Collaborating for Science and Technology Under "One China, Two Systems"†

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Abstract

Since Deng Xiaoping's implementation of the "One China, Two Systems" policy, mainland China and the other Chinese regions of Hong Kong and Macau have cooperated in various ways to work towards successfully developing China's overall economy and industries. Particularly, cooperation between Guangdong Province and adjoining Hong Kong have been contributing to China's development, and this study explores their industry conditions including their current two governments policies designed to promote collaboration. The two partners were in a cooperative relationship even before the handover of Hong Kong, beginning with a "front shop, back factory" model built on their respective comparative advantages in labor-intensive industries in the 1980s. This cooperation effectively propelled the Pearl River Delta Region's industrialization process and enabled Hong Kong to transform from a manufacturing industry-based economy to a service industry-based economy.

From the early 2000s, Guangdong and Hong Kong diversified their collaboration project from culture to high-tech. Also, both authorities produced several types of policies not only to promote both industries but also to harmonize their two different economic levels and models. As a result, the Guangdong and Hong Kong economies have developed remarkably well during the past two decades and continue to form future plans that carry plenty of optimism. Nonetheless, this study showed discrepancies between engineers and scientists from the two areas in their perception of their technology and science cooperation. Hong Kong experts were more negative in their responses but noted some successes of the collaboration, while Guangdong's group showed overall positive responses. This difference results from an unbalanced role in cooperation. Hong Kong's side responds to cooperation plans and takes on leading roles with more frequency than Guangdong's side in actual cooperation project processes.

Keywords
science and technology cooperation, supportive policy for science and technology regional cooperation, Hong Kong and Guangdong

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1. INTORDUCTION

1.1. Research Motivation

Since Deng Xiaoping developed the idea of a "One China, Two Systems" policy in 1984, the mainland and other Chinese systems, such as Hong Kong and Macau, have found various ways to cooperate with each other. Deng stated that while there would be only one China, Hong Kong and Macau would have capitalist economic systems while the mainland would continue to pursue "scientific socialism." The two-system regime worked well in developing the People's Republic of China's economy as it burgeoned into the world's second largest.

China's economic success depends increasingly on high technology. The two special administrative regions provide key support in advanced technology and highly productive economic practices. At the same time, as China's eastern cities shift to more consumption- and service-oriented economies, the manufacturing base—especially the low wage, labor-intensive manufacturers—continues to move inland and westward. This means that the eastern productive centers must in turn develop in technology and productivity, which will require closer ties among China and its regions concerning research and development projects in science, technology, and engineering.

In this respect, questions arise as to how the two different systems generate policies to facilitate their cooperation despite their different economic and technology environments. This study investigates the history of and current cooperative projects' focus on science and technology between Guangdong and Hong Kong and how their collaborations in these areas well-represent the concept of the "One China, Two Systems" policy. In addition, the local peoples' recognition and appreciation concerning the cooperation projects are also examined.

1.2. Brief Introduction of Guangdong and Hong Kong

Guangdong is located in China's southeast and borders Hong Kong and Macau. It is China's largest provincial economy with a province-level GDP topping RMB 5.25 trillion (USD 836.19 billion). It is the second largest sub-national economy in Asia and the sixth or seventh largest sub-national economy in the world as of 2011.

The Pearl River Delta (PRD) region, the heart of China's manufacturing industry, is a horseshoe-shaped arc of cities and towns stretching from the Hong Kong Special Administrative Region to the Macau Special Administrative Region and includes seven cities of over a million people. The PRD encompasses 0.4 percent of the land area and 3.5 percent of the population of the Chinese mainland (a population of 45.5 million people, according to the 2005 Interim Census).

The region accounted for 9.9 percent of the GDP and 28.9 percent of total trade in 2005. It has emerged as one of the world's most dynamic economic regions, especially in manufacturing (China Travel Depot, n.d.).

