areas, the government needs to facilitate the development of distinct capabilities and networking linkages that can prevail in the region or become a true centre of excellence. Indeed, with globalisation, support for clusters is also evolving with a view to creating world-class "nodes" to link to global innovation value chains rather than geographically bound clusters. Linkages and co-operation between regions both within and between countries are becoming more important" (OECD, 2008). TechMatrix Research Centre (2008) has argued that with appropriate policy reform Hong Kong can Leverage the "Extended Open Innovation" Business Model to become an innovation hub in the region. However, open innovation first coined by Henry Chesbrough (2003), as an antithesis of closed innovation, cannot be reduced to just a better practice for the routine innovation process (Chen, Lin, Yu and Wen, 2008). Professor Chesbrough (2008) has reminded us of the significance of architectures and systems and business model to the adoption of open innovation model. He argues:

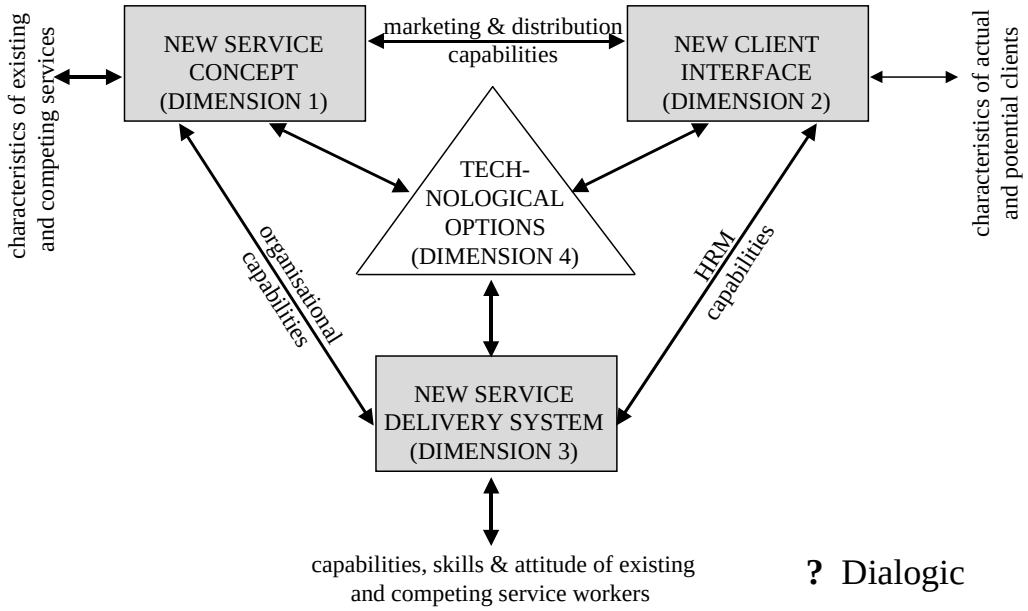
> “Open innovation processes combine internal and external ideas into architectures and systems. Open innovation processes utilize business models to define the requirements for these architectures and systems. Open innovation explicitly incorporates the business model as the source of both value creation and value capture. This latter role of the business model enables the organization to sustain its position in the industry value chain over time. ---Open innovation treats spillovers as a consequence of the company’s business model. These spillovers need not be a cost of doing business, they are an opportunity to expand a company’s business model, or to spin off a technology outside the firm to locate a different business model” (Chesbrough, 2008).

We therefore would like to argue that if the ITC and the research institutes in Hong Kong continue to devote most of their resources and efforts to short-term industry-oriented R&D or problem-solving adaptive R&D, it will not be possible for Hong Kong to become an innovation hub in the region. On the contrary, it is imperative for public R&D in Hong Kong to have a more balanced R&D portfolio, at least spending certain portion of the public R&D investment in long-term strategic topics that may involve new architectures and systems and business models, in which some of the Hong Kong-based firms have a role to play. However, for this kind of

R&D activity to take root in Hong Kong, particularly inside the research institutes, a more flexible governance relationship between the funding agencies and the research institutes is required.

