11 International R&D Management

11.1 Introduction

In order to enter into foreign markets with technical strength, it has become increasingly critical for Japanese companies to maximize the effectiveness of research and development. In addition to global western firms, companies in Korea, China, and other emerging nations are gaining strength. To maintain a superior position in relation to these competitors, Japanese companies must develop products that are attractive to customers in a timely fashion. For this purpose, research and development (R&D) will require the best personnel in a company and companies must deal with strategically crucial information. Furthermore, as a place to amass cutting-edge information, it is most efficient to determine a base and concentrate the R&D efforts. Accordingly, global firms with many foreign sales and production offices opt to keep R&D activities within their home countries.

Recently, however, globalization is occurring even within the R&D departments of Japanese companies. Till now, companies that had foreign R&D facilities typically operated them inside advanced western nations; however, in recent times, companies have increasingly begun establishing R&D centers in emerging nations such as China. The primary battlegrounds for global businesses are transitioning from advanced nations like Japan, Europe, or the US to China, India, and other emerging nations. Thus, companies find it effective to create local development centers to accurately capture consumer needs and expeditiously introduce new products into the market. In addition, most customers in emerging nations still do not have very high income levels; therefore, it is important to provide products with sufficient features at low cost. To develop new products for these "good enough" markets, companies must keep development costs under control by keeping R&D in markets with low wages.

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Companies conduct various activities to meet these objectives within their foreign R&D centers. In this chapter, we discuss management of foreign R&D by first understanding Japanese corporate trends regarding foreign R&D. The Japanese corporations became globally active in a significant way in 1985, around the time of the Plaza Accord, when the value of the yen began to climb. However, internationalization of R&D is a relatively recent trend, beginning after the year 2000. Next, we introduce a theory of the internationalization of R&D activities in three points: (1) Should R&D be conducted in foreign countries? (2) If so, what kind of R&D should be transferred to foreign countries? (3) Which countries are appropriate targets for expansion? Finally, we discuss examples of reverse innovation, or the expansion of local innovation into global markets, the latest topic regarding R&D in emerging nations.

11.2 Foreign R&D Activities of Japanese Companies

The strengthening yen after the Plaza Accord of 1985 enabled an acceleration of expansion into foreign markets among Japanese companies. This expansion temporarily diminished with the bursting of the economic bubble in the first half of the 1990s and the impact of the 1997 Asian economic crisis; however, the long-term trend over the last 20-plus years has been toward corporate globalization. R&D internationalization has also gathered steam since 2000 (Fig. 11.1). Out of a total of 22,864 foreign facilities, 667 are designated for R&D activities, representing a little

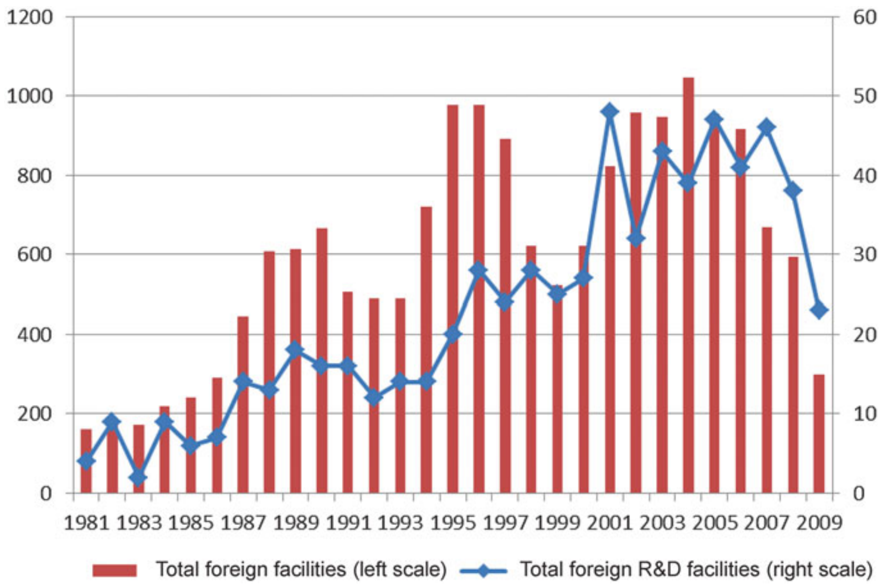

Fig. 11.1 Number of foreign subsidiaries and R&D facilities by year of establishment (*Source*: Toyo Keizai Shinhousha 2011)