FIGURE1. Cities in Pearl River Delta Zone

Source: (Enright, Scott, Petty, & Enright, Scott & Associates, 2010)

2. DAWN OF COLLABORATTION BETWEEN GUANGDONG AND HONG KONG

2.1. Initiatives and Industry Collaboration in Guangdong and Hong Kong.

There seems to be widespread consensus that the economic context for Hong Kong is rapidly changing. For the last twenty years or so, the relationship between the countries could be summarized as "front shop, back factory" (qian dian hou chang), or the location of production in the PRD and important services—such as financial services, marketing, design, insurance, communications and logistics—in the Hong Kong Special Administrative Region. But the PRD, while still China's core manufacturing area, confronts increasing competition from other places in the mainland, including the Yangtze River region and the Beijing–Tianjin corridor as well as other regions in Asia (Segal, 2010). The PRD is attempting to upgrade by committing to reform its value chain, spending more on R&D, improving manufacturing capabilities, and creating clusters of universities, R&D institutions, and new companies in such places like the Science Park in Shenzhen, Songshan Lake in Dongguan, and Bio-Island in Guangzhou (Peterson, Principle, & Industrial Practice, 2012).

TABLE 1. Stages of Models and Characteristics of Guangdong-Hong Kong Cooperation in Industry

Stage	Model and Characteristics of Cooperation
First Stage (1978 ~ 1997)	Guangdong-Hong Kong economic cooperation began with the "front shop, back factory" model, created at their comparative advantages in labor-intensive industries. This cooperation effectively propelled the Pearl River Delta Region's industrialization process. It also enabled Hong Kong's economy to transform from a manufacturing industry-based economy to a service industry-based economy. Hong Kong's status as an international financial, trading, and shipping center was strengthened.

Second Stage (1998 ~ 2003) process	An effect of Hong Kong's return to China was a rapid broadening in the scope of its investment, geographically and industry-wise. Guangdong's industrialization process accelerated. The manufacturing-based industrialization was basically completed. Meanwhile, owing to an increase in the cost of production factors, the conventional comparative advantages of Guangdong and Hong Kong for cooperation in the manufacturing industry subsided, and the "front shop, back factory" model was challenged. The labor-intensive industries of the Pearl River Delta Region were also pressurized to upgrade. The factors of competition and confrontation emerged.
Third Stage (2003 ~)	Under the CEPA and Guangdong–Hong Kong cooperation framework, Guangdong–Hong Kong cooperation in the manufacturing industry changed from the "front shop, back factory" model, which is applied mainly to the labor-intensive industries, to a higher level that centers around technological innovation and resource optimization.

Source: Bauhinia Foundation Research Centre (2008)

2.2. Development Industry of Guangdong and Hong Kong

The Mainland China and Hong Kong Closer Economic Partnership Arrangement, also known as the Closer Economic Partnership Arrangement (CEPA), underscores the cooperation that contributes to the region's prosperity. In practice, the mainland side of the CEPA focuses on Guangdong. Major manufacturing facilities in Guangdong exist in Guangzhou, Shenzhen, Dongguan, Foshan, Zhongshan, Zhuhai, Jiangmen, and parts of Huizhou and Zhaoqing. Experimental reforms were started in Guangdong Province, particularly with the first two Special Economic Zones Shenzhen and Zhuhai, established in 1979 (Lee, 2002).

The Hong Kong and Guangdong economies have become inextricably intertwined. The vast majority of the external investment in the PRD has come from, or through, Hong Kong. Hong Kong companies employ between 10 million and 11 million workers in the PRD (Schroder, Waibel, & Altrock , 2010). Both Hong Kong and Guangdong have been at the center of government efforts to strengthen cooperation in technological innovation. Both partners have leveraged comparative advantages—low labor costs for the mainland and experience in design, research capability, applied research and commercialization, as well as distribution and marketing for Hong Kong—to amplify the competitiveness of both places. Both governments have played an active role in facilitating cooperation and coordination. The aforementioned CEPA is one of the better known examples of such efforts. Others include the Guangdong Hong Kong Technology Cooperation Funding Scheme (TCFS) and the Hong Kong Science and Technology Park (HKSTP). In fact, the HKSTP develops joint programs to assist mainland companies with advanced technologies that wish to use Hong Kong as a platform for their future regional and global aspirations. The HKSTP has been widening collaboration to include assistance with partner identification and market familiarization for small and medium sized enterprises (SMEs) and newly emerging businesses (Segal, 2010).