In our views, the Hong Kong government should at least invest a certain portion of the public R&D expenditure in service innovation the systemic service innovation in particular, so that Hong Kong may build strength on strength and serve as a "testbed" for brand new service innovation. In this way, Hong Kong may be able to better serve its residents as well as China by leveraging indigenous innovation and local needs, and eventually export services to China and the rest of the world. To our knowledge, Hong Kong has managed to win the franchise bid to run an underground route in London. Hong Kong as a large metropolis creates sophisticated demand for urban services that can trigger service innovation. The success of the "Octopus Card", though based on Sony's technology, is a good example in this regard and it has expanded its usage coverage to Shenzhen. In addition, the plan to merge Hong Kong with Shenzhen to form a mega city in the future will be likely to pose challenging issues that will spur innovation. In fact, some professionals in Hong Kong endorse this idea of "testbed" and suggest that the digital TV services may provide a good chance for Hong Kong.

It is worth a while to note that systematic innovation of services entails large-scale transformation of the services as well as the goods involved. As demonstrated by den Hertog (2001), systemic service innovations require at least four elements in place, including new service concept, new client interface, new service delivery system and technological options, together to redefine the role of the key actor involved and to serve the new value proposition (see Figure 2). Therefore, when promoting systemic service innovations, the government needs to adopt a holistic and flexible approach, which will be different from that to the promotion of manufacturing-centric R&D or technology-centric initiatives.



Source: den Hertog (2001, p.4).

Figure 2 A Four Dimensional Model of Service Innovation

The Funding Mechanism and Institutional Arrangements

As vividly illustrated in the literature of national innovation systems (NIS), the way in which the diverse innovation actors of a national interact with one another within the NIS may be affected by the incentive schemes and institutional arrangements and may thus lead to different innovation performances (Freeman, 1987; Lundvall, 1992; Nelson, 1993; Chang, Liu and Yang, 2004). Therefore, even though the R&D initiatives orchestrated by the ITC have expanded the number of funding mechanisms and institutional arrangements, the way in which the research institutes interact with the funding agencies remains an issue of particular concern. Below we would like to discuss some of the relevant issues raised during our interviews in Hong Kong.

Though funded by different schemes, nearly all of the research institutes in Hong Kong are positioned to conduct industry-oriented applied research. The problem is that the funding schemes administrated by the ITC are by nature short term-oriented, dispersed and the reactive type, as discussed above. As a result, the research institutes are deficient in their R&D portfolio and short of capital for making strategic investment. Taking ASTRI as an example, its research projects are supposed to meet three conflicting criteria at the same time: innovative, with commercial value and with funding span from twelve to eighteen months. As a result, ASTRI tends to be

constrained to pursuing development work and/or me-too projects. This is compounded by the ITC's requirement of 10 % of industrial contribution basically for each project because the business sector in Hong Kong generally has a strong preference for short-term profitability.

In contrast, such a research institute as the ITRI in Taiwan, with financial support from the Department of Industrial Technology (DoIT) at the Ministry of Economic Affairs (MOEA), can propose and conduct long-term R&D projects of up to four or five years although annual reviews for checking progress are still conducted. In addition, DoIT's funding schemes for research institutes provide the latter with opportunities to conduct different types of research and/or strategic investment, ranging from pioneering technology research, the building-up of infrastructure required and large-scale R&D facilities in order to meet their long-term and strategic needs (see Table 4). More importantly, the assessment procedures can vary across different types of funding schemes. In particular, the assessment procedure for the Pioneering Technology Research Program is conducted by the ITRI itself[3] in order to provide appropriate room and flexibility for the formation of more creative projects.

[3] External and overseas reviewers with international reputation are called upon to serve on the assessment committee.

Table 4 The Types of Funding Schemes for Research Institutes, Administrated by the DoIT in Taiwan

(Unofficial Translation)

1. Pioneering Technology Research Program (獨立性創新前瞻計畫)
2.Key Technology Base Program (關鍵性計畫) (1) Forward-Looking R&D Program (創新前瞻類) (2) Key Technology/Product Program (關鍵技術/產品類) (3) Infrastructure-Building Program (環境建構類)
3.Large-scale R&D Facilities Program (獨立型環境建構計畫)

For the R&D schemes under the ITF, the ITC explicitly requires industrial sponsorship for each project, not less than 10% of the total project cost, with an aim to ensure industry-orientation. Local professionals, particularly those in the R&D centres and universities, consider this requirement troublesome and rigid. On the other hand, according to ASTRI, the ITC has shown some flexibility by allowing ASTRI to get an average of 10% from a number of projects rather than a full 10% for each project. In our view, the industrial sponsorship requirement is not as unreasonable as it looks, but the problem is that the ITC's R&D funding schemes for research institutes are not so diversified as the case of the DoIT in Taiwan. As a result, in response to such institutional arrangements, the research institutes in Hong Kong tend to focus on short term-oriented development work and/or me-too projects. In order for the research institutes to have sound and balanced R&D portfolio, we suggest the ITC to provide a wider variety of R&D schemes for the research institutes; some of the schemes could still demand industrial sponsorship, while others could allow the research institutes to

pursue strategic R&D even without industrial participation right from the beginning.

