

Hong Kong Innovation Project

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Hong Kong, Manufacturing, and General R&D

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There was a time when Hong Kong was associated with cheap manufactured goods such as toys, low-end electronics, and garments, but this was well over two decades ago. In the last two decades, Hong Kong has undergone a remarkable transformation. The factories moved north when rising costs in Hong Kong made manufacturing uncompetitive, and the territory became a high-end service centre dominated by gleaming office towers and shopping malls. Although the transformation of Hong Kong has been remarkably successful, the ever increasing capabilities within Mainland China create the potential that the competitive advantage of Hong Kong will decline over time.

The premise of this report is that Hong Kong should be wary of relying too heavily on its core strengths, and that there is an urgent need to cultivate a “core” of technology competencies. In this context, the subject of this chapter, “general” research and development (R&D), might seem like a strange topic for inclusion in a book on innovation in Hong Kong. General R&D is a catch-all category that is defined primarily by *not* being high-tech. It does not include any of the activities that are normally associated with a centre of innovation; it is not biotech, IT, software, integrated circuits, or any of the other sectors that are likely to quicken the pulse of a techno-nationalist. It is most applicable to what might be called mid-technology industries (or activities within an industry), those that involve innovation capabilities that are not based on pure science, but also involve production and project execution skills that require more than low-cost labour. Process and product innovation in these industries tends to be incremental rather than radical, and technology is widely available (for a price) from global suppliers (Berger and Lester 1997: 325). General R&D activities in Hong Kong often support the “traditional” manufacturing industries

that Hong Kong has been abandoning for two decades. Given that the firms that are involved in these activities are overwhelmingly located in Mainland China and the number of people they employ in Hong Kong is kept to a bare minimum, supporting these industries would appear to have very little impact on Hong Kong itself.

Although supporting general manufacturing might appear to be anachronistic, in this chapter I will argue that, much to the contrary, support for traditional manufacturing should be a crucial element of Hong Kong's upgrading strategy. The argument will be made in three parts. The first section of the paper explains the linkages between Hong Kong and the manufacturing that takes place in the Pearl River Delta (PRD). This is a topic that has been the topic of extensive previous research, particularly in the mid-1990s, and like some of these studies, I will also argue that manufacturing in the PRD is crucial to the economic health of Hong Kong because it supports producer-related service in Hong Kong. There have been two key changes in the last decade, however: a) the continued blurring of the distinction between a Hong Kong firm and a Mainland firm; and b) the urgency of the upgrading challenge in the PRD as costs rise in the region. As a result of these two trends, I will argue that it makes little sense to distinguish between Hong Kong and Mainland firms in the PRD; the objective should be to promote the economic well-being of the regional economy (of which Hong Kong is the core service centre). The second section of the paper analyzes potential strategies for upgrading in manufacturing and the role of government-funded research centres in this process. The final section discusses the policy implications.

I. Hong Kong and the Regional Economy

Hong Kong is one of the most service-oriented economies in the world, with the tertiary sector accounting for 90.7% of GDP in 2005 (Enright, Scott et al. 2007: 66). This was not always the case. Hong Kong made a rapid transition from an entrepôt economy to a manufacturing economy after the United Nations imposed an embargo on trade with China in June 1951 and within a decade the manufacturing sector employed 40% of the workforce and contributed one-fourth of GDP (Berger and Lester 1997: 19). Industrialization in Hong Kong was driven by small and medium-sized enterprises (SMEs) that began with labour intensive products that were exported to foreign markets and gradually upgraded into more sophisticated products and markets; the electronics industry barely existed in 1960, but produced almost one-fifth of Hong Kong's industrial output in 1980. Three decades after World War II, Hong Kong was the largest exporter of manufactured goods in the developing world (Berger and Lester 1997: 20-21). But the success of manufacturing in Hong Kong sowed the seeds of its own demise, and as wages and the cost of land increased, manufacturing operations shifted to the PRD. By the turn of the century manufacturing in Hong Kong was producing only 5.9% of GDP and employing 10.4% of the workforce (Hong Kong Policy Research Institute 2003).

Despite the decline of manufacturing within Hong Kong, numerous studies in the 1990s made the point that manufacturing continued to be of vital importance to the Hong Kong economy. *Made by Hong Kong*, a study conducted by a team of MIT researchers, argued that distinguishing between manufacturing and service activities was a statistical fiction because large numbers of service firms in Hong Kong were actually engaged in manufacturing in China and many other service firms were deeply

reliant on the manufacturing firms that rely upon their services. The important distinction was between consumer services (such as tourism, restaurants, retail trade, retails banking, health care, etc.) and producer services that provide intermediate inputs in production value chains such as design, logistics, and finance (Berger and Lester 1997: 28-29). Tao and Wong, making a similar distinction, attempted to divide out the different types of services, and document a gradual increase in producer-related services as a percentage of GDP over the course of the 1990s (2002: 2349). By 2000, manufacturing in Hong Kong had declined to only 5% of real GDP, but as Table 1 indicates, producer-related services had increased to almost 50% of real GDP. In short, the steady decline of manufacturing in Hong Kong during the 1980s and 1990s was mirrored by the increasing importance of manufacturing by Hong Kong firms in the PRD and service activities within Hong Kong to support these operations.

If the manufacturing operations of Hong Kong firms in the PRD support higher value-added service activities in Hong Kong, the primary public policy challenge is insuring that Hong Kong retains its competitive advantage in both services (in Hong Kong) and manufacturing (in China). The former requires a strengthening of the infrastructure (both physical and institutional) that supports producer services. The latter requires the development of capabilities in industry, government, and the education community that will allow firms to move from low-end production into higher value-added activities. *Made by Hong Kong*, for instance, provided detailed recommendations on the changes and investments that firms must make to create the capability to move into design activity or brand-name production, that educational institutions must make to ensure that they are providing the supply of appropriately trained managers, designers, and engineers that firms require, and that

government must make to ensure that officials have the have the technical capabilities required to oversee this industrial transformation (1997: Chapter 7).