Even with so much going for it, this cooperative system faces challenges. For instance, the global economic slowdown continues to affect firms in Hong Kong and Guangdong. More narrowly, the tried-and-true model of the "front office, back factory" may no longer be effective. In response, new initiatives have been launched including a focus on a wider mix of industries that also encompass various cultural industries. This aligns with a broader push to develop and sustain capacity in high-value added manufacturing and services. Such effort must include an understanding of policy innovations at work in the region. Following the trends and agreements of cooperation programs shows us how the two parts have been preparing for current and future challenges.

2.3. Trends of Cooperative Projects between Guangdong and Hong Kong

Science and technology innovation between Guangdong and Hong Kong already makes use of a dense web of policies, institutions, business relationships, and personal networks. Trends point toward these connections growing deeper and broader. Consequently, opportunities for joint research and development, educational exchange, business alliances, and collaborative innovation are also growing between the two areas. The wording in China's current Five-Year Plan (2011-2015) indicates further stimulation of such ties. For example, modernization, moving toward high-value manufacturing, making production systems more efficient, and continued large investments on infrastructure (especially transportation) will require commensurately large expenditures on engineering and science. This will result in a more diversified and deeper economy in the region.

The western part of the Pearl River Delta will become much more accessible to investors and will see dramatic growth as a result. The National Development and Reform Commission (NDRC), the chief economic planning agency, presented a plan for 2008-2020 that accelerates the development of the pan-Pearl River Delta as a "center of advanced manufacturing and modern service industries" and as a "center for international shipping, logistics, trade, conferences and exhibitions, and tourism." Goals include the development and expansion of road, rail, seaport and airport capacities by 2020. This includes the construction of an 18-mile (29 km) bridge linking Hong Kong to Macau and Zhuhai. Highway and road construction are projected to total 1,864 miles (3,000 km) by 2015 (Segal, 2010).

2.4. Discussion and Agreements in Government Levels for Cooperation

In April 2010, Chief Executive of Hong Kong Donald Tsang and Governor of Guangdong Province Huang Huahua signed the Framework Agreement on Hong Kong Guangdong Cooperation. The Framework Agreement builds on years of close cooperation between Hong Kong and Guangdong, and is the fruit of the rapport and consensus building through exchanges between the two regions over the years. It is also a significant embodiment of the principle of "One Country, Two Systems," bringing Hong Kong–Guangdong cooperation to new heights.

The National Development and Reform Commission (NDRC) announced in January 2009 the "Outline of the Plan for the Reform and Development of the Pearl River Delta," specifying Hong Kong–Guangdong cooperation as a national policy. In March 2009, Chief Executive and Party Secretary of Guangdong Province Wang Yang reached a consensus on deepening Hong Kong–Guangdong cooperation. An important task was the joint formulation of the Framework Agreement. The Hong Kong and Guangdong governments have actively worked on the Framework Agreement in the past year, holding many discussions on the draft document. Views were sought from the relevant central government departments. In that period, the authorities have also taken into account suggestions from various sectors the Outline on and the deepening of Hong Kong–Guangdong cooperation, including a motion carried by the Legislative Council on the implementation of the Outline on March 2009. The Greater Pearl River Delta Business Council released the results of the study on September 2009. With assistance and support from various fronts, the Framework Agreement has been endorsed by the State Council (Constitutional and Mainland Affairs Bureau, 2014).

3. COOPERATION PROGRAMS IN THE TECHNOLOGY AND SCIENCE INDUSTRY

In 2003, the governments of Hong Kong and Guangdong jointly organized the Guangdong–Hong Kong Expert Group on Cooperation in Innovation and Technology to facilitate collaboration in cutting-edge technology and the commercialization of technology achievements to increase the productivity and competitiveness of companies in both regions. The Innovation and Technology Commission (ITC) and the Department of Science and Technology of Guangdong (DSTGD) have undertaken the Guangdong–Hong Kong Technology Cooperation Funding Scheme (TCFS), a major annual initiative of the Expert Group since 2004. The TCFS aims to encourage more collaboration between research centers and private companies in Guangdong and Hong Kong in conducting applied R&D projects. On Hong Kong's side, the TCFS is a subprogram belonging to the Innovation and Technology Support Program of the Innovation and Technology Fund. Under the TCFS, Hong Kong's side accepts applications made by organizations incorporated in Hong Kong, while Guangdong's side evaluates applications with organizations established in Guangdong. Applicants must demonstrate an element of Guangdong–Hong Kong cooperation. Guangdong and Hong Kong separately process the applications received in their respective jurisdictions according to their own regulations and procedures (Commerce and Economic Development Bureau, 2009).