Some are uneasy with the regulation that approval from the Finance Committee of the Legislative Council is required for projects requesting more than HK$21 million from the ITF. The financial ceiling was increased from HK$15 million to HK$21 million only in October 2008. Moreover, research proposals have to go through five panels, including internal review, industrial review, technology review, ITC review and board of directors[4], plus the Legislative Council. This process is really too lengthy and may cost the projects time-to-market lead time. It is recommended that, as funding practices in many countries, the technology review committee should be given authority to make decisions, before reporting to the ITC for final approval.

Related to this, project management on the part of the ITC is often criticised. There is the impression that the ITC tends not to tolerate any changes in the projects. Outputs from the R&D projects are required to be specified beforehand, especially in terms of what patents are to be filed. Any changes in the projects require heavy paper work and approval from the ITC. This micromanagement induces rigidity and increases inefficiency in R&D work. It is therefore essential for the ITC to reduce administrative micromanagement. For example, changes in projects up to certain

[4] This is quoted from interviews by Douglas Fuller in June 2008.

extent should be allowed and endorsed mainly by the technology review committee rather the ITC. The way to evaluate the output, outcome and even impact of the R&D project also needs to be reconsidered. Some staff members of the R&D centres are particularly concerned with what criteria are to be used for evaluating their performances. As a matter of fact, the DoIT in Taiwan can even tolerate failures in some cases, because it evaluates the performance of the research institutes from a long-term perspective, especially regarding such a forward-looking and risky programme as the Pioneering Technology Research Program.

The way in which the government manages the R&D Centre Programme also draws criticism. It seems to us that not all of the R&D centres are truly engaged in R&D activities. Some of them function simply as a project office, creating an additional layer of bureaucracy between the ITC and the other innovation actors. To our understanding, except for the designated areas, the projects funded by the R&D centres are not that different from those funded by some other major schemes administrated by the ITC. We suggest that upon completion of their project time span, the ITC should conduct an intensive evaluation on the performance of the individual R&D centres. In particular, the ITC has to review the R&D centres' business plan, to be formulated by the centres and their major stakeholders, which should be in line with the ITC's long-term strategy, if any. Based on this, the ITC may have to make a

critical decision for the consolidation of the R&D Centres Programme in the near future. Consolidation may become even more necessary if we take into account the fact of a mismatch between public R&D and private R&D, especially in terms of the strategic areas selected by the ITC for the R&D Centre Programme. Alternatively, a more ambitious policy for the ITC to adopt is to follow the Finnish model of SHOKs or the holistic approach adopted by the Singapore government to the development of regional centre of excellence in biotechnology.

Another issue is about the shortage of dedicated professionals (technology managers) for the promotion of technology transfer on the part of the research institutions as well as the universities. According to ASTRI, its R&D personnel have to shoulder the work of R&D and the promotion of technology transfer at the same time. In Taiwan, not only do the research institutes have dedicated units for technology transfer and/or technology management, but DoIT also provides the research institutes with resources required through the Infrastructure-Building Program. It is therefore advisable for the ITC to step up its efforts in this regard. In addition, Hong Kong can also take advantage of the training and supporting system built by the Association of University Technology Manager (AUTM) in the US and/or the Association for University Research and Industry Links (AURIL) in the UK (Lee, 2006) to train and recruit the technology managers required.

5. Conclusions and Policy Recommendations

Hong Kong has begun to step up its efforts on R&D, but much remains to be done.

Since the turn of the century, R&D schemes and R&D projects funded by the ITC have grown in number, predominately through the ITSP, under the support of the ITF. The ITC has adopted a new three-tier structure for funding proposals under the ITSP since 2005. Tier 1 involves the establishment of R&D centres for the purpose of carrying out projects in their respective technology areas. Tier 2 involves the funding of project proposals submitted under the Guangdong-Hong Kong Technology Cooperation Funding Scheme (TCFS). Tier 3 involves the funding of more forward-looking and innovative R&D projects.