How has the situation changed over the course of the last decade? First, it is becoming increasingly difficult to distinguish a Hong Kong operation in the PRD from a domestic Mainland operation. As has been the case for a long time, many firms are traders in Hong Kong and manufacturers in the Mainland—there were 123,000 manufacturing and trading companies in Hong Kong in 2002 and 63,000 (or 53%) of these firms had manufacturing operations on the Mainland (HKCER 2007: 15)—but there have been subtle shifts in the nature of these linkages. A survey of firms located in the PRD that was conducted in 2005 and 2006 indicates the “shop in the front and factory in the back” model, in which there was a clear division of labour between a Hong Kong head office and PRD manufacturing facilities, is gradually becoming less prevalent.¹ 45.8% of firms surveyed had no office in Hong Kong, and the ratio of Hong Kong employees to Mainland employees in these companies has steadily declined. In 2002, the ratio was one Hong Kong employee for every 120 Mainland employees; in 2006, the ratio was 1 to 170 (HKCER 2007: 66 and 76.). After three decades of development, Hong Kong firms are now able to find workers in the PRD to perform tasks that formerly had to be carried out in Hong Kong, and like their domestic Chinese rivals, they will keep employment in Hong Kong to an absolute minimum.² In fact, the distinction between Hong Kong and Mainland firms has become quite blurry. Nearly half of the enterprises in the PRD that are Hong

¹ The HKCER survey was conducted between 20 September 2005 and 10 March 2006. Surveys of firms that responded to initial contacts were conducted by surveyors based on a questionnaire. There were ultimately 2,529 valid questionnaires. For further details on the survey see HKCER 2007: 45.

² One of the surprising results of the HKCER survey in 2005-2006, for instance, is that fewer surveyed firms were conducting financial management in Hong Kong (27.8%) than in Guangdong (31.4%). 30-40% of surveyed firms assigned the responsibilities for financial management, IT management, R&D and logistics equally between their Hong Kong offices and PRD factories (2007: 69).

Kong-funded enterprises or closely related to Hong Kong are now registered as domestic Mainland firms rather than foreign-invested firms (HKCER 2007: 110).

Second, there have been changes in the activities that Hong Kong firms undertake on the Mainland. This is partly a result slight of a shift in the competitive advantage of Hong Kong firms. In the 1980s, a Hong Kong firm was able to respond to rising costs in Hong Kong by serving as a middleman: foreign customers were not comfortable operating on the Mainland and Mainland firms were not familiar with the demands of foreign markets. Over time, the need for a Hong Kong intermediary has decreased. Many foreign retailers and brands such as Wal-Mart and Dell have established large and centralized purchasing operations on the Mainland (and often they are not in the PRD); many Chinese suppliers are comfortable directly supplying foreign customers (HKTDC 2008). The response of Hong Kong firms has been to increase the scope of their business activities. According to a survey conducted by the Hong Kong Trade and Development Council (HKTDC), compared to 10 years ago, 67% of surveyed companies had increased quality control activities, 62% had increased sales and marketing activities, 58% had increased product design and development, 51% increased product procurement, and 50% increased corporate social responsibility activities (HKTDC 2008).³ By moving towards a “full-package” of services, these firms increase their value in the global value chain. Hong Kong firms have also been increasingly focused on new market opportunities within China. The HKTDC survey (2008) indicated that almost half of surveyed firms believe that they will establish or expand their presence in the Mainland market over the next three years compared to only a quarter that intended to expand their presence in

³ In this survey a total of 2,230 valid replies were received. 38% were from traders and 62% from manufacturers-cum-traders. About two-thirds of respondents had engaged in trading business for 10 years or more. As is true of Hong Kong trading companies overall, most of the surveyed firms were SMEs: 40% of the respondents handled goods worth less than HK\$10 million, 50% between HK\$10 million and HK\$100 million, and the remaining 10% over HK\$100 million .

overseas markets. These firms believe that they have a competitive advantage in the Chinese market vis-à-vis foreign firms, and they intend to exploit this advantage to the fullest.

Although these shifts might appear to represent a de-linking of Hong Kong from the manufacturing operations in the PRD, there is little evidence of this. As Figure 1 indicates, regardless of whether a firm had operations in Hong Kong, there is still a strong likelihood of utilizing Hong Kong producer-services, particularly those related to import/export services, logistics, and customer relationship management. Demand for Hong Kong producer services is not a function solely of Hong Kong-owned firms utilizing these services, and it is not solely a function of manufacturing operations having a Hong Kong-based head office. Demand is created by the efficiency of these services and the potential savings that can be created for the manufacturing operations that utilize them. The Hong Kong government and the companies that provide producer-related services must continue to ensure that Hong Kong has a competitive advantage in these areas, but this is a familiar challenge, and one that Hong Kong has faced for over a decade.

The most important challenge facing Hong Kong manufacturing firms is not that they will cease to utilize Hong Kong producer-related services as they become more integrated; it is that they will no longer be competitive in the PRD. Costs have been rising dramatically in the PRD over the last five years.⁴ Firms in the region describe a perfect storm of rising costs. First, wages and the cost of worker benefits have been rising steadily. The minimum wage in Guangdong as a whole increased by an average of 12.9% in April 2008; the minimum wage in Shenzhen increased as much as 17.6% (see Table 2). Factories have been trying to limit the amount of

⁴ The data in this paragraph is from HKTDC 17/09/08.

overtime, in order to decrease the wage bill, and this has made it difficult to attract new workers (Interview 220708a). Second, the renminbi (RMB) has steadily appreciated. Between June 2005 and July 2008, the RMB appreciated 20% against the dollar and 18% against the yen. If an export-oriented firm in the PRD sources 30 to 50% of its inputs (by value) domestically—which survey data suggests is a typical amount—a 10% appreciation in the RMB amounts to a 3 to 5% increase in production costs. Finally, energy and commodity prices have been rising rapidly.

