

10 Open Innovation for Environmental Research

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Abstract

Innovation plays a key role in driving industries to gain competitive advantage. Increasingly, open innovation is considered a key driver to help industries accelerate the rate of innovation through exploitation of the free flow of internal and external knowledge and expertise. It is believed that industries will thus acquire stronger capability for innovation given the external input of expertise and knowledge that complements their internal capabilities. As a result, such businesses can achieve higher industrial competitiveness than those which rely only on traditional closed innovation approach. University-industry collaboration can be considered as a form of open innovation. Industries, especially small and medium enterprises, are particularly interested in partnering with universities as niche collaborators due to their innovation competence.

In face of intensive competition from other neighboring cities in China like Shenzhen, Shanghai and Beijing, and neighboring countries like Singapore, Hong Kong has increasingly attempted to achieve economic

competitiveness through innovation. University-industry collaboration has been increasingly advocated by the government as an effective means for innovation, such as the development and commercialization of niche technologies for the environment. In 2009-2010, Hong Kong ranked third in Global Innovation Index, out of 132 economies surveyed. In terms of university-industry collaboration, Hong Kong ranked twenty-seven. To gain a deeper understanding of what determines industry-university innovation, this study focusses on all cleaner energy and environmental-oriented Innovation-and-Technology (ITF) funded projects that have been approved since the establishment of Hong Kong Innovation and Technology Fund in 1999 and that have involved university-industry collaboration. A total of 145 out of 2,345 ITF funded projects that carry the theme of cleaner energy and environment research and development during 1999-2010 have been selected. Quantitative surveys and qualitative face-to-face interviews have been conducted to identify what drivers and barriers for this group of ITF industries are involved in their engagement in industry university collaboration, and why these drivers and barriers exist. The

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result obtained shows that majority of the local industries surveyed and interviewed are eager to collaborate with universities in environmental innovation for competitive advantage, especially for gaining reputations and securing future business opportunities. However, huge obstacles exist for local industries to partner with universities, especially for the SMEs, due to policy and institutional constraints. Innovation policies in support of SME innovation and institutional mechanisms to help SMEs find the right university partners are particularly relevant and critical for promoting open innovation (in the form of university-industry collaboration) in environmental and cleaner energy research among local industries in future.

10.1 Introduction

In many countries, innovation plays a key role in driving industries and businesses to gain competitive advantage (Porter, 1998). Increasingly, open innovation is considered a key driver in helping industries accelerate the rate of innovation through exploitation of the free flow of internal and external knowledge and expertise. It is believed that industries will thus acquire a stronger capability for and increase their rate of innovation given the external input of expertise and knowledge that complements their internal capabilities, as a result achieving higher industrial competitiveness than those which rely only on traditional closed innovation

approach (Chesbrough, 2003). Industry-University Collaboration (IUC) is considered a form of open innovation. Industries, especially small and medium enterprises, are particularly looking for universities as niche collaborators as they can obtain the needed innovation competence that they are lacking through university partnership (Schiessstock and Hämäläinen, 2009).

In face of intensive competition from other neighboring cities in China such as Shenzhen, Shanghai and Beijing, and neighboring countries such as Singapore, Hong Kong has increasingly attempted to achieve economic competitiveness through innovation. IUC has progressively been advocated by the government as an effective means for innovation, especially for developing and commercializing niche technologies in various domains, including the environment (Invest HK, 2011). In 2009-2010, Hong Kong ranked third in the Global Innovation Index out of 132 economies surveyed. In terms of university-industry collaboration, Hong Kong ranked twenty-seven (Insead, 2010). It would thus be interesting to observe what drivers and barriers to IUC have influenced industries engaging in innovation in Hong Kong. This study will look at one of the government-selected industries for innovation, the environmental industry, and identify ways to further enhance the sector's technology and innovation competence by means of open innovation – IUC, thereby

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contributing to enhancing Hong Kong's economic competitiveness in the long term.

IUC has been used as a strategy by industries/universities to enhance or speed up the process of innovation. In general, the key drivers to IUC include the economics of innovation: rising costs of production and decreasing revenues from closed innovation (Chesbrough *et al.*, 2006; Melese *et al.*, 2009); reputation management (Fontana *et al.*, 2006); government policies and incentives (Van Looy *et al.*, 2003; Hershberg *et al.*, 2007); openness culture (Van Looy *et al.*, 2003; Laursen and Salter, 2004; Fontana *et al.*, 2006); and reliance on university for expertise and equipment for enhancing internal R&D capability (Fontana *et al.*, 2006; Melese *et al.*, 2009). The key barriers to IUC include fear of disclosure to third parties (Melese *et al.*, 2009), and cultural, norm and value gaps between industries and universities (Fontana *et al.*, 2006; Melese *et al.*, 2009). For instance, as industry and university have different research objectives/foci, some industries may find it difficult to cope with the open innovation culture, lack of coordinating/bridging mechanisms (collaboration ad-hoc and opportunistic, often based on personal relationships), duration of innovation involved (Melese *et al.*, 2009), and problems associated with the distribution and sharing of resources (e.g. budgeting and staffing) (Melese *et al.*, 2009).