The six R&D centres are administrated by different host organizations but some of them at least are more like project offices, with limited in-house R&D capacity and a limited number of staff members. Out of the R&D centres, the R&D Centre for Information and Communications Technologies since 2006 has made a quick start and has funded a number of projects, while the other R&D centres only began to gather momentum from 2007, and are still far behind, with a limited number of projects funded. This may be linked to the mismatch between public R&D and private R&D,

especially in terms of the strategic areas selected by the ITC for the R&D Centre Programme.

The resource allocation of public R&D in Hong Kong is intrinsically short-term-oriented. Due to this orientation, the research institutes are deficient in their R&D portfolio and short of capital for making strategic investments. These deficiencies are compounded by the ITC's requirement of 10 % of industrial contribution basically for each project because the business sector in Hong Kong in general has a strong preference for short-term profitability. In our views, the industrial sponsorship requirement may not be as unreasonable as it looks, but the problem is that the ITC's R&D funding schemes for research institutes are not so diversified as the case of DoIT in Taiwan.

Above all, we would like to emphasis that if Hong Kong's R&D investment keeps moving at the same slow pace, Hong Kong will not become an "innovation hub" in the region. Also if the funding mechanism and institutional arrangements continue to operate based on administrative mindset, Hong Kong's innovation governance will be undermined. To solve the above problems from a long-term perspective, we suggest the Hong Kong government as a whole to follow the example set by its neighbouring economies to promulgate a Hong Kong version of "Science and Technology Basic Law" (Chang, Liu and Yang, 2004) that can accelerate public R&D investment with

"additionality" and the sound development of innovation governance[5].

Taken together, our policy recommendations for public R&D in Hong Kong are itemised as follows:

(1) It is imperative for public R&D in Hong Kong to have a more balanced R&D portfolio, at least spending a certain portion of the public R&D investment on long-term strategic research that may involve new architectures and systems and business models, in which some of the Hong Kong-based firms have a role to play. However, for this kind of R&D activity to take root in Hong Kong, particularly in the research institutes, a more flexible governance relationship between the funding agencies and the research institutes is required.

(2) The Hong Kong government should at least invest a certain portion of the public R&D expenditure in service innovation, particularly the systemic service innovation, so that Hong Kong may build strength on strength and serve as a "testbed" for brand new service innovation. In this way, Hong Kong may be able to better serve its residents as well as China by leveraging indigenous innovation and local needs, and eventually export services to China and the rest of the world.

[5] With particular reference to the Japanese version (MEXT, 2008), for example, in Article 7: "The government shall take the appropriate legislative, fiscal, financial and other necessary measures required to implement the policies with regard to the promotion of S&T"; in Article 9: "The Government shall establish a basic plan for the promotion of S&T in order to comprehensively and systematically implement policies with regard to the promotion of S&T." Such legal foundation may help gather momentum for Hong Kong to march towards an "innovation hub" in the region.

When promoting systemic service innovations, the government needs to adopt a holistic and flexible approach. This will be different from the approaches they adopt for the promotion of manufacturing-centric R&D or technology-centric initiatives.

(3) In order for the research institutes to have a sound and balanced R&D portfolio, we recommend the ITC to provide a wider variety of R&D schemes for the research institutes; some of the schemes could still demand industrial sponsorship, while others should allow the research institutes to pursue strategic R&D even without initial industrial participation.

(4) It is recommended that, following funding practices in many countries, the technology review committee should be given authority to make decisions, before reporting to the ITC for final approval. It is also essential for the ITC to reduce administrative micromanagement. For example, changes in projects up to a certain extent should be allowed and endorsed mainly by the technology review committee rather than the ITC.

(5) We recommend the ITC to conduct an intensive evaluation on the performance of the individual R&D centres, upon completion of their project time span. In particular, the ITC has to review the R&D centres' business plans, which should

be formulated by the centres and their major stakeholders, and should be in line with the ITC's long-term strategy. Based on this, the ITC may have to make a critical decision for the consolidation of the R&D Centres Programme in the near future.

(6) Hong Kong can take advantage of the training and supporting systems built by the Association of University Technology Manager (AUTM) in the US and/or the Association for University Research and Industry Links (AURIL) in the UK to train and recruit the technology managers required.

(7) We suggest the Hong Kong government as a whole to follow the example set by its neighbouring economies to promulgate a Hong Kong version of "Science and Technology Basic Law" that can facilitate the speeding-up of public R&D investment with "additionality" and the sound development of innovation governance.