A Hong Kong firm in the PRD that is faced with rising costs has multiple options, and although the overwhelming choice of firms is to upgrade the level of technology and raise the value-added of their product, they continue to have limited capacity to do so. In the survey of Hong Kong firms with manufacturing facilities in the PRD conducted by the HKTDC, 22.5% of responding firms indicated that they intended to scale down PRD operations and 3.1% planned to shut PRD operations. By comparison, 53.3% intended to upgrade technology and increase the value-added of their products and 29.9% intended to increase the mechanisation of their operations (HKTDC 05/09/08). As the manager of Firm A (a Hong Kong electronics firm) ruefully commented, the pressure of rising costs in the PRD is remarkably similar to the pressures that had prompted the firm to re-locate production facilities from Hong Kong to the PRD in the 1980s (Interview 180908b) and this time the response has to be different. If the firm moves to a low-cost site in the interior, it will run into the same exact problem in another three to five years.

The problem is that there is little indication that these firms have the capacity to move into higher-value added activities. According to the HKCER survey of firms in Guangdong (see footnote 1), 65.1% of surveyed firms continue to be engaged in exclusively OEM activities and only slightly over 15% were ODM or OBM (see

Table 3). Even more telling is that 65% of the surveyed firms in Guangdong do not carry out any research and development activities, a strong indication that these firms are engaged in low technology activities (HKCER 2007: 95). These are exactly the activities that will face the most difficulties as costs in the region increase. At the end of the 1990s, Firm A could consistently make profit margins of 10% in electronic manufacturing services. At this time wages were 600-700 RMB per month (and there was no insurance). In 2008, the profit margins were rarely higher than 3% for the same activities. Wages are 1600 to 2000 RMB per month (plus insurance) and overtime has increased from 1.1 times the normal wage to 1.5 times on a weekday and 2 times on a weekend. The Japanese electronic gaming company that is the primary customer requests a 2 to 3% price reduction per year (Interview 180908b).

A related problem is that as the process of industrialisation in the PRD broadens and deepens, the industrial profile of the province is shifting away from light industry and the export processing activities that favoured Hong Kong firms, and shifting towards higher-value added industry. Three of the primary targeted industries in Guangdong, for instance, are electronic information, petrochemicals, and the automotive industries. Shenzhen dominates in the electronic information industry, Guangzhou is dominant in automotive, petrochemical, and chemicals, and both Foshan and Shenzhen play key roles in electrical machinery and special purpose equipment (HKCER 2007: 37 and 40). Between 2001 and 2005, the industry with the fastest growing industrial output value was the automotive industry (see Table 4). Increasingly, the light industry will move further inland, where labour costs are lower, and this will move them further from the producer-services in Hong Kong.

In summary, any public policy that has the objective of supporting Hong Kong manufacturing must define Hong Kong manufacturing broadly. In addition to Hong

Kong firms, the target must be the entire PRD geographic region. This is partly in recognition of the simple fact that it is increasingly difficult to distinguish between Hong Kong and Mainland firms in the PRD and partly in recognition of the fact a Mainland firm might be equally likely to use Hong Kong's producer services as a Hong Kong firm. The policy approach must also be sure to promote capability-building that is relevant to the rapidly evolving industrial structure in Guangdong.

II. Upgrading Hong Kong Manufacturing

Hong Kong has its fair share of globally competitive manufacturing firms. Esquel, for instance, is one of the world's leading textile and apparel producers. A high degree of vertical integration—from cotton growing in Xinjiang to spinning, weaving, dyeing, manufacturing, and packaging—enable it to control every step of the production process, and make it a valuable supplier leading global brands and retailers. The strength of the company is the breadth of its international customer base, its understanding of customer needs, and its ability to control every step of the production process in order to satisfy these needs. TTI is a leading producer of consumer and professional products marketed to the home improvement and construction industries. It began as an OEM supplier, then moved to ODM relationships with large US retailers, and then began to purchase global brands. These brands include Milwaukee, AEG and Ryobi power tools and accessories, and Hoover, Dirt Devil and Vax floor care appliances. It has a global design process that integrates the efforts of design centres in the United States, Hong Kong, and the PRD. These are global companies that happen to be based in Hong Kong.

The vast majority of Hong Kong manufacturing companies, however, are in a very different category. As Baark and Sharif (2006: 205) point out, small and

medium sized enterprises (defined as non-manufacturing firms with less than 50 employees and manufacturing firms with less than 100 employees) accounted for 98% of the total number of enterprises in Hong Kong in September 2004. These firms are much less likely to undertake design activities or develop brands. As Table 3 indicates, the vast majority of Hong Kong firms are engaged exclusively in OEM activities. These firms are commonly criticized for taking a short-term approach; they have always made money in OEM activities and hence it is difficult to persuade them to make the investments necessary to shift to ODM or OBM activities. One firm, for instance, described how its effort to develop its own brand in the home appliance sector was blocked by its OEM customers. These customers did not want a potential rival, and without the necessary sales channels or the full range of products demanded by a big box store in the United States, the Hong Kong firm was forced to retreat to ODM. Even a company as large and successful as Goldpeak has found it difficult to move into OBM. It does well in Hong Kong and China, but has little hope of developing a brand in Western countries. Batteries are essentially commodities, and the core competency of Western brands is marketing and branding.

