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Growing R&D in Emerging Economies: Implications for International Management and Competitiveness

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Abstract

This paper presents the typology of overseas R&D, by interacting the direction of knowledge flow between home and host countries and the distinction of "research" and "development", namely (1) technology driven, (2) cost driven, (3) market driven, (4) policy driven, (5) production driven and (6) innovation driven. The management style of local R&D sites is different depending on the type of its R&D activity. For example, for a local R&D activity based on home base exploiting strategy (cost, market, policy and production driven), networking with local innovation system (local firms, university and public research institutions) is less important, but technology driven R&D (based on home base augmentation strategy) requires substantial interactions with local players. In this sense, more autonomy on local R&D activities is needed to facilitate effective knowledge flows at local. Finally, a balance of knowledge flows within firm (headquarter and overseas subsidiary) and within local (subsidiary and local players) is important for innovation driven R&D. In addition, it is important to manage the balance between benefit such as seizing market opportunity and costs such as knowledge leakage to local competitors, particularly for technology and innovation driven R&s sites. Furthermore, in this paper, the relationship between local R&D type and international competitiveness model is discussed. As multinational R&D in emerging economies grow, double diamond model, which takes into local specific factors of overseas sites, as well as domestic factors, focused by original diamond model by Porter, becomes more relevant to analyze international competitiveness of nations.

Keywords: double diamond model, emerging economies, international R&D management, international competitiveness of nations, knowledge flow

Introduction

An UNCTAD survey identifies China as the country that firms from developed nations such as Japan and the nations of North America and Europe consider most important as a site for R&D activities (UNCTAD, 2005). The world's leading high-technology firms, including IBM, Microsoft, Motorola, Nokia, Sony, Toshiba, Hitachi, Fujitsu, NEC, and Samsung, have opened research facilities in China, where they carry out R&D activities with global implications (von Zedwitz, 2004). Studies show these activities are focused on production-driven activities intended to improve production processes at production sites and market-driven activities intended to develop products meeting the needs of local markets (Motohashi, 2010). Quantitatively, China is home to a larger pool of R&D human resources than Japan, producing more than 200,000 science-and-technology graduates from its universities each year, giving it an abundance of relatively inexpensive, high-quality human resources. In other words, China is a location well-suited to the cost-driven establishment of R&D facilities. Research done at China's leading universities, including Peking University and Tsinghua University, are regarded as top-notch even by international standards. Additionally, numerous new business ventures revolving around information technologies have emerged in Zhongguancun in northern Beijing, where these universities are located, prompting some observers to dub the area "the Silicon Valley of China." Numerous high-tech firms, including IBM and Microsoft as mentioned above, have established

R&D facilities in this area, which are active in various technology-driven R&D activities (Chen, 2007). In addition to China, an overseas place of R&D for multinationals is shifting toward to emerging economies, such as India and Brazil from developed countries (von Zedtwitz, 2004). In this study, management issues to conduct R&D in emerging economies are discussed. Due to significant differences in economic conditions and institutions, multinationals in developed nations face great challenges in managing their R&D centers in emerging economies such as China and India. First, this paper presents the framework of typology of overseas activities. Then, we discuss about the managing the costs and benefits of R&D activities to provide some management implications for multinationals.

Typology of Overseas R&D Activities

An overseas R&D activity can be grouped into the following two categories: (1) technology-acquisition activities intended to apply advanced technologies from overseas to domestic business activities; (2) local-development activities intended to localize overseas business activities based on domestic technologies. The two categories differ primarily in the direction of the flow of technologies and knowledge crucial for R&D, with flows going from the counterpart country to the home country in the former case and from the home country to the counterpart country in the latter. Kuemmerle (1997) defined the former as home-base augmenting (HBA) and the latter as home-base exploiting (HBE). Cantwell and Mudambi (2005) called the former "competence-creating R&D" and the latter "competency-exploiting R&D." R&D intended to acquire technologies takes place when technologies a firm wishes to acquire are present in the country in which it invests. An example would be the case of a firm establishing a research facility in a region such as Silicon Valley or in the greater Boston metropolitan area in the US to acquire advanced technologies in fields such as IT and biotechnology. On the other hand, important factors when localizing products for markets in counterpart countries based on the firm's own technologies include the size of markets in the country invested in and differences between local consumer needs and those of the home country.