To enhance technological collaboration, a new category of joint funding projects was introduced to the TCFS in 2007. Under this category, principal cooperation partners in Guangdong and Hong Kong submit funding applications to the relevant authorities on either side for their respective part of an R&D project. The project should produce benefits to both sides. Guangdong and Hong Kong will conduct evaluations together and jointly fund those R&D projects selected by both authorities. From 2004 to 2008, the authorities provided more than 850 projects under the TCFS with a total funding of about $1.8 billion. These projects cover a wide range of technology areas including radio frequency identification (RFID) applications, electric vehicle technologies, environmental protection technologies, and biomedical technology.

3.1. Other Major Cooperation Agreements

Besides the TCFS, the ITC and DSTGD have also supported other starting projects that promote technology cooperation between Hong Kong and Guangdong. In 2006, several R&D centers were established in Hong Kong, and the ITC and DSTGD provided seminars in the Pearl River Delta area to introduce them to Guangdong's research centers and firms in order to promote cooperation opportunities. The ITC continues to work with the DSTGD to foster cooperation of research teams and organizations and further improve the technology and innovation abilities of both regions.

In addition, Guangdong Province and the ITC have also worked with the science and technology departments of other provinces in the mainland towards encouraging technology collaboration by networking with research centers and higher education institutions. As a result, there has been some movement toward the creation of common accreditation and educational standards. An example is Beijing Normal University–Hong Kong Baptist University United International College (BNU–HKBU UIC) located in Zhuhai and jointly founded by Beijing Normal University and Hong Kong

Baptist University. It is the first full-scale cooperation in higher education between the mainland and Hong Kong. This project's goal is to develop a new model of liberal arts education for Guangdong and the mainland. The Hong Kong University of Science and Technology (HKUST) also opened a campus in Shenzhen in partnership with Shenzhen University in 2014.

3.2. Agreement on the Government Level for Science and Technology Cooperation

In 2007, Hong Kong and Shenzhen governments signed a cooperation agreement for developing the concept of a "Shenzhen-Hong Kong Innovation Circle." The agreement enables Hong Kong and Shenzhen to tighten relations and increase their complementary strengths with aims of promoting overall competitiveness on both sides. Under the agreement, the two authorities created a steering group co-chaired by the Secretary for Commerce and Economic Development and the Science and Technology Adviser to the Mayor of Shenzhen. Senior officials from various departments serve as members, facilitating high-level exchanges and co-ordination of technology collaboration between the two sides. Since the signing of the agreement, both sides have taken forward a number of cooperative initiatives that includes creating a new joint funding scheme for applied R&D projects under Hong Kong's TCFS with Guangdong (Commerce and Economic Development Bureau, 2009). Also, the Shenzhen–Hong Kong Productivity Foundation was established in Shenzhen to support the high-tech manufacturing industry.

Hong Kong and Shenzhen have also been accomplishing major technology collaboration projects. The two regional governments worked together to successfully invite DuPont, a US enterprise, to locate its global thin-film photovoltaic business headquarters and research center in Hong Kong Science Park and its manufacturing facilities in Shenzhen in May 2008. This is the first major technology cooperation project under the Shenzhen-Hong Kong Innovation Circle. Hong Kong and Shenzhen are continuing this approach to attract more of the world's leading companies, encouraging them to establish factories in Shenzhen and R&D centers in Hong Kong. In addition, Shenzhen and Hong Kong agreed on a plan for technology cooperation in 2009 consisting of twenty-four cooperative projects in various domains such as RFID technology, biomedical, and new energy technology. Collaboration partners include universities, government divisions, R&D centers, and community organizations from both places (Commerce and Economic Development Bureau, 2009).