The Hong Kong government is keenly aware of the challenges that face these local manufacturing firms, and as part of the broader effort to support the development of high technology industries in Hong Kong, it has been making an effort to promote the upgrading efforts of these firms. At the core of these efforts are the five R&D facilities that were established in 2005 and 2006, two of which focus on mid-range technologies for traditional manufacturing firms: the Automotive Parts and Accessory Systems Centre (APAS) hosted by the Hong Kong Productivity Council (HKPC) and the Hong Kong Research Institute of Textiles and Apparel (HKRITA) hosted by the Hong Kong Polytechnic University. Each of these centres was initially

given operating funding for a five-year period (APAS had HK \$100 million and HKRITA had HK \$62 million). Their objective is to increase the competitiveness of Hong Kong industry by developing and transferring technology and designs to Hong Kong firms, by supporting and developing the human capital that these industries require, and by providing consulting and market intelligence activities to firms.

How can an R&D facility support the development of SMEs in Hong Kong? For the sake of simplicity, the challenges that Hong Kong manufacturing firms face can be grouped into two categories: a “technology gap” and a “marketing gap. As Hubert Schmitz explains, the technology gap is a result of being removed from international sources of technology (and in particular the feedback loop between users and producers that spurs innovation), the difficulty of accessing proprietary technology, and weak national and/or local support for innovation” (Schmitz 2007). These technologies may include the “hard” technologies that are embodied in machinery or “soft” managements systems such as quality control or supply chain management. The marketing gap is a result of the difficulty an export-oriented firm will have understanding and responding to rapidly changing consumer demand in foreign markets. It is exacerbated by highly concentrated retail sectors in these markets (which shifts leverage within the value chain to the buyer) and the capital intensity of developing a brand.

Textile and Apparel

The objective of HKRITA is to assist Hong Kong textile and garment firms in closing the technology gap. The intent is to leverage the collective R&D of universities in Hong Kong, the Mainland, and overseas to strengthen the capabilities of the Hong Kong textile and apparel industry.

The size of this industry makes it an obvious target: it accounts for 27.8% of employment in the Hong Kong manufacturing sector (46,000 workers). As the *Made by Hong Kong* study argues, Hong Kong textile and apparel firms have many advantages—highly flexible production systems, long experience and good connections with foreign customers and markets, and a strong ability to coordinate widely dispersed production networks (Berger and Lester: 1997: Chapter 9). One element of upgrading involves bolstering these traditional advantages. This set of issues falls primarily under the purview of the logistics and supply chain management R&D centre, the subject of another chapter in this volume. A second component of upgrading involves the development of new fabrics and processes. Although the industry might appear to be quite traditional, new materials (such as breathable fabrics, wrinkle-free fabrics, stain-resistant fabrics, anti-bacterial fabrics, and anti-UV fabrics) are at the core of innovation in the sector, and it is in this area that HKRITA has focused its efforts. Its core research areas are new materials and textile & apparel products, advanced textiles and clothing production technologies (such as new coloration, finishing, and spinning technologies), product design and evaluation technologies, and enhanced industrial systems and infrastructure (Interview 140308d).

As is the case with the other R&D centres, the primary purpose of HKRITA is to coordinate the relationships between firms and research organizations. Hong Kong Polytechnic University, the host institution for HKRITA, does the research and it has strong capabilities in the textile and apparel industries production. Firms are able to sponsor research in three ways. In a platform project, the firms pay a total of 10% of the project (so any one firm will be paying less than 10%) and the government pays the remainder. HKRITA controls the rights to the intellectual property (IP) and participating firms receive a discount when they license the technology. In a

collaborative project, a single pays less than 50% of the cost and it has the exclusive right to license the technology (but HKRITA owns the IP). In an exclusive project, a firm pays 51% or more of the project and it owns the IP.

A large Hong Kong firm in this sector will usually have significant internal R&D capability. Firm B, for example, is a leading firm in the industry and it has 40 staff in its R&D facility in the PRD, with backgrounds in textile chemistry, textile engineering, and engineering (for waste water treatment). Internal R&D is quite practical and applied, however, and the firm also has a strong need for more basic science research—processes like dyeing and finishing are essentially chemistry. For these projects the firm relies on collaborations with both Hong Kong universities (coordinated by HKRITA) and Mainland universities (such as Zhejiang Science and Technology, Wuhan University, and Shanghai Donghua). Each university has particular strengths, but overall the skills of Hong Kong and Mainland universities are comparable, according to the head of the firm's R&D department (Interview 200708). Hong Kong Polytechnic is excellent, but Shanghai Donghua (formerly named China Textile University), for instance, has been conducting research in the field since the 1950s, and is key institution in China for the study of textile engineering, material science, textile chemistry and dyeing and finishing engineering. It has key national laboratories and engineering research centres in these fields and a science park.

The primary problem of Hong Kong research projects is the high cost and the difficulties of transferring technology to firms. Firm B has done many projects with Polytechnic, but they have always been either platform or collaborative projects, so the firm has never owned the IP. When it has tried to buy or license technology it has found the process to be long and expensive (although this might be improved by HKRITA—it is still too soon to say). When Firm B works with Mainland institutions,

it pays the full cost of the project (because the cost is much lower) and as a result it controls 100% of the IP (Interview 200708). Although IP protection is a potential problem, thus far they have been able to structure the contracts with Mainland institutions so that the protection of IP rights is not a major issue.

In short, collaborating with Mainland universities is cheaper and in many respects more convenient. Although an obvious solution would be to allow HKRITA to work directly with Mainland universities as well as Hong Kong, government regulations do not allow this. A Hong Kong university is able to hire a Mainland university as a consultant on a project, but funding cannot go directly from HKRITA to a Mainland university. This is for two reasons. First, the government is interested in promoting research activity in Hong Kong. Second, the government is concerned that it will not be able to sufficiently audit the use of Hong Kong funds on the Mainland (Interview 281008).