The two categories differ primarily in the direction of the flow of technologies and knowledge crucial for R&D

In addition, Gammeltoft (2006) categorized such activities as follows, based on a comprehensive study of the nature of activities of overseas R&D facilities studied primarily by business administration researchers:

(1) Market driven: gathering information on local consumer needs and localizing products

(2) Production driven: technical support for local production facilities

(3) Technology driven: acquisition of advanced local technologies and monitoring of local technological trends

(4) Innovation driven: gathering ideas for new products from the local market and strengthening global product-development structures through the optimal delegation of responsibilities

(5) Cost driven: utilizing low local labor costs

(6) Policy driven: responding to various local regulations or participating in R&D incentive programs or local standardization activities

To examine the content of overseas R&D activities in greater detail, we will separate these activities into the two constituent elements of research and development, with "research" referring to activities at a more abstract level and having no specific product or service image in mind and "development" referring to activities with specific outputs in mind, such as the development of new products. By interacting the typology of Kuemmerle (1997) using the direction of knowledge flow between home and host countries and the distinction between "research" and "development", six types of R&D activities by Gammeltoft (2006) can be illustrated as the Figure 1.

The technology-driven category may be seen to be largely the same as that of technology-acquisition (or HBA-type) activities. Clearly, the issue of concern is that the concept of local-development (or HBE-type) activities contains a truly diverse range of content. While the closest of the six categories is the market-driven category, the policy-driven and production-driven categories, broadly speaking, can also be grouped under local-development (or HBE-type) activities. For the policy-driven category, this is because compliance with various regulations as well as market needs are important factors for product localization. Numerous standards and regulations require localization activities, including environmental regulations and safety standards for motor-vehicle exhaust, safety standards for cosmetics and pharmaceuticals, and electrical standards for electronics products. In many cases, shipping products that fail to meet these standards can result in significant costs and damage to brand image and the company's reputation. Development and study to monitor developments in various regulations and compliance with relevant standards is an important function with respect to managing such risks.

The production-driven category represents a development function for localization from the standpoint of optimizing local production processes. Production-driven local development functions are especially important for automakers. Producing motor vehicles locally requires building a local supply chain of parts makers. Conceivably, automakers could adopt a knockdown assembly method of importing all important parts from Japan. However, in certain cases, this method is not feasible, due to local-content regulations, or because the percentage of parts procured locally may need to be increased to cut

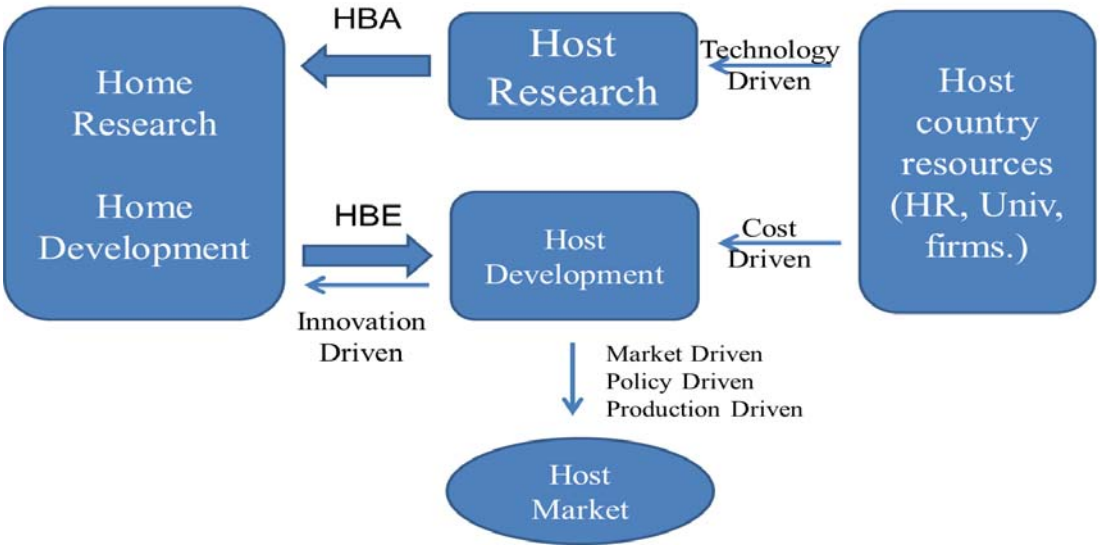

Figure 1: Typology of Overseas R&D

manufacturing costs. When using parts from local makers, parts must be inspected to confirm that they meet the automaker's standards. Given the difficulty of finding parts that meet the levels required by Japanese automakers in emerging markets like China and India, there is often a need to establish production processes to achieve quality levels for finished vehicles comparable to those achieved when using imported parts, even when using parts that may offer somewhat inferior quality. Thus, local activities intended to realize production processes suited to the conditions of production sites are important.