more than 3 % of the total. In recent times, the number of foreign operations conducting R&D has increased (Toyo Keizai Inc., "Kaigai Shinshutsu Kigyo Souran 2011"). Three periods of peak can be observed in globalization trends among the Japanese firms: the latter half of the 1980s, mid-1990s, and post-2000. The first two peaks were largely because of a rising yen that drove companies to manufacture overseas to avoid exchange rate risks: during the 1980s, the strong yen was seen post-Plaza Accord; during the 1990s, the exchange rate broke the 80 yen to the dollar barrier, reaching a high of 79.75 yen (April 1995). Overseas expansions in the 2000s were different than what occurred during the two prior peak periods, as trade and investment barriers were lowered because of the IT revolution, WTO negotiations, and free trade agreements, all phenomena of a flattened world. Among these phenomena, China's entry into the WTO in 2001 had a great impact on the sudden rise in the number of companies entering that market. The timing of the increase in foreign R&D facilities also coincided with the dawn of global economy.

Many types of activities come under the foreign R&D facility nomenclature. However, these activities can be divided into two types: (1) "technological acquisition" R&D, which incorporates cutting-edge technology developed overseas into domestic operations, and (2) "local development" R&D, which localizes technology developed domestically into foreign operations. The key difference between the two types is the direction of the flow of technology and knowledge important to R&D: in the first, the flow is from the foreign country to home country, whereas the latter is in the opposite direction. Kuemmerle terms the first "Home Base Augmenting" or HBA, and the latter "Home Base Exploiting" or HBE (Kuemmerle 1997). HBA holds true when a desirable technology exists in an investment destination; for example, companies that create research centers in Silicon Valley or outskirts of Boston to acquire cutting-edge IT or biotech technology. On the other hand, HBE is focused on market scale or market characteristics rather than the technological level of the investment destination. When local consumer needs differ from those in the home country, it becomes necessary to localize products; for example, the creation of R&D centers in China to localize home appliances such as washing machines or refrigerators for the Chinese market (Fig. 11.2).

Let us examine the R&D centers of Japanese firms more closely. Of the 667 foreign entities conducting R&D, 222 are in the US and an almost equal number, 205, in China; next is Europe with 100. These three regions total 527 R&D facilities, a lion's share of Japan's foreign R&D centers. The US and Europe are important markets for Japanese firms and, at the same time, are significant regions with superior technology. Accordingly, Japanese firms have used these R&D centers for both "technology acquisition" and "local development."

Within the US and Europe, R&D centers focusing on chemical and pharmaceutical research comprise a relatively high share of total R&D, where aggressively introducing leading technology is of utmost importance. This explains the high share of "technology acquisition" R&D centers in this region. In addition, the US has a relatively high number of R&D centers focused on electronics and IT, and those in Europe are focused on automotive research. We can interpret this as a manifestation of the differences in technological superiority by industry. The US has

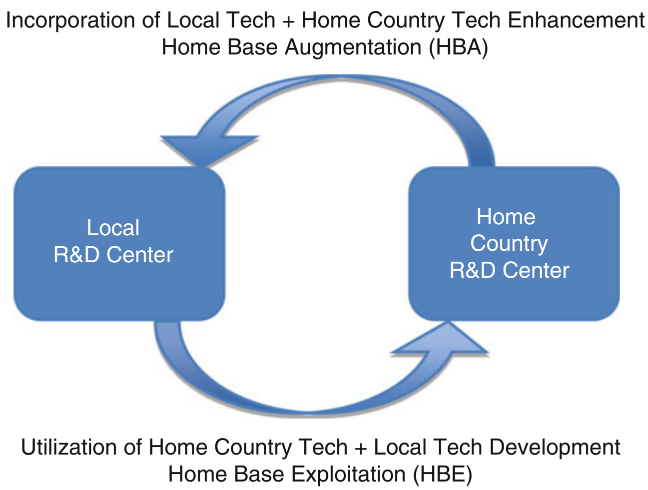

Fig. 11.2 Types of R&D internationalization

Table 11.1 Overseas R&D facilities by region and industry

	Chemical and pharma	General equipment	Automotive	Electronics and IT	Other	Total
China	31 (15.1 %)	18 (8.8 %)	26 (12.7 %)	84 (41.0 %)	46 (22.4 %)	205 (100.0 %)
NIES	10 (25.6 %)	3 (7.7 %)	3 (7.7 %)	16 (41.0 %)	7 (17.9 %)	39 (100.0 %)
ASEAN	1 (2.1 %)	2 (4.3 %)	8 (17.0 %)	19 (40.4 %)	17 (36.2 %)	47 (100.0 %)
US	53 (23.9 %)	11 (5.0 %)	15 (6.8 %)	85 (38.3 %)	58 (26.1 %)	222 (100.0 %)
Europe	16 (16.0 %)	9 (9.0 %)	17 (17.0 %)	31 (31.0 %)	27 (27.0 %)	100 (100.0 %)
Other	9 (16.7 %)	0 (0.0 %)	2 (3.7 %)	10 (18.5 %)	33 (61.1 %)	54 (100.0 %)
Total	120 (18.0 %)	43 (6.4 %)	71 (10.6 %)	245 (36.7 %)	188 (28.2 %)	667 (100.0 %)

Source: Toyo Keizai Shinhousha (2011)

many firms and research organizations with superior technology in the IT arena, as represented by Silicon Valley, whereas Europe has many automakers and auto parts manufacturers with superior technology (Table 11.1).