Firm B is a large and globally competitive firm, and most of the clients of HKRITA tend to be large firms (Interview 140308d). The absence of SME clients points to an additional problem: the high cost of Hong Kong research has the potential to prevent the centre from supporting the firms that need its assistance the most. These smaller firms—the SMEs that have no R&D capability of their own—are most likely reluctant to pay the fees that are required by Hong Kong universities. In the HKCER survey of firms in the PRD, 80% of the surveyed enterprises considered high cost to be the primary problem of conducting R&D activity in Hong Kong (HKCER 2007: 98). While supporting the development of local research capabilities is a worthy goal, the Hong Kong government may have to make a decision whether its primary policy goal is to ensure that funds are spent within Hong Kong institutions or whether it seeks to support firm development.

Automotive

If the textile and garment industry is an obvious choice for government support in Hong Kong, the automotive industry is much more unusual: Hong Kong does not have much of an automotive industry. There are approximately 280 firms in Hong Kong that are auto-related, and most of these are producing aftermarket parts for export—the lowest category of activity in the automotive value chain.

Although it might seem strange to create an R&D centre for an industry that does not really exist, it begins to make more sense when one considers that the car is increasingly an electronic product. Approximately 35% of the value of a car is currently in electronics and this percentage is increasing, and according to the Hong Kong Productivity Council (HKPC), in the next 3 to 5 years, 90% of the innovation in the sector will be in onboard electronics (e.g. collision control, navigation systems, voice recognition, traction control, tire pressure monitors, etc.).⁵ The car is rapidly becoming more of an electronic product than a mechanical, and unlike autos, electronics is a dominant industry among Hong Kong manufacturing firms. Perhaps even more importantly, the automotive industry is the fastest growing industry in Guangdong (see Table 4). Ideally, firms would move out of OEM activities in electronics—a sector that is rapidly losing comparative advantage in the PRD—and into a sector that is growing rapidly in the PRD. The sales value of auto electronics in China in 2007 reached RMB 86.76 billion (US \$12.2 billion), an increase of 40% over the previous year, and are expected to reach 240 billion by 2011.⁶ Tire pressure

⁵ HKPC, “Advanced Automotive Electronics,” Presentation, February 2008, p. 13.

⁶ “China’s Auto Electronics Sales Jump 40% in 2007,” *Asia Pulse*, 13 March 2008.

monitoring systems, for example, became mandatory in all new cars sold in North America in 2007, but are included in only 5% of Chinese vehicles.⁷

The key question is whether Hong Kong firms will be able to develop the capabilities needed to compete in the automotive industry. The development literature gives reason for pessimism. The “technology gap” that was referred to earlier is particularly high in the auto sector because the industry is dominated by the assemblers and the top tier of global suppliers. Design costs in the industry are extremely high, and these high costs create strong incentives for the global assemblers to: 1) capture global economies of scale (in order to spread the cost of design over larger volumes; and 2) push part of the burden of design onto the Tier 1 supply firms. The latter dynamic serves to limit the range of opportunities for small suppliers in developing countries because Tier 1 suppliers must follow the global assemblers to new production sites (Humphrey and Memedovic 2003). The Toyota supply network in Guangdong, for instance, shows strong evidence of this “follow-sourcing”; overwhelmingly the key suppliers are Japanese firms that Toyota has brought to China (see Table 5). These firms will use local Chinese suppliers in lower tiers of the supply chain, but these tend to be low-value added activities.

Will global firms dominate in China? There is an important reason why the conventional wisdom might not apply in this case. Discussions of industrial development in East Asia generally focus on export-led growth, and this focus on export markets defines the nature of the challenge that home country firms face. The marketing gap is large because firms are far removed from final markets; the technology gap is large because the objective is to reach the cutting-edge technical and quality standards demanded by foreign customers. China presents an unusual

⁷ Megan Lampinen, “China: Lear to launch production of tyre pressure monitoring systems,” *Automotive World*, 25 March 2008.

opportunity because the focus is on the domestic market. Domestic demand for passenger vehicles has increased from 504,562 units in 1998 to 6.3 million vehicles in 2007, and China is now the second largest market for passenger cars in the world. Within this domestic market there are distinct segments that have a variety of demands for quality and performance. The fastest growing component of the market over the last ten years has been individual first-time car buyers. In 1995, 25% of Chinese automobiles were registered to private individuals. In 2005, this figure stood at 55.3% (14.97 million units) and it has been rising steadily.⁸ Consumer research in this segment indicates that more females are buying cars, and consumers are increasingly well-educated and wealthy (see Table 6). These consumers demand high value for money, a variety of styles, and are more likely to be swayed by the recommendation of a friend or relative than by the particular make or model of car.⁹ Between 2001 and 2007, the number of small car models sold in China increased from 4 to 19 and the average price decreased by nearly 33% (from US \$10,566 in 2001 to US \$6,931 in 2007 (Mei 2007)).

Rapid growth at the low-end of the market and intense price competition has created opportunities for domestic Chinese auto assembly firms. In some respects, the products that the multinationals bring to China are too advanced and over-engineered for the lower segments of the Chinese market, and because the objective of these firms is to maximize globalize economies of scale, they are reluctant to create designs specifically for the Chinese market. This has created an opening for independent Chinese firms that use low-cost suppliers, less capital-intensive manufacturing techniques, and simpler designs than their foreign competitors. At the end of the

⁸ "Vehicle Ownership in China" *Fourin China Auto Weekly*, December 5, 2005.

⁹ Surveys of purchasing decisions by small car owners indicate that between 2001 and 2007 the percentage of people who bought primarily on the basis of brand reputation decreased from 10 to 5%, the percentage were simply seeking a particular model decreased fro 13 to 10%, and the percentage that were swayed by the recommendation of a relative or friend increased from 4 to 8% (Mei 2007).

1990s, this category of firm occupied a small fraction of the marketplace, and by 2007 they controlled a third of the market.¹⁰ Anhui-based Chery, the most successful of these firms, began producing cars in 1999 and only four years later it had achieved annual sales of 80,000 vehicles. In March 2008, Chery sold more vehicles in China than any other manufacturer.