Other firm characteristics also affect companies' involvement in IUC. Company size and innovation intensity, and the nature of company business have an impact on IUC. Companies that have a higher dependence on science or engineering, e.g. pharmaceutical or nanotechnology firms, carry a higher track record of IUC (Lausen and Salter, 2004; Fontana *et al.*, 2006; Parkmann and Walsh, 2007). This is the same with companies that have a higher R&D intensity (Lausen and Salter, 2004; Fontana *et al.*, 2006), and, larger firm-size (Fontana *et al.*, 2006). To date, successful cases of open innovation are limited to multinational companies and high technology companies with a considerable company size and capital in global context (Chesbrough, 2003; Herzdog, 2009). Not much work has been done to investigate Hong Kong in the area of green technologies and the potential for local industries to make good use of IUC for enhancing their competitive advantage. This study intends to close the research gap.

10.2 Methodology

To understand the drivers and barriers pertaining to IUC within the context of Hong Kong, a research project was conducted with industries that have successfully obtained project funding from the Hong Kong Innovation-and-Technology Fund and that have been involved in university-industry collaboration during the period of 1999-2011.

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As of October 2010, a total of 145 out of 2345 ITF funded projects fall into the environmental category, 89 of them involving industry-university collaboration.

A closer look at the 89 collaborative projects reveals that 29% of the collaborative projects are energy-related, and within this category renewable energy represents 27% of the total (see Figure 1).

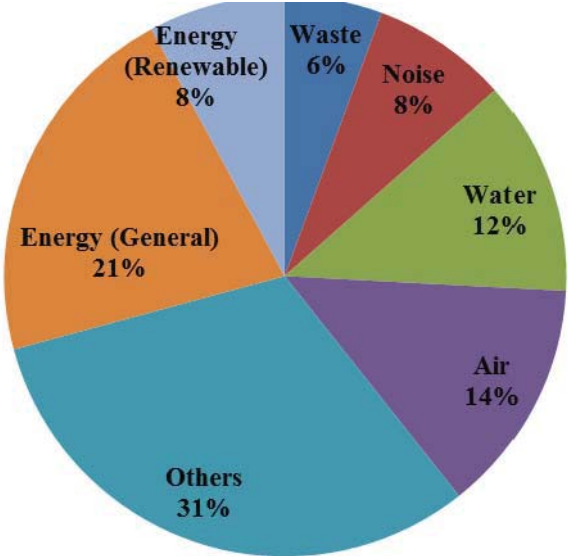


Figure 10-1 *Composition of Industry-University Collaborative ITF-funded Environmental Projects*

To identify the key drivers and barriers for industries to take part in IUC and the types of IUC that these parties have established, an

online-quantitative survey was distributed during October 2010 – March 2011 to all coordinators/deputy coordinators of the companies who partnered with universities in environmental-related funded projects. A total of 12 companies have completed the online-questionnaire. To gain a deeper understanding of how these drivers/barriers influence UIC and how open innovation affects the company’s competitive advantage, we have conducted qualitative face-to-face interviews. 4 companies, including 2 large and 2 SME companies, have been selected for interviews.

12 respondents have completed the survey and responded to our interview. The respondents are top decision-makers of their company, normally in charge of the R&D team, and project coordinators/deputy project coordinators of the ITF-funded environmental projects. Of the 12 companies surveyed, the majority of the companies are SMEs (10 of them having no more than 50 research and non-research personnel); only 2 companies are comprised of a company size of more than 150 staff (including research and non-research staff), and are grouped as large companies. The amount of funding obtained for each ITF project ranged from \$165,000 to \$2,655,000, covering environmental topics ranging from air, water, waste, and energy, to other issues such as climate change, material science, and environmental health and safety.

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10.3 Survey Results

Drivers and Barriers to IUC for Environmental ITF-funded Projects in Hong Kong

The survey attempts to understand the key barriers and drivers affecting decisions of industries involved in ITF-funded environmental projects to collaborate with university partners, the form of IUC they have established, and what areas of competitive advantage these IUC open innovation environmental projects bring to their companies.

A question was raised concerning the key drivers for the ITF-funded industries to adopt IUC for their environmental projects. Among all respondents, “innovative and unique business model with the potential to increase our company’s competitive advantage” topped the list of key drivers for companies to adopt IUC (55% of surveyed companies). In addition,

reputation management, pressure to produce more innovative and user-friendly products, emerging culture for open-innovation in their own business field, limited firm-internal innovation potential, and scale, constituted the second tier driving factors (36%) motivating companies to seek an open innovation approach for R&D through collaborating with universities. However, at the moment, there are few motivations for the surveyed companies to engage in IUC for ITF-funded environmental projects for the sake of skill and knowledge leveraging, compliance with strict environmental standards, intensive competition in the technology market (27%), or for enabling the voice of external stakeholders (18%). Other additional drivers cited by the surveyed companies included: same mission and interests with external partner, and the need to look for external funding and resource support due to limited support from the government for innovation (18%) (see Figure 2).