Many Japanese corporations have R&D centers in the emerging nation of China in addition to the US and Europe. Since the 1990s, the Chinese government has pursued an aggressive policy of introducing foreign capital, making China the "factory of the world." In addition, with the expansion of its economy and rising income levels of its citizenry, China's appeal as the "market of the world" has increased, sustaining strong level of investments in the country. Recently, the Chinese government has announced a policy for raising the technological capability of homegrown enterprises, describing this policy with the catchphrase "indigenous innovation."

Because China is the most important foreign market for many Japanese firms, "local development" R&D centers in China that can develop products based on the local market needs are deemed to be necessary there. Since China has abundance of low-cost, high-quality personnel, many companies also outsource their product development to China. More than 40 % of R&D centers in China are in the electronics and IT sectors. These industries spend a high percentage of their revenues on research and development, and much of their human resources on product development. Thus, they can expect to see huge cost reductions from outsourcing their product design and development. On the other hand, China has relatively few auto-related R&D facilities. Developing a new vehicle in the automotive industry requires a vast amount of resources, and with business in China often being done in joint ventures with local partners, many companies are hesitant to transfer R&D functions out of the fear of technology leaks (Table 11.1).

Activities within the newly industrialized economies (NIEs; Korea, Taiwan, Hong Kong, and Singapore) or ASEAN (excluding Singapore) countries are very important for the Japanese firms. The technological level of NIEs is very high compared with other countries in Asia, such as China or the ASEAN nations. This explains the relative abundance of R&D centers in chemical and pharmaceutical fields, where "technology acquisition" is important. In particular, Singapore is investing in the biotech industry, and has established itself as biocluster with R&D facilities including those of western pharmaceutical manufacturers. The share of electronics- and IT-related R&D centers is also growing, although this is primarily in Korea and Taiwan, where progress is being made on development centers' infrastructures.

The ASEAN countries saw many investments made in their countries by the electronics and automotive industries during the initial foreign investment boom in the 1980s. Prior to China adopting more open policies during the 1990s, the ASEAN countries provided important investment destinations for Japanese firms, with some facilities boasting relatively long history. However, the creation of R&D facilities in these regions is a fairly recent trend, with the share of electronics- and automotive-related R&D facilities growing. For the electronics and IT industries, many operations begin as offshore R&D centers. It is expected that the automotive industry will establish R&D functions locally as adjuncts to its manufacturing operations. The automotive production facilities within the ASEAN countries are concentrated in Thailand, with the Japanese manufacturers moving forward in creating development centers in the Bangkok vicinity. Most of these facilities were created after 2000.

11.3 R&D Internationalization Theory

In this chapter, we explain three points regarding theories of R&D internationalization in the following order. First, we discuss the need to create a research facility in a foreign country. The incorporation of latest technologies available overseas and development of products adaptable to local needs are possible without the establishment of overseas facilities. For example, information about foreign markets can come from academic groups or research papers, and it may be more efficient for product development to be done centrally within domestic operations. We categorize the merits and demerits of conducting R&D in overseas facilities.

Next, we discuss the purpose of a company to create a foreign R&D facility. The comparison between the "technology acquisition" model and a "local development" model provided above is one way to frame the argument, but there are many possible activities that a R&D facility can perform. For example, offshoring design and development of electronics can be difficult to place in either of the aforementioned categories. Moreover, we discuss the best means for position development facilities to promote local parts supply, as automakers expand overseas. An explanation of a more detailed method of classification is given below.

Finally, we discuss the means of how companies can select candidate countries for their expansion. To proceed with global expansions of R&D facilities, an important question for any business is "which are the appropriate countries to expand". For example, a company may want to create design and development operations for electronics products in emerging nations; however, should a company co-locate these facilities with their sales operations in China or build new facilities in India? Discussions such as these occur daily in global enterprises. It may come down to the types of work done by a company's local operations, but many facets should be considered, such as the level of technology in local universities and research centers, quality and cost of research personnel, intellectual property institutions, and economic incentives for investment. We discuss each of these points below.