In short, the low-end of the market provides a critical learning opportunity for indigenous firms and offers the potential for them to increase scale. Because foreign firms are rarely able to meet the price points demanded by consumers in this segment, the domestic firms have the benefit of being insulated from foreign competitors. The high-end remains the market is the domain of the foreign firms, and the indigenous Chinese firms rarely have the deep know-how to design, manufacture and market products that can compete in this segment. Neither foreign nor domestic firms are content to stay in their respective segment, however. The domestic firms want to upgrade and escape the intense competition at the bottom of the market; the foreign firms want to lower costs so that they can compete in the rapidly growing middle segments of the market.¹¹

This segmentation of the domestic market in China and the competition between domestic Chinese and foreign firms creates an opportunity for Hong Kong firms that are seeking to develop new capabilities. On the one hand, a global assembler will continue to use global Tier 1 suppliers, but due to the intense price pressure, these global suppliers will make every effort to utilize lower-cost suppliers. The global Tier 1 firm works with the low-cost supplier to improve and maintain

¹⁰ “China’s Independent Automakers: Independent Brands Climbed to No. 2 Spot in 2005,” *Fourin China Auto Weekly*, May 8, 2006; “Carmakers brace for touch small car race,” *China Daily*, April 22, 2008.

¹¹ Loren Brandt and Eric Thun, “The Fight for the Middle: Upgrading, Competition, and Industrial Development in China,” paper presented at Bocconi University, Milan, 16 October 2008.

quality levels, but also takes care to insure that it is only out-sourcing the lower-value added activities. On the other hand, the domestic Chinese assemblers, because they have limited R&D capabilities, will give less assistance to their suppliers, but they are eager to allow a supplier to engage in a full range of design activities.

The technical director at one Chinese supply firm compared the relationships with a foreign versus domestic assembly firm to a rectangle that is sitting on end as opposed to one that is lying flat. The former symbolizes the relationship with a foreign company that is seeking to lower its costs: it is narrow and deep. The domestic supplier can achieve a high level of competence very quickly because a global supplier will be assisting them, but the range of capabilities will be narrow. The latter represents the relationships with a domestic assembler that seeks to upgrade: the domestic supplier has an advantage over foreign suppliers on cost and it can engage in a wider array of activities because the technical demands are lower, but it learns less because the domestic assembler is not in a position to provide as much assistance. The objective of a Hong Kong firm should be to maximize the benefits of participation in multiple value chains.

APAS is in a position to provide critical assistance to Hong Kong firms that seek to develop automotive components. The research centre is wisely concentrating its efforts on automotive systems that maximize the experience that Hong Kong firms have in electronics, and it is trying to develop expertise with products that are not too sophisticated (because it will not be able to compete with global firms) but are more sophisticated than the average Mainland supplier will be able to handle. Rather than focus on airbags and anti-lock braking systems (i.e. core systems), for instance, the centre is focused on collision alert, GPS, adaptive headlight systems, and audio/visual units (Interview 140308b). The centre has three areas of focus—advanced materials,

safety, and software/electronics—and it provides a range of services to firms. First, it can prove the testing that is necessary to achieve the certifications and international standards that are critical in the auto component sector, and it can provide the analysis that will allow firms to achieve these standards. Second, it is able to provide SMEs with turnkey solutions or testing in areas that require expensive machinery (such as the machining necessary for molds) that an SME might be reluctant to invest. Third, it coordinates projects and serves as technical consultant. Firms have the same three options that they do with HKRITA (a platform project, collaborative project, or exclusive project) and often APAS plays the role of matchmaker, putting together firms that have the complementary skills that are needed for a new project.

Within the HKPC, the host institution of APAS, firms are able to find people with the specialized technical skills needed for a project. A headlight project, for instance, involves 3 to 4 optical consultants, 4 people to create the algorithms for the required software, and 2 to 3 people in mechanical design (Interview 140308b). As the design manager in one Hong Kong firm explained, firms would probably be able to create these capabilities themselves, but it would take a great deal longer and they would have to generate the capital to support the project. Firms are skilled in manufacturing and the electronics industry, but have little experience with automotive technology. The problems that the firms encounter are high-level technical problems, and these are exactly the type of problems that the specialists at HKPC are able to provide assistance on (Interview 180708b). The intent is not necessarily to find a better solution than a major global player such as Toyota would be able to provide, but to develop a low-cost and innovative solution that could then be marketed to domestic firms in China or foreign firms that are struggling to lower costs.

The primary challenge, and the primary area that firms could use more help from ASAP, is with finding customers. Most of the Hong Kong firms do not have connections in the industry, and it is difficult to establish relationships with the assembly firms. Beyond the obvious need for a buyer for the product that is being developed, the lack of a customer can slow development time. Often the products are not plug-and-play, but require integration with the specifications of a particular vehicle, and the software cannot be completed until the supplier has the specs of the customer.

III. Policy Recommendations

1. There are four principle policy recommendations that from this report. First, the government of Hong Kong must decide whether the primary purpose of the R&D centres is to support research activities in Hong Kong (i.e. universities) or the development of firm capabilities. Currently it is difficult (although not impossible) to utilize Mainland universities for research. Given that many of the research activities of general R&D are small scale and are seldom using cutting-edge technologies, and consequently are unlikely to support the development of core capabilities in universities (and unlikely to solve the funding problems that David Mowery highlights on p. 31 of Report #1), it makes more sense to focus on firm needs. The primary firm need is for lowering the cost of R&D support. Rather than force the R&D centres to work solely with Hong Kong universities, and relegating Mainland institutions to secondary consulting roles, the government should allow the R&D centres to work directly with Mainland universities on short-term very applied research projects. Eventually a division of labor is likely to emerge. One firm, for instance, pointed to the more creative design activities that have remained in Hong

Kong even though the firm has opened a large R&D centre in the PRD. The firm reaps the advantage of both systems.