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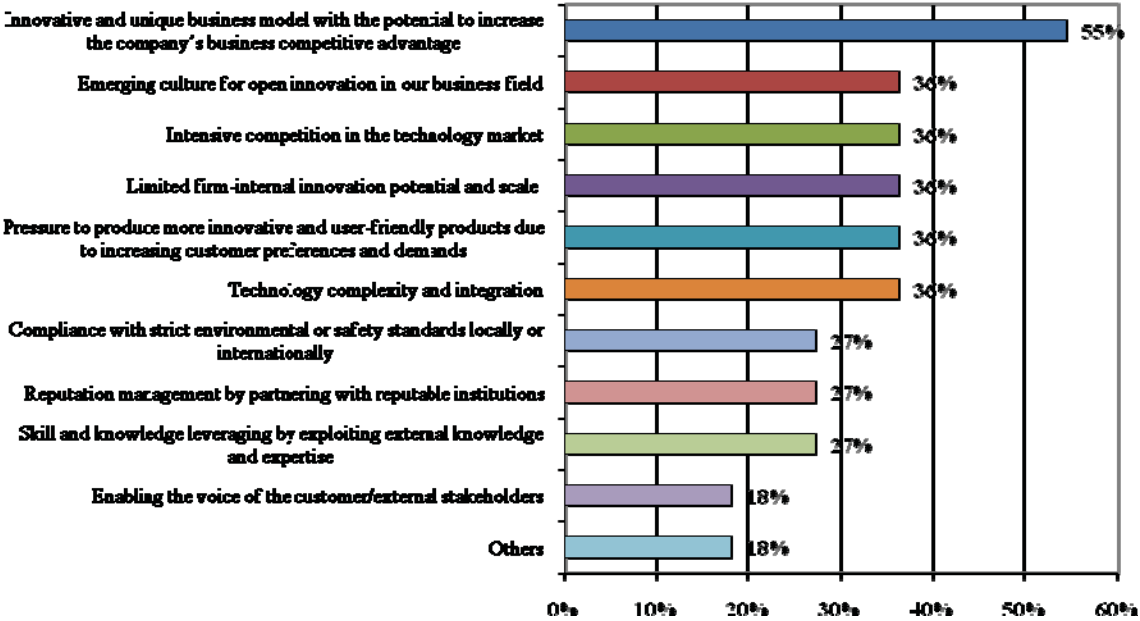


Figure 10-2 Drivers for industries to collaborate with university in ITF environmental projects

To understand the key barriers for the industries to adopt IUC open-innovation for their ITF-funded environmental projects, the majority of companies revealed in the survey that they considered the unavailability of competent external partners to provide the necessary knowledge and technologies for IUC as the key barrier (58%), and the fear of disclosure of their own intellectual property to external partners became the second top rated key barrier (50%). For some companies, innovation was considered a rather easy task and companies did not think they needed to rely on external partners to achieve the target, which was considered by

some a key barrier to IUC (33%). A small number of companies named strong internal competence, difficulty in integrating external and internal knowledge, higher uncertainty and unpredictability concerning overall planning and implementation of IUC projects, as well as the lack of demand for generation of knowledge and technologies that are more client/user responsive (25%) as key barriers. Very few companies considered the absence of corporate policies to incorporate external ideas (8%) as a key barrier. In addition, the lack of funding support, small company scale for R&D, immature technology market, the observation that a lot of claimed

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open innovations are not yet ready for commercialization, and uneven distribution of risks and benefits between industries and universities, were considered by some companies as key barriers (25%). Interestingly, no companies considered that existing

legislation, norms and regulations had discouraged IUC, or that resistance to involving external parties by corporate management was a key barrier to IUC (See Figure 10-3).

