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PERSPECTIVES

Internationalization of R&D in China and India: Conventional wisdom versus reality

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Abstract In spite of a growing trend of foreign research and development (R&D) investment in China and India, academic research in this field has not kept pace. To what extent are opportunities and challenges of managing R&D different in these countries from those in the West? By drawing on academic literature as well as press articles on this topic, we compare and contrast what the conventional wisdom suggests and what the realities are in China and India. We suggest that multinational corporations (MNCs) should not forget the conventional wisdom of managing their innovative R&D policies but should also learn from the unique challenges and capabilities in China and India.

Keywords International R&D · China · India · Conventional wisdom · Reality

The phenomenal growth of the Chinese and Indian economies accompanied by the increasing foreign direct investment (FDI) in these two countries has led to an increase in foreign research and development (R&D) activities in this region. The challenge of foreign firms is to know how to best organize themselves to stay competitive. It is an increasingly pressing question as the challenge from China, India and elsewhere in Asia gathers momentum. This is especially true in the case of R&D.

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A growing number of Western and Japanese firms have been launching their R&D operations in China and India. The Economist Intelligence Unit (EIU), in its survey of 104 senior executives conducted in 2004, cited China and India as the world's leading R&D hotspots along with the United States. In the survey, 39% and 28% of respondents answered that their companies plan to spend the most on R&D in China and India, respectively, in the next three years. More recently, the *Wall Street Journal* reported that more than three-quarters of R&D sites planned through 2007 were slated for India and China (Rajagopalan, 2006). Developed countries' R&D investments in India concentrate on such sectors as information technology, telecommunications, automotive, pharmaceutical and biotechnology, whereas their R&D investments in China are centered on the personal computer (PC) and telecommunications industries followed by chemical, petrochemical, pharmaceutical, biotechnology, automotive and transportation industries. In terms of the nationality of investing companies, the presence of US, European, and South Korean companies stands out in India. Meanwhile, in China, US companies have the greatest presence, followed by European and Japanese companies (Bowonder & Richardson, 2000; Gassmann & Han, 2004; von Zedtwitz, 2004).

However, in spite of this growing trend of foreign R&D investment in Asia, academic research has not kept pace with it. Although there exists a growing body of literature on the topic,[1] until recently, researchers have primarily focused their attention on the R&D internationalization within the West (Ambos & Schlegelmilch, 2004, 2007; Dalton & Serapio, 1995; Hakanson & Nobel, 1993; Hakanson & Zander, 1986; Niosi, 1999; Ronstadt, 1977), as locations for the overseas R&D and the R&D headquarters. Japan has been the focus of attention as the only non-Western location within the multinationals' R&D networks (Asakawa, 2001; Iwata, Kurokawa & Fujisue, 2006; Iwasa & Odagiri, 2004; Kurokawa, Iwata & Roberts, 2007; Papanastassiou & Pearce, 1994; Odagiri & Yasuda, 1996; Westney, 1993).

It is only recently that the interest in R&D investment in China has grown, but we still do not know much about the uniqueness of opportunities and challenges facing the R&D internationalization in China.[2] Even less is known about international R&D in India. A reason for this neglect in the past may be due to the rapidly emerging status of this region as a site for R&D investments. Another reason may be the conventional wisdom that R&D is the most universal function and therefore is least affected by the regional specificity of Asia. However, we argue otherwise. Specifically, we argue that managing R&D in emerging economies such as China and India call for an approach which may differ from what the conventional wisdom (Wright, Filatotchev, Hoskisson, & Peng, 2005) would suggest.

Thus the key research question that we try to address in this article is the uniqueness for multinational corporations (MNCs) in managing their R&D in China and India. Specifically, to what extent are opportunities and challenges of managing R&D in these countries different from that in the West? After briefly summarizing some of the conventional wisdom of international R&D management in general, we

[1] The special issues of *IEEE Transactions on Engineering Management* 43(1) in 1996 and of *Research Policy* 29 in 1999 are among the most visible ones.

[2] The Special Issues of *R&D Management* 34(4) in 2004 and *Asia Pacific Business Review* 13(3) in 2007 focus on this topic in depth.

turn our attention to the uniqueness of China and India as the host countries of R&D localization.