3.3. HKSTP as a Role Leader for the Cooperation

The Hong Kong Science and Technology Parks (HKSTP) Corporation is a statutory body set up by the Hong Kong Special Administrative Region Government and made operational on 7 May 2001 to support the science and technology innovation development of Hong Kong. The corporation is responsible for the management of the Hong Kong Science and Technology Park in Pak Shek Kok, Tai Po, the three industrial villages in Tai Po, Yuen Long, and Tseung Kwan O, and the InnoCenter in Kowloon Tong in Hong Kong.

The HKSTP has an area of twenty-two hectares featuring a campus-style environment and an emphasis on four areas of science and technology that include electronics, information technology and telecommunications, biotechnology, and precision engineering. Through its incubation programs, the HKSTP provides support in infrastructure, shared use of equipment for R&D, and laborato-

ries to newly established companies in the fields of science and technology from Hong Kong and Guangdong. Total investment amounts to US $2 billion with Phase I and II completed in 2002 and 2007 respectively, involving global science and technology enterprises and cooperating with the mainland IT sector (Bauhinia Foundation Research Center, 2008). The HKSTP Corporation is an important Hong Kong member of the "Shenzhen/Hong Kong Innovation Circle" as it attempts to transcend the "front shop, back factory" convention to open a new era in the regions' collaboration.

Based on these merits from both sides, the HKSTP provides Guangdong with various advantages:

- Capitalization on the respective strengths of the two areas
- Provision of an integrated and comprehensive package that covers R&D and product development
- Production and access to market
- Assistance to overseas companies unfamiliar with the regulations and practices of the mainland
- Facilitation of identification of business partners and acting as business modeling intermediates

3.3.1. Taking Advantage of the "One China, Two System" Policy's Opportunities

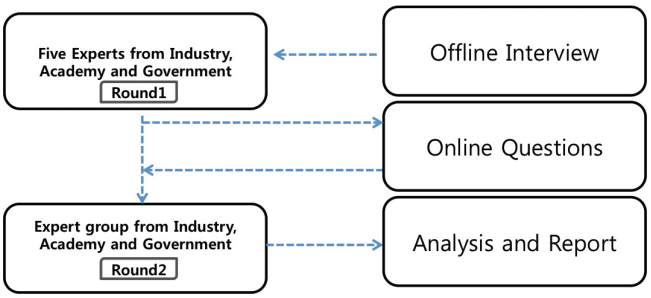
The HKSTP continues to promote the unique combination of Hong Kong as an IT hub and Guangdong as a recognized center for value-added manufacturing production. It is also developing joint programs that assist mainland companies with advanced technologies wishing to use Hong Kong as a platform for their future regional and global aspirations. The HKSTP has been widening collaboration to include assistance with partner identification and market familiarization for SMEs and newly emerging businesses.

4. RECOGNITION OF COOPERATION PROJECTS BY LOCAL EXPERTS

As this study explored, various policies for science and technology collaboration between Guangdong and Hong Kong have been formed and adjusted every year, expanding their boundaries in accordance with demand from the two regions.

Many local experts have been involved in the cooperation projects. How do local engineers and scientists in collaborative projects perceive the cooperation from their two different sides? To find the answer to this question, questionnaires following the Delphi method were sent to key actors in the regions. Five experts were selected for the first-round offline interview, with two from Hong Kong and three from Guangdong. Sixty-seven experts from Guangdong and Hong Kong were invited for the second-round online survey. Respondents have at least ten years of experience in the information or engineering industry or have a PhD in a scientific field. The schema below shows the process of survey.

FIGURE 2. Survey Process



The five sections of the questionnaire were derived through the first-round interview, with questions examining the local experts' evaluation of past and current cooperative projects in Guangdong and Hong Kong (Table 2).