11.3.1 Merits and Demerits of Foreign R&D Centers

We have not treated the "research" and "development" aspects of R&D centers independently up to this point, but now discuss them separately. The term "research" denotes activities more abstract than products and services, whereas the term "development" denotes any activity that creates plans for specific new products and services. These two activities are often performed separately within corporations. For example, for a general electronics equipment manufacturer with several divisions, such as computers, appliances, and telecommunications equipment, "research" is executed by the "R&D Division" or the "Central Research Center," i.e., a corporate division not belonging to any one division. On the other hand, "development" is often done in specific product divisions such as the appliances division or telecommunications equipment division. Within pharmaceutical companies, research typically refers to activities performed prior to the clinical trials process, whereas everything afterwards is considered “development.” As with an electronics manufacturer, “research” and “development” are typically executed in separate divisions, with former being conducted in research laboratories and the latter in development divisions. In debating whether to place the functions of “research” and “development” in an overseas setting, a company considers the issue within each organization and division. In other words, research facilities are overseen by research divisions, whereas development facilities are overseen by respective divisions. The reporting structures for overseas facilities basically flow upward through each organization in the home country.

“Research” and “development” activities tend to be more centralized within headquarters than “production” and “sales” functions, and the level of internationalization is also said to be low (Asakawa 2003). There is a theory of gradual development within corporate internationalization that mentions companies pass through four stages of development: (1) indirect exports (i.e., using trading companies), (2) direct exports (creating local sales subsidiaries), (3) local production, and (4) consolidated sales and production centers (Dunning 1993). “Research” and “development” are functions that companies ultimately transfer to their foreign facilities during the final stages of development, when globalization has reached its furthest point. We have seen the globalization process followed by the Japanese firms in Fig. 11.1, and noted that the creation of R&D facilities started after 2000, much later than production or sales facilities. In conducting research and development, new research topics, product ideas, and viewpoints are paramount; however, there are many hidden areas of tacit knowledge, and these activities are most efficiently carried out by groups with certain focus. Further, information on new products and services is strategic for some companies, and if leaked, it could damage the company significantly. When we consider these factors together, we see that companies must be more deliberate about the creation of R&D facilities than their production or sales facilities, when located geographically distant from headquarters. When the proportion of overseas activities of a company increases and consolidated centers are being built offshore, in fact, it is common to conduct a portion of its R&D overseas.

By conducting research overseas, companies can efficiently incorporate local technology. Having continual contact with local universities, research organizations, and the science community as a whole allows for advancement in technology acquisition (or home base augmenting). For example, many electronics and pharmaceutical companies have research centers in Silicon Valley on the West Coast of the US for the exclusive purpose of gathering information regarding the latest research and technology trends in real-time. Having this listening function located right at the scene of events enables joint research with local researchers as necessary or research facilities in home countries to capitalize on. New discoveries are made in cutting-edge disciplines on a daily basis, and so the merits in creating local centers to use this information as quickly as possible are large. Research has shown that companies with foreign research organizations designed for technology acquisition use technology from foreign scientific communities more effectively alongside their own research and development (Iwasa and Odagiri 2004).

On the other hand, the merits of creating "development" centers overseas are not as clear. The objective of "local development" (or home base exploiting) operations is to bring in products and technologies that are already competitive in their home countries and localize them to meet the needs of the local consumers. The key points to consider are as follows: (1) the high level of technology in the home country and (2) gathering local information for localization. The latter is a part of marketing, making it unnecessary for the development itself to occur locally. For example, Panasonic created a Life Research Center in Shanghai, and uses this center to survey how Chinese consumers use appliances. The center was created primarily as a marketing function to support a particular division, with actual product development managed by the company's headquarters.

However, many Japanese global firms have overseas development centers, and have them for several reasons. First, these centers can reduce development costs. For example, average salaries for new college graduates in China are about one-tenth of that of their Japanese counterparts. Companies with development centers in countries with abundant engineers, like China or India, have their centers in these countries to greatly reduce costs. In addition, local support is required to meet products' safety or other regulations. For example, pharmaceutical companies conduct clinical trials in each country to ensure compliance with drug regulations in that country. In such cases, local development centers are a must. As can be observed, the purposes for creating overseas development facilities and their activities vary depending on the circumstances of each company. This is discussed in further detail in the next chapter.

We discussed whether "research" and "development" functions should be performed overseas or not. We conclude this portion of the discussion by summarizing the relationship between a company's home country and its foreign facilities. International R&D projects can be classified into four types (Ghoshal and Bartlett 1990):

1. Center-for-global: developing new products and processes in the home country for global markets
2. Local-for-local: developing products and processes for local markets independently in each foreign R&D center
3. Locally for global: developing products for global markets in foreign R&D centers
4. Globally linked: developing products with multiple R&D centers in various markets networked together

The pattern to be selected depends on the type of project and corporate policy; however, pattern (1) is typically chosen by companies whose foreign R&D organizations play a small role. These foreign organizations are effective in finding the latest technologies, but they do not need to be large-scale in nature. Projects for (2) and (3) require foreign R&D centers. Type (2) is the norm for R&D centers that work as a part of integrated companies existing in each region, and are most independent from their respective parent company organization. Type (3), on the other hand, often operates as foreign R&D centers controlled by the home country, targeting global markets. Type (4) is the pattern used when a company has a global project in which multiple regions participate.