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Appendix: A highlight of R&D in Hong Kong

Hong Kong has not been very active in R&D and technological innovation. Its R&D expenditures in 2006 amounted to HK$ 11.95 billion (about US$ 1.54 billion), accounting for 0.81% of GDP. This percentage is relatively low by international standards, lower than its major neighbouring economies, Taiwan (2.58%) and China (1.42%) in particular, and even much lower than a few other economies of similar size, such as Finland, Sweden, Israel and Singapore (TechMatrix Research Centre, 2008). However, a positive trend was the growing momentum of the private (business) sector in R&D investment. The business sector accounted for 53% of the total R&D expenditure in 2006, a substantial increase from 33% in 2002, and has overtaken the higher education sector to become the major R&D performing sector since 2005. On the other hand, the government sector, including the public technological supporting institutions, has played quite a minor role as an R&D performer, with its R&D share being as low as about 2.08% in 2006, though the government remains an important source of funds for R&D (see Table A.1 and Table A.2).

Of note is the fact that despite a publicised commitment by the government to the improvement of R&D activities, the R&D expenditure invested by the government either fluctuates over time or at most grows at a modest rate. Over the period 2002-2006, as shown in Table A.2, R&D expenditure from government had fallen from HK$4.736 billion in 2002 to HK$4.468 billion in 2004 and since then had grown at a rate of less than 8% annually.

A close look at R&D expenditure in the business sector by industry sector suggests there is a predominant role played by the service industry. As shown in Table A.3, in Hong Kong enterprises with R&D activities were mainly clustered in two broadly-defined industry sectors, namely, (1) the wholesale, retail and import and export trades, restaurants and hotels sector; and (2) the financing, insurance, real estate and business services sector. These two sectors contributed to 58% and 24% of the total R&D expenditure of the business sector respectively, followed at a distance by the manufacturing industry (6%). However, an extra part of R&D for manufacturing may be hidden in the wholesale, retail and import and export trades, restaurants and hotels sector because R&D activities in this sector are predominantly performed by trading firms with sub-contract processing arrangement. “This apparent peculiarity was in fact a feature in Hong Kong where many establishments previously engaged in manufacturing relocated their labour-intensive manufacturing processes to the mainland of China through sub-contract processing arrangement, leaving in Hong

Kong only the higher value added activities like product design and R&D" (HKCSD, 2008b, p.FA8). As for the financing, insurance, real estate and business services sector, R&D activities undertaken by the constituent firms were mainly related to information technology" (see Table A.4).

In addition, there seems to be a mismatch between public R&D and private R&D, especially in terms of the strategic areas selected by the ITC for the R&D Centre Programme, including automotive parts & accessory systems, information & communications technologies, logistics & supply chain management enabling technologies, nanotechnology & advanced materials, textiles & clothing, and Chinese medicine. As shown in Table A.4, the R&D expenditure in the business sector predominately concentrates on information technology (including information system & technology, computer hardware technology, computer software technology and communication technology) and electrical & electronic engineering technology, with these two areas contributing to 42.5% and 33.6% of the total private R&D respectively. On the other hand, for such areas as Chinese medicine and nanotechnology, the R&D investment of the private sector is negligible.

Table A.1 R&D Expenditure by Performing Sector, 2002-2006

Sector	R&D expenditure (HK$ million)				
	2002	2003	2004	2005	2006
Business	2,505.8	3,545.1	4,590.3	5,621.6	6,287.4
	<33%>	<41%>	<48%>	<51%>	<53%>
	[0.20%]	[0.29%]	[0.36%]	[0.41%]	[0.43%]@
Higher education	4,800.7	4,796.2	4,707.3	5,085.0	5,410.9
	<64%>	<56%>	<50%>	<47%>	<45%>
	[0.38%]	[0.39%]	[0.36%]	[0.37%]	[0.37%]@
Government	237.1	207.5	207.6	215.2	248.6
	<3%>	<2%>	<2%>	<2%>	<2%>
	[0.02%]	[0.02%]	[0.02%]	[0.02%]	[0.02%]@
Total	7,543.6	8,548.8	9,505.2	10,921.8	11,946.9
	<100%>	<100%>	<100%>	<100%>	<100%>
	[0.59%]	[0.69%]	[0.74%]	[0.79%]	[0.81%]@

Notes: Figures in < > represent the percentages to total. The percentages in a year may not add up to 100 due to rounding.