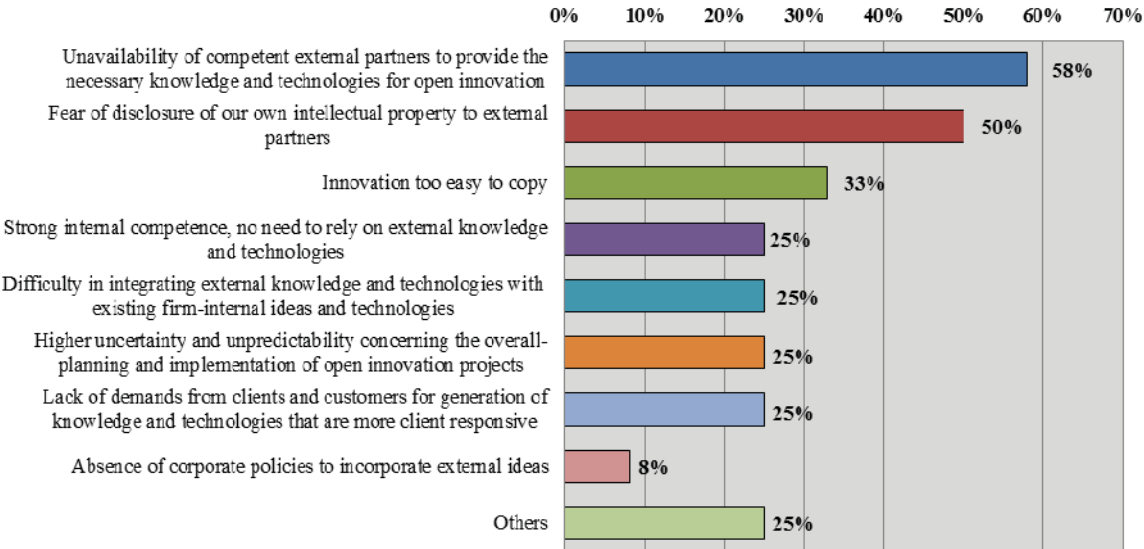


Figure 10-3 Key Barriers for Industries to Collaborate with Universities

An important question was raised over whether an open innovation approach in the form of IUC has led to higher competitive advantage. There was a strong view held by the surveyed companies regarding the overall enhancement in company competitive advantage as a result of collaboration with university partners on ITF-funded environmental projects (Mean Score =

4.45). This group of companies strongly believe that an open innovation approach can lead to higher profitability of open innovation products and services (Mean Score = 4.18); as well as higher user/customer satisfaction (Mean Score = 4.09); and higher innovation competence (Mean Score = 4.00). Companies held neutral to strong views regarding the following aspects of competitive advantage as a result of adopting

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the open innovation approach in the form of IUC, including: reputation management (Mean Score = 3.64); higher cost-saving and

outcompeting industry/business partners (Mean Score = 3.55) (see Figure 4).

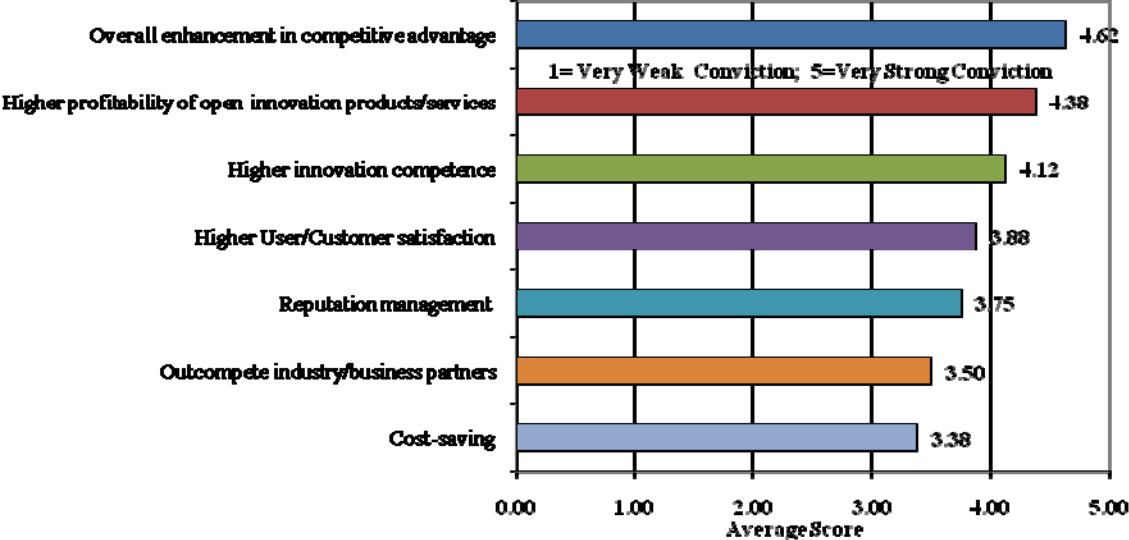


Figure 10-4 Competitive advantage achieved after engaging in Industry-University Collaboration

It would be interesting to understand what types of collaboration companies engaged in ITF-funded environmental projects had established with their collaborators. The use of codified scientific knowledge accessible through scientific publications, conferences and networking with collaborator, the less institutionalized form of collaboration (58%) became the most popular type of collaboration between industries and university partners,

followed by integration of users’ feedback (50%), and more institutionalized forms of collaboration, covering both inter-organizational arrangements for pursuing collaborative R&D (42%), as well as commissioned contract research and consulting between both parties (42%). Industries, however, did not collaborate frequently with universities by means of human resource transfer (25%) or by informal interaction (25%) (see Figure 5).