TABLE 2. The Questionnaire's Five Sections and Their Specific Questions

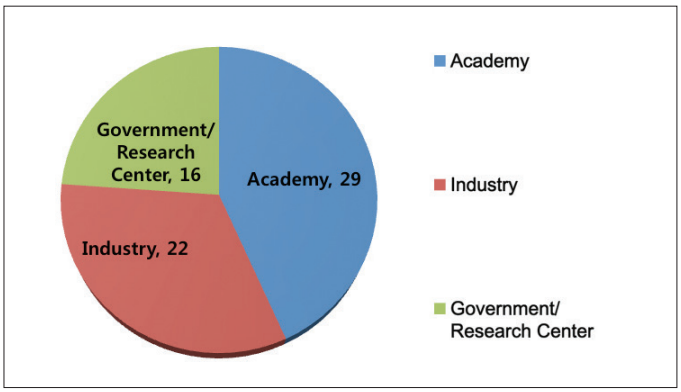
Section	Specific Question
Human Resource/ Education Section	I think exchanging and sharing ideas between expert groups from the two areas are taking place properly.
	I think seminars and conferences are taking place properly.
	I think quantity of experts exchanging is enough.
	I think quality of experts exchanging is enough.
Legal/Monetary Support Section	I think legal support from both sides is enough.
	I think quantity of funds for cooperation is enough.
	It is easy to apply and use the funds.
Policy Appropriateness Section	I think a right policy is set up and applied for cooperation from both sides.
	I think a right policy is set up and applied for cooperation from Hong Kong's side.
	I think a right policy is set up and applied for cooperation from Guangdong's side.
Technical Depth Section	I think the actual cooperation for high technology has been taking place properly.
	I think discussion for actual cooperation has been taking place well.
All-around Section	Overall, I think the cooperation between Guangdong and Hong Kong progress well.
	Overall, I think the cooperation between Guangdong and Hong Kong are actually enhancing science and technology of both sides.

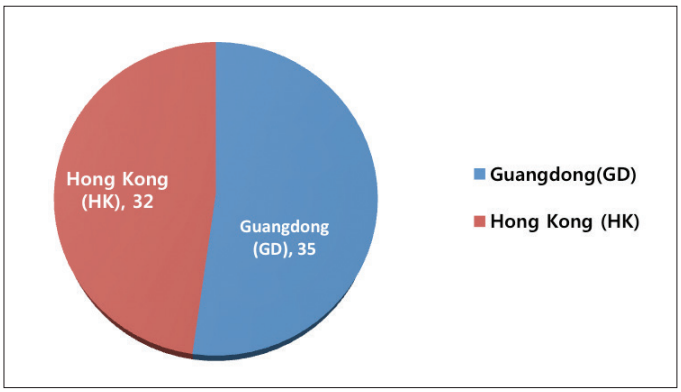
Seven-point Likert scales were provided with the entire questions to measure the experts' recognition of and expectations for the cooperation programs. The responses are noted in the following results chapter.

4.1. Results

As noted before (Figure 2), five questionnaire sections and fourteen specific questions with seven-point Likert scales were developed from the first-round survey. The questions were delivered to the sixty-seven local experts through an online survey page. Sixty-seven interviewees in the second round-online survey had professional backgrounds in academia, industry, or government/research institution. Thirty-two experts were from Hong Kong and thirty-five were from Guangdong (Figure 3).

FIGURE 3. The Characteristics of the Affiliation and Location of the Interviewees

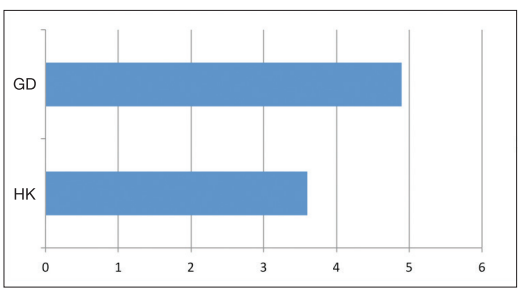




4.1.1. Human Exchange and Education Section

A. I think exchanging and sharing ideas between expert groups from the two areas are taking place properly.

FIGURE 4. Response to Question A.



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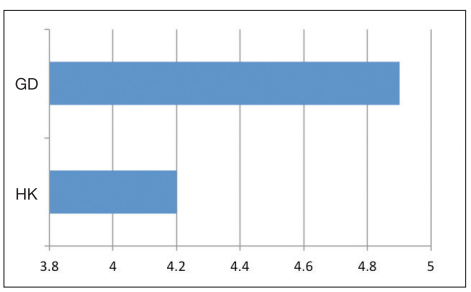
B. I think seminars and conferences are taking place properly.

FIGURE 5. Response to Question B.