Figures in square brackets represent the ratios to GDP. The GDP estimates are based on the data on expenditure-based GDP estimates at current prices released on 27 February 2008.

@ Figures are subject to revision later on.

Source: Adapted from HKCSD (2008a).

Table A.2 R&D Expenditure by Source of Funds, 2002-2006

Source of funds		R&D expenditure (HK$ million)				
		2002	2003	2004	2005	2006
Local parties						
	Business sector	2,655.3	3,641.9	4,538.3	5,786.7	6,304.1
		<35%>	<43%>	<48%>	<53%>	<53%>
	Government sector	4,736.6	4,704.3	4,467.8	4,816.7	5,151.4
		<63%>	<55%>	<47%>	<44%>	<43%>
	Higher education sector	14.9	22.2	5.7	48.4	25.4
		<0.2%>	<0.3%>	<0.1%>	<0.4%>	<0.2%>
	Others	7.4	1.6	7.4	0.8	2.2
		<0.1%>	<§>	<0.1%>	<§>	<§>
Parties outside Hong Kong		129.4	178.9	486.0	269.1	463.8
		<2%>	<2%>	<5%>	<2%>	<4%>
Total		7,543.6	8,548.8	9,505.2	10,921.8	11,946.9
		<100%>	<100%>	<100%>	<100%>	<100%>

Notes: Figures in < > represent the percentages to total. The percentages in a year may not add up to 100 due to rounding.

§ Less than 0.05%.

Source: Adapted from HKCSD (2008a).

Table A.3 R&D Expenditure in the Business Sector by Industry Sector, 2002-2006

Industry sector	R&D expenditure (HK$ million)				
	2002	2003	2004	2005	2006
Manufacturing	481.9	406.1	587.1	471.3	369.0
	<19%>	<11%>	<13%>	<8%>	<6%>
Wholesale, retail and import and export trades, restaurants and hotels	936.3	1,255.6	2,310.8	2,541.9	3,676.1
	<37%>	<35%>	<50%>	<45%>	<58%>
Financing, insurance, real estate and business services	552.8	1,493.7	1,299.2	2,184.4	1,528.5
	<22%>	<42%>	<28%>	<39%>	<24%>
Others	534.8	389.7	393.1	424.0	713.8
	<21%>	<11%>	<9%>	<8%>	<11%>
Total	2,505.8	3,545.1	4,590.3	5,621.6	6,287.4
	<100%>	<100%>	<100%>	<100%>	<100%>

Notes: Figures in < > represent the percentages to total. The percentages in a year may not add up to 100 due to rounding.
Source: Adapted from HKCSD (2008a).

According to the 2007 Annual Survey of Innovation Activities in the Business Sector conducted by HKCSD (2008b), the business sector in Hong Kong is engaged substantially in R&D outsourcing. In 2007, a total of HK$3,223.7 million was spent by this sector in R&D outsourcing, with its size accounting for more than half the total business R&D expenditure. The wholesale, retail and import and export trades, restaurants and hotels sector as a whole not only was involved substantially in R&D outsourcing but also spent 93.9% of the total expenditure for outsourced R&D activities (HK$ 2,442.5 million) to parties outside Hong Kong (see Table A.5). This type of R&D outsourcing also accounted for about 74.8% of the total expenditure for outsourced R&D activities by the financing, insurance, real estate and business services sector, the second largest R&D performing business sector. Table A.6 goes further to show the geographical and organizational patterns of the performing parties of the outsourced R&D concerned. It is apparent that an intra-corporate cross-border network, especially within the PRD Economic Zone, is the dominant type of R&D outsourcing to be adopted by the Hong Kong-based firms/establishments. This is consistent with the above-mentioned significance of Hong Kong-based trading firms with sub-contract processing arrangement in the wholesale, retail and import and export trades, restaurants and hotels sector.

In terms of R&D cooperation arrangements, the geographical and organizational

patterns of the performing parties are somewhat different. Public technology support organizations in Hong Kong, such as ASTRI and Hong Kong Productivity Council (HKPC) seem to play a more active role in the Hong Kong-based firms' R&D cooperation arrangements than the case of R&D outsourcing. According to the survey mentioned above, out of 1,339 establishments with R&D cooperation arrangements, 234 respondents (17.5%) teamed up with public technology support organizations in Hong Kong; relatively few of them cooperated on R&D with public technology support organizations outside Hong Kong. On the other hand, for the Hong Kong-based firms their cooperative partners of higher education institutions (HEIs) seem to be more geographically dispersed, not mainly concentrated in Hong Kong (see Table A.7).