Cost-driven and innovation-driven R&D represent activities not taken into consideration when grouping activities into the categories of technology-driven or local development. The goal of cost-driven R&D is to reduce the cost of R&D activities by transferring them to emerging markets. Since R&D is an advanced intellectual production activity, little consideration to date had been given to establishing such activities in emerging markets. However, countries with low wage levels such as China and India have improved their higher-education institutions and each year graduate large numbers of high-quality science and technology human resources. Western and Japanese software firms were the first to identify these conditions, opening a succession of offshore development facilities in India, China, and elsewhere. This trend has spread to design and development activities for electronics products such as medical devices and telecommunications equipment. This cost-driven approach is spreading not just to the development field, but to research. Microsoft's research unit has opened Microsoft Research Asia in Beijing, where hundreds of researchers take part in advanced research projects. IBM's research unit has also opened research facilities in the cities of Beijing, Delhi, and Bangalore, which now play an important role in the company's globally oriented R&D system. In their research units, these firms have realized the globally linked organization advocated by Ghoshal and Bartlett (1990).

The final category, that of innovation-driven R&D activities, refers primarily to adoption in development sections of activities and ideas from the overseas country in the home country. While this can be said to be the most advanced of efforts in R&D internationalization, the numbers of actual examples are few. Still, cases in which product-development ideas from emerging markets are applied to global products are expected to grow as the leading role in global markets shifts from developed to emerging markets. A concept deeply related to this point is reverse innovation. Based on the case of a portable ultrasound diagnostic device developed in China by GE Medical, products developed based on the needs of emerging markets becoming successful products in the home country, in this case, the US (Immelt et. al, 2009). The term "reverse" is applied to this concept because it involves products embodying local product-development ideas from overseas returned to the home country. This is an advanced concept with which to examine global R&D management.

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Implications for International Management and Competitiveness

As regards to R&D management in emerging economies, it is important for multinationals to understand local economic institution and business environment. Frist, the level of technology in universities and firms in emerging economies is relatively low, so that the activities at local R&D sites tend to be development rather than research one. Motohashi (2010) shows that major part of multinational R&Ds in China are production driven or market driven. In

addition, cost driven R&Ds are also found particularly in a software company, such as Microsoft. Among these three types of R&D, partnership with local player is particularly important for market driven R&D, since a local market needs is too much different from home country, so that it may be difficult to understand without help of local players. In contrast, production driven R&D, providing technical and process engineering support to production lines, is often co-located with factory. Due to increasing cost pressure for overseas production, a multinational is always seeking for new local suppliers. In this sense, it becomes important to conduct R&D for fitting production facility to local parts and materials with relatively lower quality. However, this activity can be managed by intra firm communications between home and host sites. As for cost driven R&D, an access to well qualified human resources is important, so that it might be effective to make strong relationship with local universities. Some US firms, such as Microsoft, IBM and Intel, invest in local universities in China very much, by way of providing scholarships, joint research agreements and holding symposiums. However, the style of R&D management should be centrally organized, as is the case of production driven R&D, and there may not be a lot of interactions with local players.

A typology of overseas R&D activities also provides useful guideline for international competitiveness framework

An interaction with local universities and firms is beneficial in a sense of accessing local information, knowledge and human resources. However, it is important for multinationals to be aware about the cost associated with local interactions. In a process of information exchange and joint research activities, knowledge flow occurs in both way, and advanced technology at multinationals leak out to local players. The speed and volume of such technological leakage depends on (1) relative difference of technological level between multinationals and local players, (2) type of product architecture and (3) technology management of multinationals. First, technology leakage is not so detrimental when technology gap is so large, and local players cannot catch up with easily. Second, it is more difficult for local players to catch up when technology is complex in nature which is consisted by various components inter-related each other. Complex machinery such as automobiles and industrial machinery is a good example. In contrast, modularized products such as computer and electrical appliances, which can be decomposed into parts easily, can be more easily imitated.