11.3.2 Activities of Foreign R&D Centers

There are many ways to classify the activities of foreign R&D centers, including Kuemmerle's HBA and HBE. Gammeltoft created the following classifications on the basis of a comprehensive empirical research of R&D internationalization that occurred up until that time (Gammeltoft 2006):

1. Technology-driven: acquisition of local cutting-edge technologies and monitoring of technology trends
2. Market-driven: incorporation of local consumer needs and product localization
3. Policy-driven: responding to local regulations, participation in local standardization movements, and incentives for R&D
4. Production-driven: technology support for local production facilities
5. Cost-driven: utilization of local low-cost labor
6. Innovation-driven: acquisition of ideas for new products from local markets and strengthening of global product development structure through optimal division of labor

To increase the understanding of each of these classifications, the following figure (Fig. 11.3) describes in greater detail the simple framework of HBA and HBE

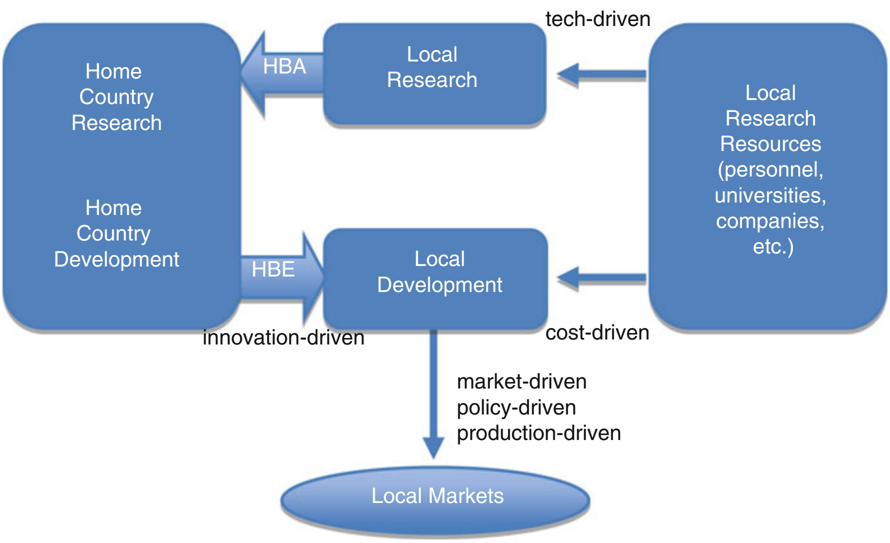

Fig. 11.3 Typology of overseas R&D activities

in Fig. 11.2. The main point to note is the separation of "research" and "development," which were treated together in Fig 11.2.

Reviewing our previous explanation of "technology acquisition" (HBA) and "local development" (HBE) models, the former is primarily a "research" function, where activities in foreign research centers strengthen research capability in the home country. The latter shows primarily product localization by development teams using home country technology as a foundation.

However, in its simplification of activities performed by various local R&D entities, we can see that this framework overlooks several key points. Returning to Gammeltoft's six classifications, we can view "technology-driven" as being more or less the same as "technology acquisition" (or HBA). The issue is with "local development" (or HBE), as the concept in reality contains various significances. Of the six classifications, the closest is "market-driven." However, "policy-driven" or "production-driven" can also be generally classified as "local development," or HBE, models. As for the "policy-driven" classification, product localization requires compatibility with regulation, in addition to market needs. There are many standards and regulations that must be met when localizing products, such as environmental regulations and safety standards for exhaust gasses in the automotive industry, safety standards for cosmetics and pharmaceuticals, and electronic standards for electronic goods. If a product is shipped that does not meet these standards, it may not only cause accidents, but if violations were to become known, it can also often lead to great loss such as reputational damage. In view of these risks, monitoring of regulations and research and examinations that comply with such standards are important functions of foreign R&D centers.