The paper is exploratory in nature, due to the emerging phenomenon. We draw on two types of references: (1) academic literature on international R&D and (2) press articles. On the one hand, we know that in the growing academic literature on international R&D management in the past decade, very few articles focused on China and India (Li & Zhong, 2003; Lu & Liu, 2004; Gassmann & Han, 2004; Sun & Wen, 2007; von Zedtwitz, 2004; see selected sample of literature in Table 1). On the other hand, we are surprised by the large amount of articles on R&D in China and India in non-academic outlets. Evidently, this phenomenon has been grabbing the attention of practitioners and journalists. Our intention in the paper is to bridge the gap between these two worlds so as to identify the extent to which what is going

Table 1 Selected literature on R&D internationalization in China and India.

Location	Selected literature	Research focus
In China	Li and Zhong (2003)	Pattern of foreign R&D in China; explaining the growth of international R&D alliances in China
	Gassmann and Han (2004)	Drivers and barriers for conducting R&D in China
	Lu and Liu (2004)	R&D internationalization of Taiwanese IT companies in mainland China
	von Zedtwitz (2004)	R&D missions, site build-up, integration with the parent organization, and overall performance measurement
	Zhao (2006)	Weak intellectual property rights (IPR) protection
	Cheng (2007)	The upgrading of multinational regional innovation networks in China
	Medcof (2007)	Review on technology upgrading of MNC and the research on the development of Chinese high-tech firms
	Sun and Wen (2007)	The concentration of foreign R&D in Shanghai and Beijing explained by imitative behaviors
	von Zedtwitz, Ikeda, Gong, Carpenter and Hamalainen (2007)	Whether China R&D is more hype than reality; whether cost advantages really outweigh the risk of losing technology
	Walsh (2007)	Motivations and changing trends of establishing R&D centers in China by foreign investors
	Yang and Jiang (2007)	The challenge of high employee mobility under the weak intellectual property protection regime and its impact on location advantages
In India	Bowonder and Richardson (2000)	Market reforms, liberalization and globalization of business-led R&D in India, with a focus on national innovation system and international R&D
	Feinberg and Majumdar (2001)	Whether knowledge spillovers from MNC's local R&D activities benefit domestic firms in the Indian pharmaceutical industry
	Kathuria (2001)	Whether presence of foreign-owned firms and technology import in a sector leads to higher productivity growth for domestic firms
	Manral (2001)	Whether domestic Indian firms have benefited from foreign direct investment because of the transfer of technology from MNCs
	Nagesh and Aggarwal (2005)	Determinants of R&D behavior of Indian enterprises and their impact on the R&D behavior of MNE affiliates and local enterprises
	Zhao (2006)	Weak intellectual property rights (IPR) protection

on in today's China and India differs from what has happened in the West in the past decades. In other words, we endeavor to compare and contrast what the conventional wisdom suggests and what the realities are in China and India.

Conventional wisdom and anomalies in R&D internationalization

Various insights into the way firms run overseas R&D have been gained from the past decades of study on global R&D management, mostly in the West and Japan as locations of overseas R&D units and R&D headquarters. As summarized in Table 2, we discuss the following points in our paper in greater details:

- To what extent is investment decision in overseas R&D made based on careful assessment of risk?
- To what extent does R&D internationalization take incremental paths?
- To what extent is the role of each overseas R&D location clearly defined as "learning" or "leveraging"?
- To what extent is striking a right balance between local autonomy and internal control possible?
- To what extent is building trust with local community important for an overseas lab to become an insider?

Investment decision based on careful assessment of risk

Conventional wisdom in developed countries has it that R&D investment should be made in a gradually progressive way based on careful consideration of the costs and benefits involved. In particular, a country without a regime for intellectual property protection should be avoided as a destination for R&D investments. One important

Table 2 Summary of conventional wisdom and emerging trends.

Conventional wisdom	Emerging trends
Investment decisions: based on today's costs and benefits; careful assessment of investment risk is needed for overseas R&D investment	Investment decision needs to be based on future potential: Opportunity is so tremendous that time-consuming assessment of uncertainty in the current business situation at the expense of speedy action would often make the existing business opportunity obsolete
Incremental, step-by-step approach: Evolving role of overseas R&D activities—incremental	Radical changes in economy and society require drastic decision-making in R&D investment
Either learning mode or leveraging mode, depending on the evolving stage of R&D units	Rapid technological catching-up in India and China makes local R&D centers conduct both learning and leveraging
Balancing local autonomy and internal control—much more emphasis on local autonomy	Optimal balance of local autonomy and internal control should be different—much more emphasis on internal control to cope with uncertainty
Trust in local context: Fostering a mutual trust relationship with the local community is important to become an insider of the local community so as to share knowledge and information	Trust is important to gain legitimacy to be an insider of the local community; but trusting without taking local situation in consideration is risky

criterion is to decide whether R&D investment should be made abroad and whether such investment would pay off. Thorough economic analysis on costs and benefits of such investment is important (von Zedtwitz, Ikeda, Gong, Carpenter, & Hamalainen, 2007). As for R&D, immediate result is less visible, and causal ambiguity exists between investment and output. Under such a circumstance, careful assessment of potential return is made based on today's reputation about R&D capabilities in particular overseas locations. The logic behind a company's decision to locate its R&D site in an innovation cluster lies in the assumption that more output is likely when located within a capable innovation cluster (Porter, 1990). Such a logic is consistent with the theory of locational decision of value-added activities, which holds that firms invest in activities, with competitive advantage in locations where comparative advantages lie (Kogut, 1985).