Finally, technology management for deterring technology leakage is important. Intellectual property protection is one way to appropriate economic rent from invention, but enforcement of IP system is generally weak in developing economies. In addition, a high labor turn over facilitates technology leakage embodied in human capital, even though a firm tries to protect its technology by trade secret. One way to control technology leakage is to introduce complexity in product design, which makes reverse engineering slower. Another technique is making a core technology part of product "black box", and shipping it from home country instead of producing in local factory. In addition, some firms control information access by their employees to mitigate the damage associated with labor turnover. In order to introduce such system in operation, a firm needs to construct company-wide knowledge management system, and information policy inside firm based on the system.

A technology leakage is one of major concern at multinational's R&D in emerging economies. However, a firm should not be over-protective in its activity. An effective R&D management overseas is based on win-win interactive process with local players, and too cautious approach impedes a great opportunity in seizing valuable information and resources at local economies. Motohashi (2011) shows that Japanese firms cannot use local information very well, as compared to their European and US competitors in China, due to their technology leakage concern. Therefore, a good balance between openness and well managed information control system is important to maximize the rate of return by investing R&D in emerging economies.

A typology of overseas R&D activities also provides useful guideline for international competitiveness framework. Porter's diamond model is widely used for analysis of competitive advantage of nations (Porter, 1990). This framework identifies four location specific factors to determines international competitiveness, namely, (1) firm strategy, structure and rivalry, (2) factor conditions, (3) demand conditions and (4) related and supporting industries. However, double diamond model, which takes also into account overseas factors, as well as domestic factors, focused by original diamond model, is more relevant for open economies such as Canada (Rugman and D'Cruz, 1993). As multinational R&D in emerging economies grows, the concept of double diamond model becomes fitted to developed countries with large domestic markets as well. Multinationals of Europe, Japan and the United States facilitates linkages of knowledge between their home countries and emerging economies such as China and India. As economic importance of those developing countries grow, the national competitiveness of large developed countries cannot be determined solely by their domestic factors, but their complementarity with another diamond in emerging economies becomes more and more important.

References

Cantwell, J. And R. Mudambi (2005) NME Competence Creating Subsidiary Mandates, *Strategic Management Journal*, 26, 1109-1128.

Chen Y-C (2007) The Upgrading of Multinational Regional Innovation Networks in China, *Asia Pacific Business Review* 13(3), 373-403.

Gammeltoft, P. (2006) Internationalization of R&D: Trends, Drivers and Managerial Challenges, *Int. J. Technology and Globalization*, 2(2006), 177-199.

Ghoshal,S. And C. Bartlett (1990) The Multinational Enterprise as an Interorganizational Network, *Academy of Management Review,* 15(4), 603-625.

Immelt, J. R., Govindarajan, V. And C. Trimble (2009) How GE is Disrupting Itself, *Harvard Business Review*, September 2009.

Kuemmerle, W. (1997) Building Effective R&D Capabilities Abroad, *Harvard Business Review*, March-April 1997.

Motohashi, K. (2011) Measuring Multinational's R&D Activities in China by Patent Database: Comparison of European, Japanese and US Firms, a Paper Presented at Academy of Management Conference, August 2011, San Antonio, TX.

Motohashi, K. (2010) Management of Offshore R&D in China: Motivations and Cross Country Differences, *ChinaÿWorld Economy*, 18(6), 2010/11, 56-72.

Porter, M. E. (1990) *The Competitive Advantage of Nations*, New York, Free Press.

Rugman, A. M. And D'Cruz, . R. (1993) The Double Diamond Model of International Competitiveness: Canada's Experience, *Management International Review*, 32(2), 17-39.

UNCTAD (2005) UNCTAD Survey on the Internationalization of R&D: Current Patterns and Prospect on the Internationalization of R&D, UNCTAD, Geneva, December.

Von Zedtwitz, M. (2005) International R&D Strategies of TNCs from Developing Countries: The Case of China, in Globalization of R&D and Developing Countries, Proceedings of the Expert Meeting, United Nations, Geneva.

Reflecting Applicability in Real Life

Is knowledge flow becoming more important in your firm and industry? How do you plan to leverage?

What strategy seems to be more common in your industry? Which element of typology of overseas R&D will become important for your firm?

Do you see any trends towards modular architecture or otherwise in your industry? What implications do you see?

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