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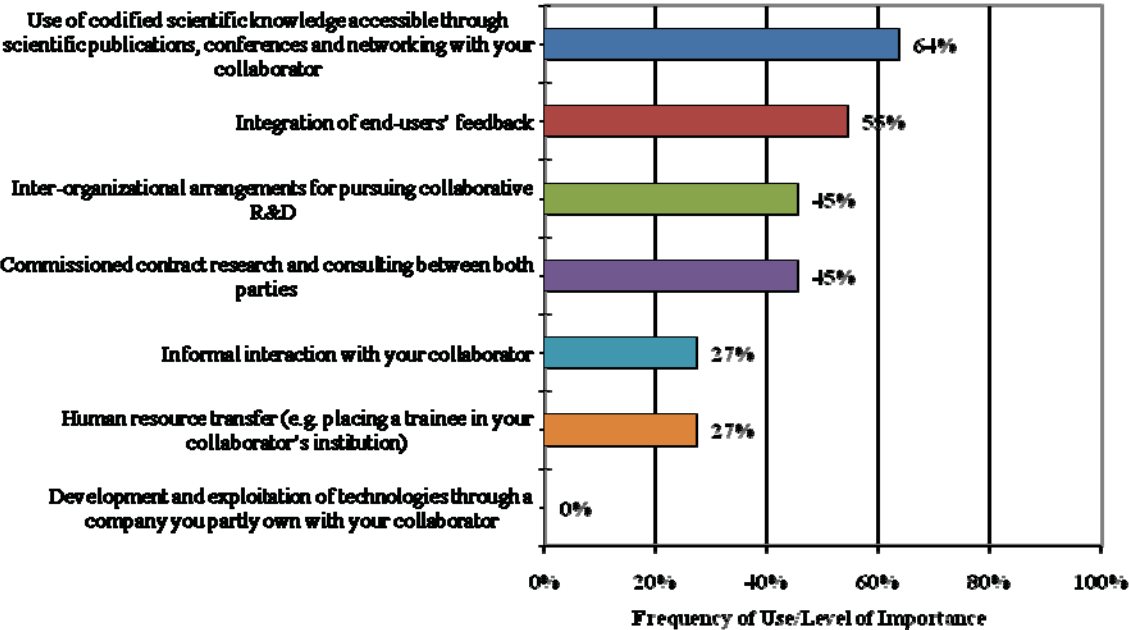


Figure 10-5 Types of Collaboration in Industry-University Collaboration

Finally, concerning the types of external source that industries would frequently use and consider as important external sources in generating ideas or innovations, it is interesting to note that customers were the most frequently used and the most important external source of ideas and innovations (Mean Score = 3.5), followed by lawmakers/regulators (Mean Score

= 3.2), universities (Mean Score = 2.8), research institutes (Mean Score = 2.6), and engineers/consultants (Mean Score = 2.5). Although all companies surveyed had partnered with universities for ITF-funded environmental projects, universities had not been considered the most important external source for generating ideas and innovations (see Figure 10-6).

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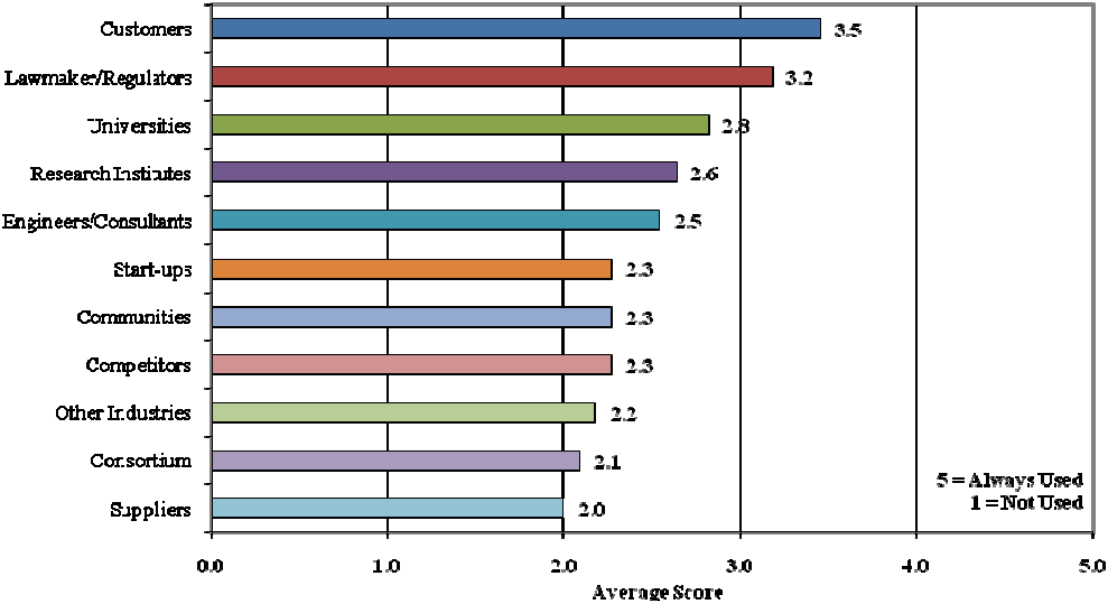