China Judging from the risk management criteria in the West, intellectual property right (IPR) remains a major concern (Hill, 2007; Yang & Jiang, 2007; Zhao, 2006). While meticulous analysis of investment is important, over-reliance on existing data of country risk and IP regime may be short-sighted. Bold decisions often become necessary from time to time if a company is really serious about investing in China. Excessively careful assessment of today's business risks would only slow down the investment decision so that a firm would miss huge opportunities in the rapidly changing business environment in China. Different criteria other than the universal ones need to be taken into account as well (Gassmann & Han, 2004; Walsh, 2007). MNCs that have alternative mechanisms for protecting their intellectual properties (such as strong internal linkages) find it attractive to operate R&D in countries with weak IPR protection (Zhao, 2006). In reality, a number of US and European companies have made massive and aggressive R&D investments in China,[3] and the attractiveness of China as an R&D investment destination is expected to persist for the time being (Tung, 2005).

India In India, opportunity is so tremendous that time-consuming assessment of uncertainty in the current business situation at the expense of speedy action would often make the existing business opportunity obsolete. Where opportunity is obvious, firms are reluctant to fall behind competitors due to the excessive evaluation of risks. In the pharmaceutical industry, most foreign majors, such as Pfizer and GSK, are expanding their R&D presence in India. The opportunities in the area of drug discovery are tremendous given the low cost of doing discovery and clinical development in India in direct contrast to rising R&D budgets in the US. Pipelines of newly discovered drugs in Big Pharma are dwindling and the opportunities for smaller innovative companies are abundant there.

[3] For example, Dow Chemical's presence in China includes 10 manufacturing sites, business centers in five cities, and more that 1,200 employees (Dow will establish a center in China. *China Chemical Reporter*, February 2005, 16/26: 5). And its Chinese center will be as important as six other R&D centers in the world (US Dow Chemical, establishing R&D facililties in China, operating within three years, including information-processing tasks. *Nikkei Sangyo* 2005, Jan 26: 2). Nokia has five units, four manufacturing sites, with the total number of employees in China over 4300 (Nokia expands R&D in China. *Worldwide Telecom* July 2004, 16(7): 1–3).

In the automobile market, most of the motorcycle companies have obtained basic R&D from their global partners—with whom they have or had technical collaboration—and then customized models for local customers. The other area in which R&D is put to use is to tweak existing models for better performance in critical areas like fuel efficiency or design. Basic research is not yet a priority in the manner it is for pharmaceutical companies. Also, automobile manufacturing has traditionally revolved around buying technology and critical parts off the shelf, so a company does not have to do everything by itself to be R&D savvy. The basic platform is what the company has to focus on.

Incremental approach to R&D internationalization

Internationalization of R&D is considered an incremental process. As Ronstadt (1977) documented, US companies started to set up their overseas R&D units that were responsible for applying the US-based technologies to the local environments (called the Transfer Technology Units). And over time, such overseas units start to take on a new role of developing technology themselves (called the Indigenous Technology Units). Some of them have eventually transformed themselves to the role of contributing to the global-scale innovation and/or to the corporate R&D innovation (i.e. Global Technology Units and Corporate Technology Units). Such a move is consistent with a study of Japanese MNCs localizing their R&D units in the US and Europe, in which the overseas R&D units have gradually shifted their role from being the local starters to the local innovators and eventually to the global contributors (Asakawa, 2001). This evolutionary shift is usually a long, incremental process, due to the lack of capability of the overseas units in the beginning, and due to the resistance of the parent company to accept the enhanced role of the overseas units.[4] And it is generally perceived that the pace of this evolution may be slower for those located in developing countries.