A concern of the government is that it is more difficult to track and monitor the use of funds that are spent on the Mainland. While it is certainly admirable to make every effort to insure that Hong Kong taxpayer money is not squandered, this is excessively cautious. Organizations such as the Ford Foundation have run major programs on the Mainland, dispersed large grants of money, and presumably performed adequate audits of its use. One approach would be to create a single platform for these collaborations on the Mainland (or different platforms in different regions), so one organization can handle the interaction with Chinese collaborators for all of the Hong Kong R&D centres. As Adam Segal argues in his report (p. 10), the regulations that prevent “money from crossing the river” must be reconsidered.

2. Second, the government should continue to broaden its definition of a Hong Kong firm. In the PRD it is increasingly difficult to distinguish a Hong Kong firm from a Mainland Chinese firm. This is true in terms of ownership structure, the number of people the firm employs in Hong Kong, and the extent to which the firm utilizes Hong Kong’s producer-related services. The objective of government policy should be to promote industrial upgrading and economic growth in the PRD region as a whole because all firms within this region are equally likely (or unlikely) to utilize the producer-services of Hong Kong. There are indications that this redefinition is well underway. APAS, for instance, is able to work with Guangdong as well as Hong Kong firms. The government can support these efforts by working at the governmental level to coordinate R&D efforts in Guangdong with similar efforts in Hong Kong—these should be complementary rather than competing efforts. An important benefit of coordinating efforts in the auto industry is that the governmental

involvement on the Mainland will help secure customers for the firms that APAS is doing projects with. The municipality of Guangzhou is a joint venture partner with Honda, and Guangzhou auto has aspirations to develop an independent brand. This is exactly the sort of firm that APAS should be seeking to support.

Beyond the short-term applied research mentioned in the first recommendation, a requirement of reciprocity is needed. Hong Kong should only spend public money on research activities in the Mainland if equivalent sums of public money from the PRC central, regional or local governments are being spent to support research activities in Hong Kong.

3. Third, the government must make sure that the SMEs that need R&D support the most are able to afford it. Allowing research to take place in Mainland universities is one means of achieving this, but it might also be necessary to create further incentives such as tax rebates for R&D expenditures or flexible payment methods. Many respondents spoke of the need to shift the mentality in traditional Hong Kong manufacturing away from short-term profits that had always been available in OEM activities towards the more long-term perspective that is necessary to develop the capabilities that higher-value added activities will require.

4. Finally, the government must provide funding with a longer time frame. The R&D centres were funded initially for five years. If further funding is made contingent on seeing results from this initial funding, the government is being hopelessly unrealistic. HKRITA has funded 21 projects that will take two to three years, for example. Not only is this time period not yet concluded, but the projects will only result in the development of prototypes. It could take another 5 to 10 years for commercialization. R&D is inherently a long-term endeavour and it is inherently a cost centre. The research centres are providing useful services to firms, and the

challenge is to insure that these services are being received by the firms that need them the most.

Tables and Figures

Table 1: Producer Services in Hong Kong (HKCER 2007: 21)

	1980	1985	1990	1995	2000	2005
	Share % of Real GDP					
Manufacturing	14.6%	13.5%	14.0%	8.7%	5.4%	3.3%
Total Services	79.3%	79.5%	78.5%	83.6%	86.6%	90.8%
Producer Services	36.1%	31.6%	34.7%	41.7%	45.8%	52.8%
Consumer Services	34.9%	38.4%	35.9%	33.6%	33.3%	31.4%
Government Services	8.3%	9.6%	7.9%	8.3%	7.6%	6.6%
Others	6.1%	6.9%	7.5%	7.8%	8.0%	5.9%

Source : CEIC, YCR Wong, Z Tao and CS Chan, *An Economic Study of Hong Kong's Producer Service Sector and Its Role in Supporting Manufacturing*, funded by Industrial Support Fund, May 2000, 112 pages; and Z Tao and YCR Wong, "Hong Kong: From an Industrialized City to a Center of Manufacturing-Related Services", *Urban Studies*, vol. 39, no.12, 2002, pp. 2345-2358.

Table 2: Changes in Guangdong Minimum Wage (HKTDC 17/09/08)

	1 Nov 2002	1 Dec 2004	1 Sep 2006	1 Apr 2008	% change since last increase
Guangzhou	510	684	780	860	10.3
Zhuhai, Foshan, Dongguan, Zhongshan	450	574	690	770	11.6
Shantou, Huizhou, Jiangmen	400	494	600	670	11.7
Shaoguan, Heyuan, Meizhou, Shanwei, Yangjiang, Zhanjiang, Maoming, Zhaoqing, Qingyuan, Chaozhou, Jieyang, Yunfu	360	446	500	580	16.0
Shenzhen Special Economic Zone	595 ^a	690 ^b	810 ^c	850 ^d / 1000 ^e	17.6

^a 1 May 2002 ^b 1 July 2005 ^c 1 July 2006 ^d 1 Oct 2007 ^e 1 July 2008

Source: Labour and Social Security Office of Guangdong

Table 3: Production Mode of Guangdong Enterprises (HKCER 2007: 56)

	% of enterprises		
	All Sample	FIEs	OCFs
Original Equipment Manufacturing (OEM)	65.1	61.9	68.6
Original Design Manufacturing (ODM)	9.8	13.2	6.0
Original Brand Manufacturing (OBM)	6.6	7.0	6.1
OEM & ODM	11.9	10.3	13.8
OEM & OBM	3.0	3.3	2.6
ODM & OBM	1.1	1.4	0.8
OEM & ODM & OBM	2.1	2.4	1.8
Others	0.4	0.5	0.3

Note: FIEs are foreign-invested enterprises (including Hong Kong; OCFs are other contractual firms (which include processing firms and foreign-invested firms that have registered as domestic enterprises))