In addition, from the perspective of optimizing local production processes, the "production-driven" classification is a development function for localization. A local development function for the "production-driven" model is particularly important for automakers. Creating supply chains that incorporate local parts manufacturers is important for local automobile production. Of course, it is possible to make vehicles via knock-down assembly by importing all critical parts from Japan. However, local content regulations may not allow for such methods, and furthermore, increasing the share of locally procured parts is essential to reducing manufacturing costs. When using locally manufactured parts, it is necessary to conduct inspections to ensure that parts conform to an automaker's specifications. In emerging nations like China or India, it can be difficult to find parts that meet Japanese automaker's standards, making it necessary to modify production processes to achieve the same finished vehicle standard using parts of somewhat lower quality. Therefore, local research and development is necessary to achieve production processes that match local circumstances.

"Cost-driven" and "innovation-driven" are patterns not covered by "technology acquisition" and "local development" R&D models. R&D for "cost-driven" models is done in emerging nations, the goal being to reduce costs. R&D is an advanced intellectual production activity, and until recently, conducting R&D in emerging nations has not really been considered. However, in countries with low-wage levels, such as China and India, the level of institutions of higher learning has risen, enabling quality engineers to be produced in greater numbers each year. The first to observe this phenomenon were western and Japanese software firms, the results of which were successions of development centers being built in India and China. This has since spread to electronics design and development in the medical device and telecommunications industries. Further, note that the “cost-driven” approach has spread to the “research” arena, and not just in “development.” Microsoft’s research group created the Microsoft Research Asia organization in Beijing, which has hundreds of researchers working on leading-edge projects. IBM’s research division also has research facilities in Beijing, Delhi, and Bangalore, which play an important role in IBM’s global research and development. These corporations have created globally linked research organizations of the type advocated by Ghoshal and Bartlett (1990).

Finally, “innovation-driven” R&D activities are those that incorporate ideas from foreign markets into new product development processes. Many companies have global product development centralized in divisions at headquarters, with overseas R&D centers playing a supporting role. However, local innovations are obviously necessary for localized products. “Innovation-driven” activities are conducted in foreign development centers created with the expectation of new innovations, ideas, and concepts from local markets. Product development ideas from emerging nations being used for global products will surely become more common in the future.

11.3.3 Selecting a Destination Country

The final point of our discussion on R&D internationalization is the question of which countries to expand into. In this stage, the characteristics of the countries in question are listed and the relative merits of each debated. Various cultural, administrative, geographical, and economic characteristics following Ghemawat’s CAGE framework, outlined in Chap. 2, can be listed. From the perspective of geographical locations for R&D centers, the administrative and economic characteristics are particularly relevant. The administrative aspects may include preferential policies for R&D of foreign firms, or the environment for IP protection, whereas the level and costs of R&D personnel are examples of important economic factors. When selecting locations for overseas R&D facilities, the following items and related issues can be considered as important economic factors (Chiesa 1995):

- Startup costs: wage levels of research and engineering staff, facilities costs.
- Startup resource quality: quality of research and engineering staff
- Organization costs: administrative fees for starting a new research center, costs for creating internal organization infrastructure and hiring researcher
- R&D infrastructure: networking services with local universities as in science parks, investment incentives for research center startup

Many market-driven and production-driven R&D centers are co-located with existing local sales and production facilities. Because a company may already have a certain level of activity within a country, the locations of R&D centers may be decided by creating them alongside production facilities that have been around for some time. However, when creating a new facility, it is important to survey the above factors and compare them against expectations of such facility in selecting ideal locations from a list of candidates.

Furthermore, to understand the quality of available research and technology staff, it is beneficial to begin by acquainting with the state of each country's science and technology industries. For example, when comparing India and China, China's GDP is approximately three times that of India, and total R&D spending is more than six times. In addition, an examination of R&D spending by sector reveals that most spending in India is done by government-related research organizations and that the innovation abilities of private companies are quite low. On the other hand, R&D spending by private companies in China is growing. From this, we can glean that finding development resources among private companies in India who can be immediate assets is difficult, whereas the possibility of finding advanced technology in government research centers is high. In contrast, China has deep pools of quality research and development talent. China has a greater number of R&D personnel than Japan and is an attractive target location for R&D centers. However, China has weak intellectual property institutions. Thus, when building an R&D center in China, companies must be stricter with their technical information. Note that these comparisons merely consider macrolevel R&D environments, and because both China and India are large countries, circumstances vary greatly by region. For example, universities and research organizations conducting advanced research have centered on Beijing, whereas corporate innovation is largely led by Shanghai and the surrounding Yangtze area, and Shenzhen in the Zhujiang area. Thus, it is important to closely observe the state of R&D infrastructure in each region and city.