Figure 10-6 Reliance on External Sources for Ideas and Innovations

10.4 Discussion

10.4.1 Open Innovation Drives Competitive Advantage

The quantitative results and case study findings confirm that there is general recognition among the industrial R&D executives that open innovation, such as IUC in ITF-funded environmental projects, has enhanced their company’s competitive advantage. The general agreement that competitive advantage has led to higher profitability and innovation competence reinforces the conception that open innovation

provides a good opportunity for companies to gain competitive advantage (Chesbrough, 2003, Chesbrough *et al.*, 2006). Case studies conducted with SMEs and large IUC companies have revealed that competitive advantage as a result of their engagement in IUC open innovation projects differ in dimensions. Whilst large companies cite the security of future business opportunities and maintenance of a continual positive relationship with clients/customers as two prominent areas of competitive advantage as a result of IUC - open innovation, SME companies have highlighted additional aspects such as product differentiation and profitability.

Innovation turns useless into useful

The poster features the CYBERPORT logo (數碼港) and the 'I love Green Cyberport' logo. The main title is '玻璃樽回收計劃' (Glass Recycling Programme) in large, colorful characters, with 'GLASS RECYCLING PROGRAMME' below it. Text in both Chinese and English explains that two bottles can be recycled into one glass paver. A central illustration shows a green recycling bin labeled 'Glass' filled with various bottles, with a blue arrow pointing to a single rectangular glass paver. A circular badge at the bottom right encourages 'GREEN LIVING' (綠色生活) and joining the effort to protect the environment.

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10.4.2 Key Drivers for IUC Open Innovation

Quantitative data show that the development of an innovative and unique business model with the potential to enhance a company's competitive advantage tops the list of drivers for IUC – open innovation. Cultural factors, technology complexity, limited firm-internal potential and scale, and increasing customer demands for more innovative products create considerable impetus for companies to take the open-innovation pathway by collaborating with universities (see Figure 10-2).

A closer look at the composition of the survey respondents reveals that the majority are SMEs (10 out of 12 companies). These companies are searching for innovative and unique business models to enhance their innovation capabilities, as SMEs generally lack such capabilities in house. Large and small companies look to universities for collaboration to enhance product differentiation and reputation management. Innovative products developed in partnership with universities are considered by clients/customers as more credible and reputable and therefore more competitive in the market. The drivers we identified are consistent with the findings from the literature review on drivers of IUC (see Section 10.1).

10.4.3 Key Barriers to IUC Open Innovation

SMEs are generally characterized by small size and capital ownership, lack of expertise and

resources, and weak networking capability. Universities generally do not find them an attractive partner to work with. This explains why 58% of the survey respondents cited the unavailability of competent external partners to provide the necessary knowledge and technologies for open innovation as the key barrier to IUC (see Figure 10-3). University partners are often not readily available for partnership. SMEs also find it difficult to locate the right candidate for IUC, due to the lack of appropriate institutional mechanisms to match the industrial and university partners. SMEs often miss the opportunities for innovation because of their relatively weak networking capability. Furthermore, the fear of the disclosure of one's own intellectual property to external partners also created another major barrier (50% of agreement) for collaboration with universities in open innovation environmental projects (see Figure 10-3).

10.4.4 Industry-University Collaboration: To Be or Not to Be

Companies are keen to work with universities to acquire ideas and innovation, as universities have good mastery of knowledge and technology and offer a higher chance for success, with a good track record of research ethics and good observers of intellectual property rights. Even though the ITF-funded companies gained competitive advantage through collaboration with universities, in reality, the surveyed companies seem to be

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hesitant with IUC. Although universities are attractive partners, they are often not the right candidate for partnership. These companies prefer working with other external partners such as customers. As shown by the quantitative survey, customers (Mean Score = 3.5) and law-makers (Mean Score = 3.2) are more likely to be partners for ideas and innovations. The scores for universities (Mean Score = 2.8) or research institutes (Mean Score = 2.6) are consistently lower (see Figure 6). Companies, especially SMEs, find it hard to persuade universities for partnership because of their small size and scale of operation and innovation competence, lack of investment funding, and weak networking capabilities, companies.

10.4.5 The Constraints of Local Industries under the Current Funding and Institutional Mechanisms for Technology and Innovation

In Hong Kong, local industries can apply for funding support through various schemes under the Innovation and Technology Fund. In particular, the Small Entrepreneur Research Assistance Programme is set up to support SME innovation. As of 2011, a total of 5798.8 million dollars have been delegated to support 2,345 ITF-funded projects, amongst which only 6.3% is allocated to SMEs under SERAP (Innovation and Technology Commission, 2011a). However, there is a restriction imposed on SMEs in the applications. SMEs are required to contribute 50% of the overall project cost. The University-Industry Collaboration Programme mainly supports collaborative research projects that

involve private companies engaging in commercial business as the applicant, university as a partner, and under the stipulation that 50% of the project cost must be borne by the participating company (Innovation and Technology Commission, 2011b). Other funding schemes, for instance the Innovation and Technology Support Programme and the General Support Programme, are mainly reserved for government-funded R&D centres, academic institutions, or government-related organizations. The current funding mechanism has left little room for industries to self-initiate innovation projects. Industries are either handpicked by universities and other research institutions as collaborative partners or they do not have enough financial funding to kick start innovation. Institutional mechanisms are not readily available to help industries select the most relevant university partner that fit their requirements. While large industrial companies have to rely on their own networks to search for the right candidates, small companies have no such privilege and have to try their own luck.