China There is a good possibility that the role of R&D bases will evolve in a very short period of time in China. Behind this prospect are special factors such as the upgrading of the local R&D capabilities (Cheng, 2007; Medcof, 2007) through the recruitment of many returnees from the US and vigorous technical support from headquarters in the US and Europe. There are huge numbers of Chinese nationals who hold PhDs in science and engineering fields. According to recent NSF data, Chinese represents 20% of the total non-US citizens in the US who earned PhDs in Science and Engineering fields in 1999 (NSF, 2004). It is said that the basis for their educational training is almost the same as their US counterparts (Santini, 2004).

The Chinese government also encourages the compatriate PhD holders from the US universities to return to China with lucrative incentives (Saxenian, 2006). Such a public policy surely precipitates the rate of enhancing the standard of R&D capabilities in Chinese universities and firms. Therefore, under such situations, incremental steps following the Western experiences may not apply, as R&D

[4] It took 20–30 years for the Western firms to reach the stage of internationalizing basic research (Mitsubishi Research Institute, 1987).

capabilities in China, tapping into the experience and expertise of returnee PhDs, may leapfrog.

India The situation is similar in India. For example, in 2003, Intel's Indian subsidiary filed for 63 patents with a workforce of 1,500 IT professionals in Bangalore. Intel's Indian workforce is said to be engaged in complex challenges, and uses the fastest supercomputer in India (ranked as the 109th most powerful computer in the world). It is divided into four product-design divisions covering ultra-wideband radio, enterprise processors, mobile and wireless chip-sets, and communications. For Intel, which has a similar R&D operation in Israel, and smaller facilities in Russia and China, the attractions of Bangalore are simple: the best climate in India and "very smart people," who are technically well-educated and speak good English. Intel's approach is to hire and train college graduates, supplementing them with about 100 senior engineers, mostly returning expatriates. Intel in India has developed a Regional Training Agency (RTA) which is part of the Intel Innovation in Education initiative, a multi-million dollar effort to help realize the possibilities of science and technology education in India. In its 5 years in India, Intel has taken a rapid capability-enhancement approach (as opposed to slow, incremental approach) in its development which culminated in December 2005 announcement by Intel's Chairman, Crag Barrett that Intel's investment plan in R&D would excel US $1 billion over the next 5 years with $800 million in expanding its business operations, while with the balance Intel will set up a $250 million venture-capital fund.

Such a rapid capability-enhancement approach is possible in India because the nation is already equipped with the high standard of basic research at the universities so that India did not necessarily have to follow the slow development path in cumulating R&D capabilities.

Either "learning" mode or "leveraging" mode

Overseas R&D investment is done for various reasons. Putting non-innovation-related factors aside, there are two major reasons for overseas R&D investment: "learning" and "leveraging". The former refers to the purpose of acquiring new knowledge and capabilities that are not available at home; the latter refers to that of applying the parent firms' own capabilities and technologies to other overseas locations to accommodate the need of the overseas markets. The former type corresponds to the "home-base-augmenting" lab while the latter corresponds to "home-base-exploiting" (Kuemmerle, 1997).

Firms tend to locate more technologically advanced R&D tasks in developed countries which are more likely to provide infrastructure necessary to conduct state-of-the-art research, such as universities, research institutions, and government labs. Nations with superior technological capabilities are generally better equipped with capable researchers, engineers, and their human networks (Lundvall, 1992; Nelson, 1993). Firms tend to locate less technologically advanced R&D tasks in less developed countries. For example, Japanese MNCs' R&D units in the US and Europe tend to focus on more technologically advanced R&D with the objective of

enhancing their research capabilities, whereas their Asian counterparts have been in charge of adapting their products to the local markets (Nomura Research Institute, 2005).

Conventional wisdom implies that firms tend to conduct technology-seeking FDI in the advanced countries (Dunning, 1993). Firms localize their R&D in countries where the most advanced knowledge is available, especially when they aim at acquiring state-of-the-art knowledge that is missing in their home country (Peng & Wang, 2000; Song & Shin, 2007). Until recently, firms localized such advanced R&D tasks in the developed countries such as the US, Europe and Japan, and only considered emerging countries as the site for market-seeking FDI.

However, such a preconception may become obsolete, as China and India are beginning to attract even the advanced area of R&D investment.

China Foreign firms are now investing in China not only for its cheap labor, but also for its supply of abundant and talented human capitals (Li & Scullion, 2006). China has strong human resource in engineering. OECD reports that 61% of the college graduates are science and engineering majors. As of 2001, OECD reports that China is the second largest country in terms of the number of researchers in a single country (EIU, 2004: 10). China also tries to attract Chinese returnees from the US to enhance its technological standard (Saxenian, 2006). For Ericsson, China was the only country in which the company's R&D investment increased over the three consecutive years in the early 2000s, according to a comment by Hakan Djuphammar, vice president of systems management of R&D at Ericsson (EIU, 2004: 10). Mobile technology is one of China's strongest R&D fronts. China is particularly attractive for Japan and Korea which carry the same double bytes program[5] (EIU, 2004: 11). Alcatel does tests in its 3G Reality Center in Shanghai, and NTTDoCoMo conducts 4G research in its Beijing Lab.