11.4 Reverse Innovation

We now explain reverse innovation as a concept for the locally-for-global model that utilizes innovations from emerging nations in global products. This concept arose from a case study of a portable ultrasound device developed by the Chinese subsidiary of GE Healthcare (Immelt et al. 2009). GE Healthcare attempted to sell a device in China, for which it had a high market share in the US. However, because the price was too high, the company decided to develop a new low-cost product in its development center in China. The development center understood that Chinese hospitals needed low-cost products even though these products may somewhat lack precision in making diagnoses; therefore, they created a low-cost product built around a standard computer. This product was a major success. Thus, in our story, this was a local-for-local project, but GE Healthcare made the decision to sell this product in the US. The product swapped what had until that time been performed by hardware with software, making it small, light, and portable. It became a strong seller in the US, creating new demand for its use in ambulances and the personal-use

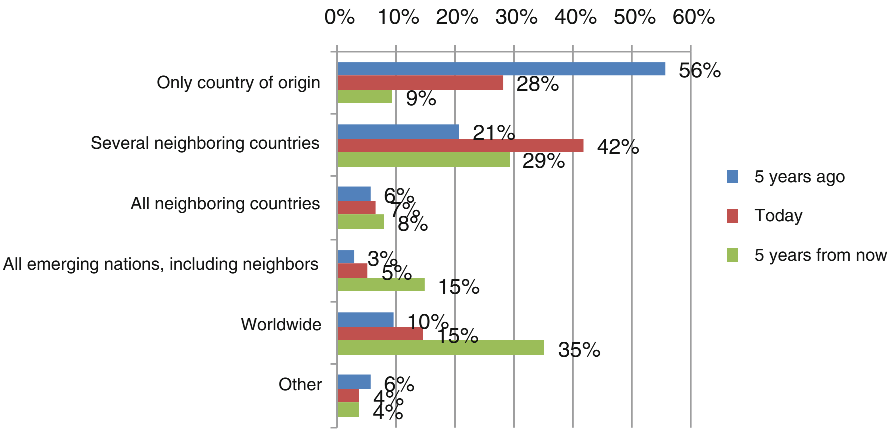

Fig. 11.4 Sales destination of products designed in emerging nations (*Source*: Ministry of Economy, Trade, and Industry 2010)

market. These cases in which an emerging nation's product is sold in a company's home country are termed "reverse innovation."

There are not many cases of reverse innovation occurring within advanced nations similar to GE Healthcare's case. However, it is likely that cases with products developed in one emerging nation such as China being sold in another emerging nation like India will become more common. Figure 11.4 shows the results of a survey sent to the Japanese firms regarding sales destinations for products designed in emerging nations (Ministry of Economy, Trade, and Industry 2010). The companies answering that products were sold only in the emerging nations in which they were developed dropped from 55.6 to 28.2 % in 5 years. This figure is predicted to be 9.3 % in another 5 years. On the other hand, 14.6 % of companies responded that they sold these products worldwide, and this number is predicted to rise to 35.2 % in another 5 years. This clearly shows a trend from local-for-local to local-for-global in product design within emerging nations.

However, there are many issues in seeing this trend come to fruition. In *Reverse Innovation*, Govindarajan states that a totally new management approach and a change in management vision that makes emerging nations its engine of growth are necessary for companies from advanced nations to succeed in emerging nations. This is because business environments in emerging nations are completely different than those in advanced nations (Govindarajan and Trimble 2012). With regard to national differences in the approach to global business, we have till now discussed Ghemawat's CAGE distance framework and Khanna's institutional voids. In cases where distances or voids are too great, a complete overhaul in management thinking becomes necessary. In GE Healthcare's ultrasound device project, the company set a goal of delivering a project having 50 % of the performance at 15 % of the price. This shows the fundamental differences in needs between customers (in this case, hospitals) in the US and China. Reaching this goal was impossible without modifications to current products, and therefore, the research center in China decided to start its own unique product development project.

The GE Healthcare project started out as a local-for-local model with local development of a product for local use. If one scours through global companies, these types of projects, if small, can certainly be found. However, for a product to be rolled out globally, in which a company invests great resources, it requires a change of thought process at the management level. The top management must decide how far they will go to include emerging markets in its future corporate growth. In GE Healthcare's case, Immelt, the company's chairman at the time, had a project leader reporting directly to him, facilitating great accomplishments by breaking down barriers both inside and outside the company.

However, there are great risks in making large investments in new markets that have completely different business environments from those in advanced nations. In high-risk high-return investing, lowering the risk as much as possible is the key to management. In addition, it does not mean that all aspects of a project should be left to the local subsidiary just because a company has that local project based on a new idea. However, the risk on a project of this sort will be somewhat high, thereby requiring the commitment of top management. As can be observed from the GE Healthcare's case, a company may wish to form a highly independent Local Growth Team (LGT) that reports directly to the top management. LGT leaders should be those from the headquarters who possess abundant business experience working in emerging nations. In addition, it is important to consider how heterogeneous elements will be incorporated into the corporation as a whole. While the LGT monitors the progress of projects, it can be effective to place resources and organization as bridges between the home and emerging nations to bring in local ideas for new businesses and share them across the company (Washburn and Hunsaker 2011). Typical Japanese firms have made decisions about corporate strategy with more homogeneous personnel than western firms. To capture the emerging markets' growth opportunities, these firms will need to incorporate more heterogeneity. This will be a great challenge for Japanese companies, but as global competition heats up, managements must face these challenges with gravity.