Table 4: Industrial Output Value of Nine Targeted Industries in Hong Kong, 2000-2005 (HKCER 2007: 36)

	2000	2005	2001-2005
	RMB bn	RMB bn	Average Annual Growth Rate (%)
Three Emerging Industries	540.0	1,836.3	27.7
Electronic Information	241.8	983.1	32.4
Electrical Machinery and Special Purpose Equipment	162.6	525.7	26.4
Petroleum and Chemical	135.6	327.5	19.3
Three Traditional Industries	264.4	507.3	13.9
Textile and Garments	122.7	215.0	11.9
Food and Beverages	79.9	163.6	15.4
Building Materials	61.8	128.6	15.8
Three High-Potential Industries	88.1	248.6	23.1
Logging and Papermaking	38.8	84.0	16.7
Medicine	18.4	28.7	9.3
Motor Vehicle	31.0	136.0	34.4
Total Industrial Output Value of Nine Industries	892.5	2,592.2	23.8
Total Industrial Output Value of Enterprises above Designated Size	1,248.1	3,594.3	23.6

Source: Guangdong Statistical Yearbooks

Table 5: Ownership of Toyota Group Suppliers established in Guangzhou in 2004

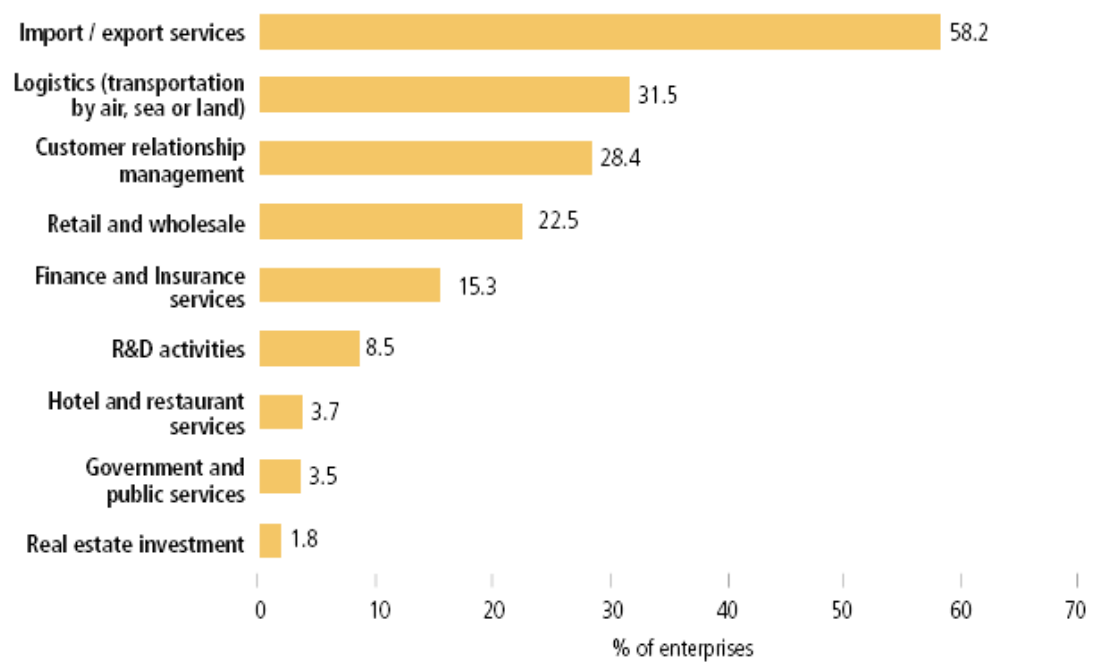
Firm	Investment Share	Major Products	Major Customers
Fengai Guangzhou Automotive Seat Parts	Toyota Boshoku 51%; Aisin Seiki 49%	Seat backs, cushions, tracks, etc.	Guangzhou Intex Parts
Guangzhou Intex Auto Parts	Toyota Boshoku 50%; Takanichi 25%; GAIC Auto Parts 25%	Seats, door trim, headliners, etc.	Fengai Automotive Seat Parts
Toyota (Foshan) Gosei Auto Parts	Toyota Gosei 65%; Taiwan subsidiary 30%; Toyota Tsusho 5%	Interior and exterior parts	Toyota and other Japanese automakers
Toyo Automotive Parts (Guangzhou)	Toyo Tire & Rubber 100%	Rubber NVH products	Japanese automakers
Aisan (Foshan) Autoparts	Aisan Industry 95%; Yoyoda Tsusho 5%	Fuel injectors, related engine parts	Toyota and other Japanese automakers
Foshan Tokai Rika Automotive Parts	Tokai Rika 100%	Key-lock sets, seat belts	Toyota and other Japanese automakers
Aisin Seiki Foshan Automotive Parts	Aisin Seiki 100%	Engine parts	Toyota and other Japanese automakers
Huizhou Zhucheng Wiring Systems	Sumitomo Wiring 20.4%, Shenzhen Dongf. 25%, Shenzhen Sumitomo Equipment 24%	Automotive wire harness	Japanese automakers
Guangzhou Hayashi Telemu	Hayashi Telemu 51%, GAIC 49%	Interior Parts	Japanese automakers
Mitsui Chemicals Plastic Compounds (Zhongshan)	Mitsui Chemicals 100%	Poly propylene compounds	Japanese automakers

Source: "Toyota suppliers advance in Guangzhou," *Fourin China Auto Weekly*, December 27, 2004, p. 2.

Table 6: Profile of Small Car Buyers in China (Mei 2007)

	2001	2007
% Female	27	35
% First time buyer	83	87
% University educated or above	31	37
% with monthly income of RMB 8,000 or above	17	26

Figure 1: Utilisation of Hong Kong's Service Industry (HKCER 2007: 79)



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