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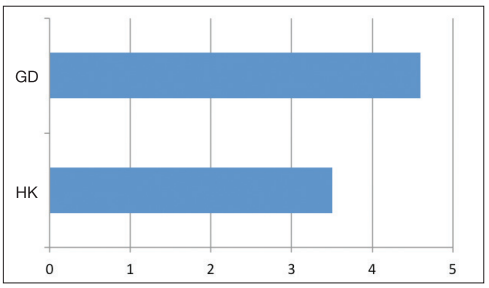
C. I think quantity of experts exchanging is enough.

FIGURE 6. Response to Question C.



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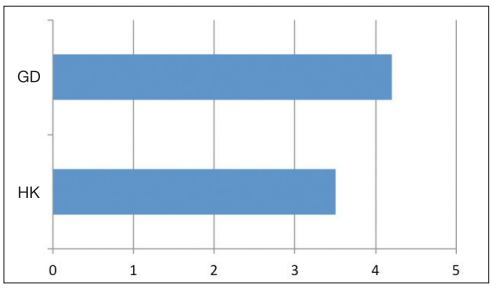
D. I think quality of experts exchanging is enough.

FIGURE 7. Response to Question D.



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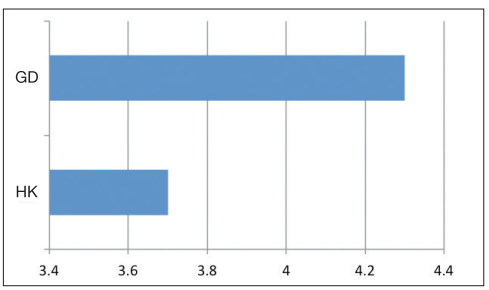
4.2. Legal/Monetary Support

E. I think legal support from both sides is enough.

FIGURE 8. Response to Question E.



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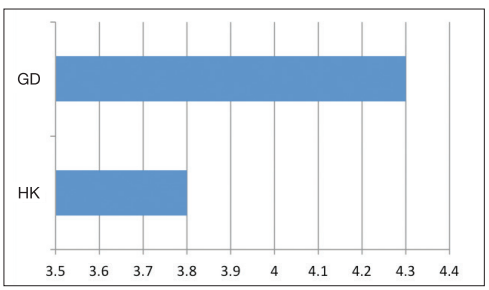
F. I think quantity of funds for cooperation is enough.

FIGURE 9. Response to Question F.



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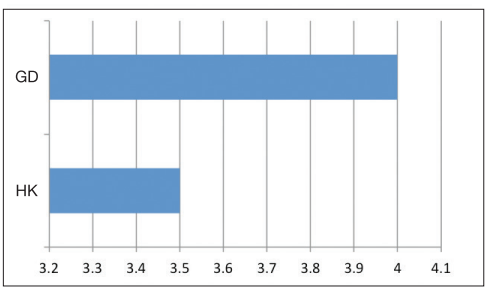
G. It is easy to apply and use the funds.

FIGURE 10. Response to Question G.



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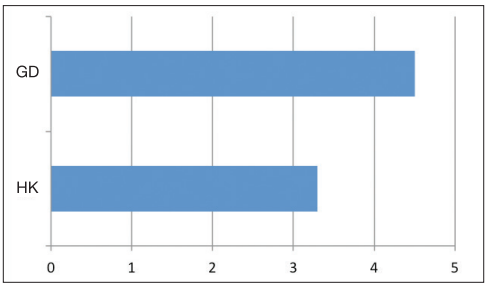
4.3. Policy Appropriateness

H. I think a right policy is set up and applied for cooperation from both sides.

FIGURE 11. Response to Question H.



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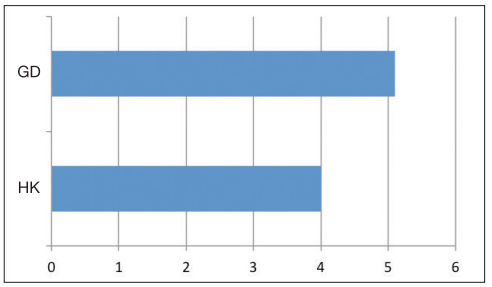
I. I think a right policy is set up and applied for cooperation from Hong Kong's side.