11.5 Conclusion

In this chapter, we discussed the globalization of R&D by first uncovering the state of Japanese companies and its trends, and subsequently introducing theoretical aspects of R&D internationalization and the research results of Chinese R&D management as case studies. The theoretical aspects include the following questions: (1) Should R&D be done overseas? (2) If so, what activities should be shifted overseas? (3) Which countries are appropriate for overseas R&D? For the first two questions, it is appropriate to consider "research" and "development" separately. The purpose of research is to bring in advanced technology from overseas. Development has a variety of goals, which include the following:

- Technology-driven (incorporating advanced foreign technology)
- Market-driven (incorporating local consumer needs and product localization)

- Policy-driven (responses to local regulations, R&D incentives, and participation in local standardization activities)
- Production-driven (technical support for local production facilities)
- Cost-driven (utilization of cheap local personnel)
- Innovation-driven (acquisition of local ideas for new products, strengthening of global product development structures through optimal division of labor)

The countries and regions that are targets for overseas R&D need to be considered in conjunction with the above R&D activities, alongside institutional factors such as preferential policies for foreign R&D firms or intellectual property frameworks of the country and economic factors such as the level of local R&D personnel and costs.

Furthermore, we introduced the concept of reverse innovation, in which innovations from emerging nations are rolled out to global markets. Because of the vastly different business environments between emerging nations and a global company's home nation, global companies often cannot respond by just improving products originally made for the home nation for local markets. In these cases, it is necessary to develop products with a completely new mindset using a team focused on the unique qualities of the local subsidiary. Commitments from the top management for these projects, and resources and organizations to bridge the gap between both countries are necessary to incorporate local innovations into corporate-wide activities.

Finally, we must comment on topics not raised in this chapter with regard to R&D internationalization. First, we need to address the question of how reporting lines in overseas facilities should be structured. As shown in this chapter, it is easier to discuss "research" and "development" separately. "Research" in overseas facilities is often a part of home country's corporate research groups or R&D centers, whereas "development" is often performed within the division of each product line. However, there are recent movements to strengthen the connections between "research" and "development." For example, many divisions outsource certain projects to corporate research groups, and researchers that conducted basic research in the firm's research center are transplanted to development groups to manage projects for specific products and services. In these cases, the reporting lines of research centers and operating divisions in overseas research organizations can become entangled, creating the risk of decreased efficiency. In these instances, companies must consider on a project-by-project basis whether the technology or region axis is more important and structure reporting accordingly. For example, for projects that have a common technology platform, it is effective to work under the home country's research group; for projects that involve regional business development, it is effective to work under the regional headquarter. Of course, both sides must share information, but matrix organizations with multiple reporting lines often do not work well.

In addition, as a practical matter for overseas R&D management, the management of technical information is important. The importance of this issue differs greatly between research and development groups. Research groups often conduct basic research in a relatively open fashion, whereas development groups often handle details with high degree of confidentiality, such as nonpublic, new products information, and project cost structures. Of course, measures such as increasing of building security and having nondisclosure agreements as part of employment contracts are critical, but overseas personnel are mobile, and the above measures may be of limited effect. In addition, companies with overseas production may find it possible to treat technically critical parts as black boxes and export them from Japan or to not send all product design documents out of the country. However, in development, communication of critical technology with headquarters is fundamentally necessary. Thus, carefully setting the level of technical information and limiting access, or depending on projects, concentrating product development in headquarters and having local R&D centers focus on information gathering such as communicating local needs and following up on regulatory changes are also possibilities.

In conclusion, we would like to promote open innovation at the local level. The global R&D activities of Japanese firms are often conducted with a centralized authoritarian style that revolves around the company's headquarters. This style functions effectively when customizing global products for local markets, but has weak information flow from local markets back to the headquarters, which would include access to local technology and integration of local innovations. In partnerships with local universities, the Japanese firms will conduct joint research with clear objectives, whereas the western firms tend to take a longer view of partnerships, sponsoring broadly themed seminars, providing scholarships, and establishing endowed chairs. With markets opening up globally led by the emerging nations, there is a strong need for diversity in R&D perspectives and ideas. Companies will be required to grant a certain amount of autonomy to local R&D centers and utilize more open management styles that spread the seeds of innovation around the globe.

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