Table A.4 Total Expenditure for in-House R&D activities in 2007 by Technology Area by Industry Sector

(HK$ million)

	Technology area												
	Information technology												
	Information system and technology	Computer hardware technology	Computer software technology	Com-munication technology	Subtotal	Electrical & electronics engineering technology[@]	Manu-facturing technology	Bio-technology	Chinese medicine	Nano-technology	Advanced materials technology	Others	Total[(1)]
By industry sector													
Manufacturing	25.7	47.6	27.0	8.1	108.3	201.0	220.2	4.3	3.8	3.9	49.9	0.1	591.5
	<4.3%>	<8.0%>	<4.6%>	<1.4%>	<18.3%>	<34.0%>	<37.2%>	<0.7%>	<0.7%>	<0.7%>	<8.4%>	<#>	<100.0%>
Wholesale, retail and import and export trades, restaurants and hotels	60.0	126.1	189.4	273.2	648.8	1,410.8	448.9	31.6	0.0	45.1	156.3	0.0	2,741.4
	<2.2%>	<4.6%>	<6.9%>	<10.0%>	<23.7%>	<51.5%>	<16.4%>	<1.2%>	<0.0%>	<1.6%>	<5.7%>	<0.0%>	<100.0%>
Financing, insurance, real estate and business services	616.5	189.6	610.2	146.9	1,563.2	399.3	32.9	65.5	1.4	14.8	92.9	2.2	2,172.3
	<28.4%>	<8.7%>	<28.1%>	<6.8%>	<72.0%>	<18.4%>	<1.5%>	<3.0%>	<0.1%>	<0.7%>	<4.3%>	<0.1%>	<100.0%>
Others	68.5	25.3	76.9	80.9	251.7	26.1	10.4	238.5	0.5	0.1	0.9	21.1	549.4
	<12.5%>	<4.6%>	<14.0%>	<14.7%>	<45.8%>	<4.8%>	<1.9%>	<43.4%>	<0.1%>	<#>	<0.2%>	<3.8%>	<100.0%>
Total	770.7	388.6	903.5	509.2	2,572.0	2,037.2	712.5	339.9	5.8	63.9	299.9	23.4	6,054.6
	<12.7%>	<6.4%>	<14.9%>	<8.4%>	<42.5%>	<33.6%>	<11.8%>	<5.6%>	<0.1%>	<1.1%>	<5.0%>	<0.4%>	<100.0%>

Note: (1) Figure include expenditure for in-house R&D activities conducted by a local party for itself and / or for other organisation.

Figure less than 0.05%.

@ Electrical and electronics engineering technology associated with (a) computer hardware (such as integrated circuits) was included in the area of computer hardware technology; (b) communication technology was included in the area of communication technology.

Source: Adapted from HKCSD(2008b).

Table A.5 Total Expenditure for Outsourced R&D Activities in 2007 by Outsourced Party by Industry Sector

(HK$ million)

	Expenditure for outsourced R&D activities to local parties	Expenditure for outsourced R&D activities to parties outside Hong Kong	Total expenditure for outsourced R&D activities
By industry sector			
Manufacturing	22.6	13.5	36.1
	<62.6%>	<37.4%>	<100.0%>
Wholesale, retail and import and export trades, restaurants and hotels	149.1	2,293.4	2,442.5
	<6.1%>	<93.9%>	<100.0%>
Financing, insurance, real estate and business services	137.6	408.8	546.3
	<25.2%>	<74.8%>	<100.0%>
Others	120	78.7	198.7
	<60.4%>	<39.6%>	<100.0%>
Total	429.3	2,794.4	3,223.70
	<13.3%>	<86.7%>	<100.0%>

Source: Adapted from HKCSD (2008b).