10.4.5 Policies and Institutional Arrangements for Promoting IUC

In view of the situation above, two measures are necessary to move local industries out of the current deadlock and enable them to take advantage of IUC open-innovation. They include funding support for SMEs in technology development and innovation, and institutional mechanisms to help local industries locate the right university collaborators

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Top innovative countries have focused on supporting SMEs for innovation. Government support mainly consists of monetary funding and the provision of technical know-how. In Germany, up to 450 million Euros of funding support was given to assist SMEs under the ZIM programme during 2009-10. In Sweden, although the SME sector is not a major contributor to R&D, their policies encourage SMEs to innovate. Between the years 2006-2008, the Swedish Agency for Innovation Systems provided 36 million Euros to 360 companies through its “Research and Grow” programme for the SMEs to directly support the SME sector for innovation. Indirect support was provided to let SMEs have access to people with experience in innovation and R&D. In 2006-2007, 67% of the projects involved new collaborations with R&D performers, universities, research institutes or other companies. In Denmark, direct and indirect support was given to support SME innovation. A “double-up” initiative started in 2008 with a funding of DKK 30 million plans to offer public co-financing of research projects between SMEs and academic and research institutions. Institutional mechanism was established to serve as the portal to help SME obtain knowledge from academic and research institutions. For instance, under a programme “Regional Innovation Agents”, SMEs which are not traditionally innovative were contacted to encourage them to imitate regional “innovative agents” through innovation and knowledge

collaboration. Other indirect support was given to SMEs by means of a mentorship scheme. The purpose of the planned scheme was to loan experienced and competent industry managers to SMEs so as to provide them with the right competence and tools for innovation management and to help them develop right strategies leading to innovation (Capgemini Consulting, 2010)

Promoting industry-academic linkage is a prominent trend across top innovative countries in the world; it also constitutes a key pillar of innovation strategies. This linkage is promoted in a number of ways, including: companies promoting commercialization in universities, increasing the number of industrial PhDs co-supervised by industrial enterprises and universities, launching innovation funds to promote entrepreneurship education and technology incubators in universities. In Denmark, promoting interaction and the infrastructure between the research and industry communities are among the key foci of the Danish government. An action plan was developed by a Danish government institution to promote more innovation and effective knowledge dissemination during 2007-2010. The plan covered the SMEs and called for the strengthening of knowledge dissemination and interaction between the research community and industry (Capgemini Consulting, 2010).

Among top innovative countries, direct funding support in the form of public co-financing of

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collaborative projects between industrial enterprises and academic institutions is a good strategy to encourage the local industries. It is especially helpful in engaging SMEs to participate IUC. However, it must be complemented by institutional support. For instance, a portal can be set up to help industries obtain knowledge and expertise from academic and research institutes. Mentorship schemes can be promoted through loaning experienced and competent industrial personnel to the market. Better interaction and infrastructure building can be encouraged in industrial-university collaboration. New funds can be injected to strengthen the linkage between local industries and universities such as entrepreneurship education and technology incubators in universities.

10.5 Conclusion

Hong Kong's industries are at a cross-road. 98.9% of them are SMEs (Trade and Industry Department, HKSAR Government, 2011). With increasing competition from neighbouring cities, such as Shanghai, Beijing and Shenzhen in mainland China, Hong Kong's industries should turn to innovation for enhancing their competitive advantage and securing their competitiveness in the long-term. However, SMEs are characterized by their small size and scale of operation with weak innovation competence, which makes it an attractive idea for them to open innovation by relying on external parties to strengthen their internal

innovation capabilities through capitalizing on external resources and expertise. Collaborating with universities becomes the single most preferred option but huge barriers exist.

Surveyed and interviewed companies which have engaged in ITF-funded environmental projects reveal that companies perceive that there are definite competitive advantages for collaborating with universities, but find that universities are highly hesitant about the idea of collaboration with SMEs. Universities find SMEs not attractive enough with their small size and limited capital, as well as innovation competence. Their plights can be demonstrated by a company interviewed which is keen on collaborating with universities but experiences repeated declines from universities because of the lack of substantial benefits that universities foreseen to be reaped from such collaboration. Though they were able to secure one university partner to collaborate in a renewable energy project at the initial phase of innovation the university had declined to continue the partnership during the second phase.