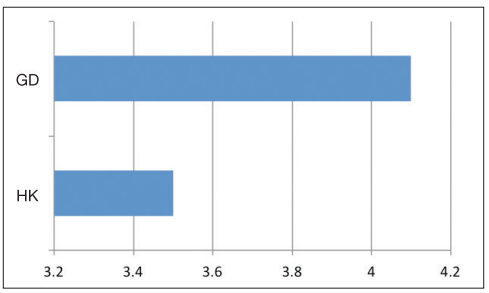
FIGURE 12. Response to Question I.



GD: Guangdong, HK: Hong Kong

J. I think a right policy is set up and applied for cooperation from Guangdong's side.

FIGURE 13. Response to Question J.



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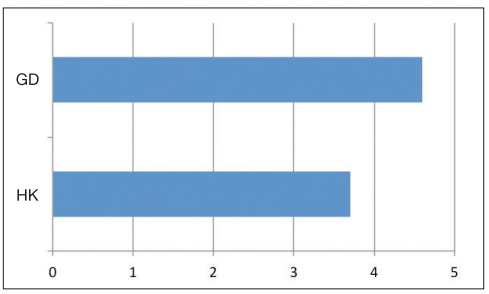
4.4. Technical Depth

K. I think the actual cooperation for high technology has been taking place properly.

FIGURE 14. Response to Question K.



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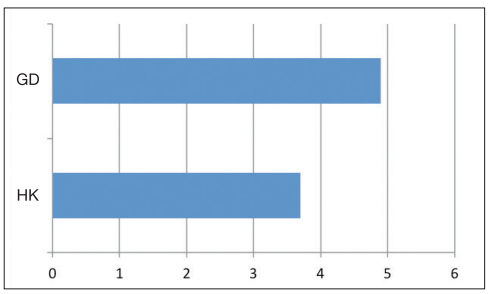
L. I think discussion for actual cooperation has been taking place well.

FIGURE15. Response to Question L.



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4.5. Overall Questions

M. Overall, I think the cooperation between Guangdong and Hong Kong progress well.

N. Over all, I think the cooperation between Guangdong and Hong Kong is actually enhancing science and technology of both sides.

FIGURE 16. Response to Question M.

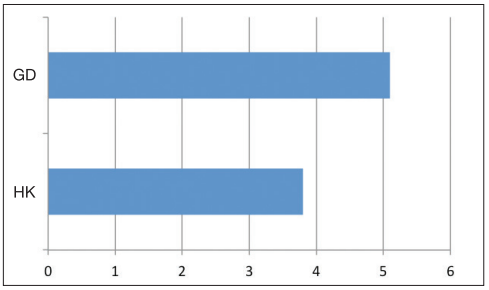

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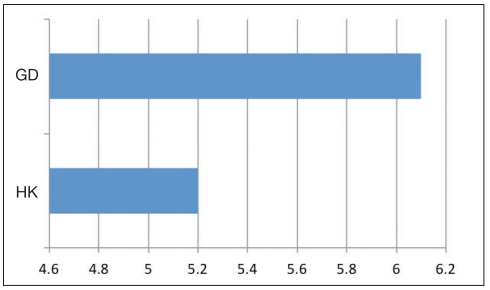
FIGURE 17. Response to Question N.



GD: Guangdong, HK: Hong Kong

5. CONCLUSION

This study explored the various cooperative industrial connections between Guangdong and Hong Kong in order to understand their policies that promote science and technology development on both sides. While science and technology cooperation accelerates the development of Guangdong and Hong Kong's industry and economy, this study's findings indicated some differences in the two local expert groups' recognition of the science and technology cooperation. New approaches for cooperation policy design are needed, particularly in the aspects of monetary and legal support, found unsatisfactory by both regions. Furthermore, there are remarkable differences between the two regions' expert groups in the legal and actual technical cooperation sections. Hong Kong experts were very negative to the supportive policies compared to the Guangdong group, and also gave unfavorable answers concerning supportive policies from Guangdong. Hong Kong in general showed more negative views for every question section and was also in doubt about the science and technology cooperation projects overall. This results from the leading role in the cooperation project. Unlike other collaborations, Hong Kong must be more proactive than its partner and be more responsible in the current science and technology cooperation project process.

This study has a limitation that the Guangdong interviewees are mainly from Zhuhai and Shenzhen. Thus, the sampling area as well as their professional fields needs to be broadened in future studies.

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