Table A.6 Total Expenditure for Outsourced R&D Activities in 2007 by Performing Party and Source of Funds

(HK$ million)

Type of organization	Party performing R&D activities		Source of funds: Outsourced to local parties		Source of funds: Outsourced to parties outside Hong Kong	
Local parties						
Self-financed	-	(-)	310.1	<72.2%>	2607.5	<93.3%>
Government	11.9	<0.4%>	46.7	<10.9%>	8.7	<0.3%>
Public technology support organisations	28.1	<0.9%>	-	<->	-	<->
Higher education institutions	47.9	<1.5%>	0.7	<0.2%>	0.0	<0.0%>
Other business firms within an establishment's own enterprise group	136.4	<4.2%>	16.1	<3.8%>	8.9	<0.3%>
Business firms outside an establishment's own enterprise group	204.9	<6.4%>	54.3	<12.6%>	1.4	(#)
Others	0.1	(#)	0.0	<0.0%>	0.0	<0.0%>
Parties outside Hong Kong						
Other business firms within an establishment's own enterprise group	2,025.9	<62.8%>	0.9	<0.2%>	101.2	<3.6%>
Business firms outside an establishment's own enterprise group	758.0	<23.5%>	0.5	<0.1%>	66.7	<2.4%>
Others	10.5	<0.3%>	0.0	<0.0%>	0.0	<0.0%>
Total	3,223.7	<100.0%>	429.3	<100.0%>	2,794.4	<100.0%>

Notes: - Not applicable.

Figure less than 0.05%.

Source: Adapted from HKCSD (2008b).

Table A.7 Distribution of Establishments with R&D Activities in 2007 by the Types and location of Their Cooperation Arrangements

Whether having cooperation arrangements on R&D activities with other organisations/Type of cooperation organisation[1]	No. of establishments having undertaken R&D activities	Location of cooperation organisation [1]					
			The mainland of China and Macao				
		HK	Pearl River Delta (PRD) Economic Zone[2]	Pan-PRD Region[3] other than PRD Economic Zone and HK	Other regions	Places outside HK, the mainland of China and Macao	Overall
Having cooperation arrangements on R&D activities with other organisations	**1339**						
	[27.5%]						
Government	43	0	0	0	1	44
	<3.2%>	<0.0%>	<0.0%>	<0.0%>	<0.1%>	<3.3%>
Public technology support organisations[4]	234	28	0	1	25	259
	<17.5%>	<2.1%>	<0.0%>	<0.1%>	<1.9%>	<19.3%>
Higher education institutions	169	114	112	10	9	284
	<12.6%>	<8.5%>	<8.4%>	<0.7%>	<0.7%>	<21.2%>
Other business firms within an establishment's own enterprise group	40	213	3	56	44	336
	<3.0%>	<15.9%>	<0.2%>	<4.2%>	<3.3%>	<25.1%>
Business firms outside an establishment's own enterprise group	405	224	5	49	188	636
	<30.2%>	<16.7%>	<0.4%>	<3.7%>	<14.0%>	<47.5%>
Private non-profit organisations and others	7	107	107	0	116	230
	<0.5%>	<8.0%>	<8.0%>	<0.0%>	<8.7%>	<17.2%>

Whether having cooperation arrangements on R&D activities with other organisations/Type of cooperation organisation[1]	No. of establishments having undertaken R&D activities	Location of cooperation organisation [1]					
			The mainland of China and Macao				
		HK	Pearl River Delta (PRD) Economic Zone[2]	Pan-PRD Region[3] other than PRD Economic Zone and HK	Other regions	Places outside HK, the mainland of China and Macao	Overall
Overall		751	574	120	96	373	
		<56.1%>	<42.9%>	<9.0%>	<7.2%>	<27.9%>	
Not having cooperation arrangements on R&D activities with other organisations	**3,525**						
	<72.5%>						
Total	**4,864**						
	<100.0%>						

Notes: (1) May select more than one organisation and/or location.

(2) The Pearl River Delta (PRD) Economic Zone covers urban area of 14 cities and counties including Guangzhou, Shenzhen, Zhuhai, Foshan, Jiangmen, Dongguan, Zhongshan, Huizhou City, Huiyang county, Huidong county, Poluo county, Zhaoqing City, Gaoyao and Sihui.

(3) The Pan-PRD region covers Fujian, Jiangxi, Hunan, Guangdong, Guangxi, Hainan, Sichuan, Guizhou, Yunnan as well as Hong Kong and Macao. Cooperation arrangements with PRD Economic Zone and Hong Kong are excluded in this column.

(4) Examples are Hong Kong Productivity Council (HKPC), Hong Kong Applied Science and Technology Research Institute Company Limited (ASTRI), Hong Kong Jockey Club Institute of Chinese Medicine Limited (HKJCICM) and R&D Centres.

Figures in square brackets represent the percentages to total no. of establishments having undertaken R&D activities.

Figures in round brackets represent the percentages to total no. of establishments having cooperation arrangements on R&D activities with other organisations.

Source: Adapted from HKCSD (2008b).