Compounded by SMEs' weak networking competence, the current situation makes it very difficult for local industries to adopt an open innovation approach and collaborate with universities in environmental and cleaner energy research. Given that 98.9% of Hong Kong's manufacturing industries are SMEs, for the sake of Hong Kong's long term competitiveness, it is vital for the Hong Kong government to

investigate new ways of engaging the local industries, especially the SMEs in IU collaborative innovation projects, by providing relevant direct or indirect supports, including funding and institutional support for the local SMEs. With reference to top innovative countries in the world, more direct funding support, for instance, public co-financing of collaborative projects between industrial enterprises and academic institutions is a good strategy to encourage the local industries to innovate – especially the SMEs. Given the weak networking capability with universities by the SMEs in Hong Kong, complementation by institutional support by, for instance, providing mentorship through loaning experienced and competent industrial personnel to the industries; providing a portal to help industries obtain knowledge and expertise from academic and research institutes; promoting interaction and providing infrastructure to encourage IUC; and injecting funds to help strengthen the linkage between local industries and universities; is necessary to help Hong Kong SMEs enhance their competitive advantage through open innovation in the form of IUC.

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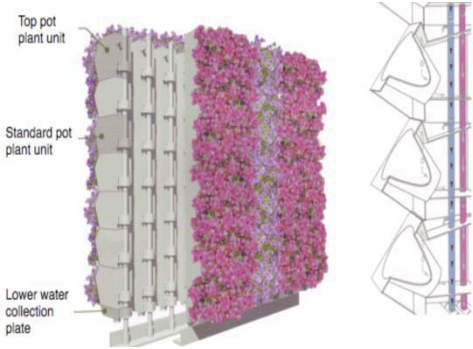
Reference

1. Capgemini Consulting, 2010, *Benchmarking Study on Innovation Policy*, CC India, Research Services.
2. Chesbrough, H.W., 2003, *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Cambridge, Harvard Business School Publishing.
3. [3] Chesbrough, H., W. Vanhaverbeke, and W. en West, J., 2006, *Open Innovation: Researching a New Paradigm*, Oxford University Press.
4. Fontana, R., Geuna, A., Matt, M., 2006, Factors affecting university-industry R&D projects: The importance of searching, screening and signalling, *Research Policy*, **33**, 309-323.
5. Herzdog, P., 2009, Innovation and the open innovation concept, *Open and Closed Innovation: Different Cultures for Different Strategies*, Gabler.
6. Hershberg, E., Nabeshima, K., Yusuf, S., 2007, Opening the ivory tower to business: university-industry linkages and the development of knowledge-intensive clusters in Asian cities, *World Development*, **35**, **6**, 931-940, doi:10.1016/j.worlddev.2006.05.006.
7. Innovation and Technology Commission, HKSAR Government, 2011a, *Innovation and Technology Fund Statistics of Approved Projects*,

Clean Energy and Environment

- <http://www.itf.gov.hk/1-eng/StatView101.asp>
8. Innovation and Technology Commission, HKSAR Government, 2011b, *About the Innovation and Technology Fund*, <http://www.itf.gov.hk/1-eng/about.asp>
 9. INSEAD, 2010, Global Innovation Index Report 2009-2010, INSEAD and India's Confederation Industry, http://www.globalinnovationindex.org/gii/main/reports/2009-10/FullReport_09-10.pdf
 10. Laursen, K., Salter, A., 2004, Searching high and low: what types of firms use universities as a source of innovation? *Research Policy*, 33, 1201-1215.
 11. Melese, T., Lin, S.M., Chang, J.L., Cohen, N.H., 2009, Open innovation networks between academia and industry: an imperative for breakthrough therapies, *Nature Medicine*, 15, 5, 502-507.
 12. Perkmann, M., Walsh, K., 2007, University-industry relationships and open innovation: Towards a research agenda, *International Journal of Management Reviews*, 9, 4, 259-280, doi:10.1111/j.1468-2370.2007.00225.x.
 13. Porter, M., 1998, *Competitive Strategy*, Free Press.
 14. Schienstock, G., Hämmäläinen, T., 2007, *Transformation of the Finnish Innovation System: A network approach*, Sitra Reports, Helsinki, HakaPaino Oy.
 15. Trade and Industry Department, HKSAR Government, 2011, *Hong Kong: the Facts*, <http://www.gov.hk/en/about/abouthk/factsheets/docs/trade&industry.pdf>
 16. Van Looy, B., Debackere, K., Andries, P., 2003, Policies to stimulate regional innovation capabilities via university-industry collaboration: an analysis and an assessment, *R&D Management*, 33, 2, 209-229, Blackwell Publishing Ltd.

**Green-roof and Green-wall Technologies
Developed by an ITF-funded Companies in
Hong Kong by Open Innovation - IUC**



Barriers of IUC

- Time consuming
New collaborative partners need to be brought up-to-speed and gain familiarity with research topics
- Time constraint in short-term internship programme for students may be inadequate in allowing collaborative R&D to be conducted

Drivers of IUC

- Ability to develop a new business model for enhancing competitive advantage
- Business trust – gain credibility through collaboration with university
- Prospect of future business opportunities
- Long-term competitive advantage

Courtesy of Everplant Technology Ltd.