China's economy is rapidly growing, and so is its standard of innovation. Besides market-seeking R&D, technology-seeking R&D is also beginning to take place by foreign MNCs in China. For example, Nokia's Beijing Product Development Center succeeded the development of N2100, N6108, and applied them to Asia and other regions. Here "learning" mode and "leveraging" mode can co-exist in the emerging countries, where stereotype view of host location is getting less relevant.

India Both types of R&D—leveraging and learning—can coexist in India as well. India has its strong scientific base at the university level, but such scientific base is not effectively leveraged for commercialization due to the lack of business orientation. Western MNCs, especially the US firms, bring their own business models to leverage India's strong scientific base. For example, Adobe developed its product PageMaker 7.0 locally by utilizing its Indian engineers successfully. This is an example of the way a foreign firm adopted the learning mode in India. At the same time, foreign firms still leverage their own competencies in Indian local market. For example, Suzuki, at the R&D center of its JV partner Maruti Udyog, is

[5] Korean, Japanese and Chinese languages "require 16 bits of data – two bytes – per character instead of the single byte required for letters in most alphabet-based languages." (EIU, 2004: 11).

localizing existing models and designing new compact cars for India. Here again, learning mode and leveraging mode co-exist in India.

Balancing local autonomy and internal control

Both local autonomy and parent control are important to conduct successful R&D operations abroad (Behrman & Fischer, 1980). However, striking a right balance is challenging, and it often entails a tremendous amount of organizational tension (Asakawa, 2001). What is especially important for R&D managers is not to regard autonomy and control as trade-offs, but rather as equally important targets to achieve. A certain amount of local autonomy is indispensable to foster local scientists' creativity as well as to facilitate local market-driven innovation. At the same time, a certain amount of internal control is also necessary to align overseas R&D activities with the firm's overall R&D strategy (Behrman & Fischer, 1980; Cheng & Bolon, 1993; DeMeyer & Mizushima, 1989).

The challenge of striking a right balance between the two forces is perhaps one of the most frequently discussed issues in running R&D abroad (Asakawa, 2001; Birkinshaw & Morrison, 1995; Ghoshal & Bartlett, 1988; Taggart, 1997). And yet it has been investigated in the contexts of the Western and the Japanese MNCs that operate their R&D labs in the West and Japan. We know very little about the appropriate level of local autonomy and control for the firms operating their R&D labs in India and China.

China While this continues to be important in China, we suspect that the optimal balance between local autonomy and parent control may differ from that in the Western context. We identify two reasons for such a difference. First, weakness of intellectual property regime in China would deter foreign firms from granting sufficient local autonomy to their R&D sites in China, at least in the beginning, until they are reassured that their local labs' intellectual property rights are protected when they engage in knowledge exchange with the local R&D partners.

Second, rapid pace of R&D internationalization by foreign firms in China would make it difficult for the foreign firms to identify and adjust the optimal level of local autonomy. It was found by a number of researchers that the level of local autonomy changes along differing stages of R&D internationalization (Asakawa, 2001; Birkinshaw, Hood, & Jonesson, 1998; Cantwell & Mudambi, 2005). However, the pace of R&D internationalization is much faster in China than elsewhere in the Western context, so that the judgment of appropriate level of autonomy remains unidentified in the Chinese context. A large amount of uncertainty in R&D environment in China would make foreign MNCs be more cautious about local autonomy.

For these reasons, we argue that a rule of thumb gained from the prior experiences in the Western context should not be trusted too much. Foreign MNCs recognize the need for granting local autonomy to R&D units in China. At the same time, IPR concern and the uncertainty pertinent to rapidly changing environment (Peng, 2002) tend to make MNCs more cautious about granting excessive autonomy to Chinese

R&D labs, especially under the circumstances in which the labs' employee mobility is high and protection of core knowledge becomes difficult (Yang & Jiang, 2007).

India The same can be said about the situation in India, except that concern for IPR is significantly less than that in China. The balance between autonomy and control is also important in India, but the desired level of local autonomy is different from that in the West. As in the West, granting local autonomy enhances motivation of local scientists and engineers. At the same time, India's research environment has traditionally been isolated from the business community so that granting local autonomy may not generate much locally driven entrepreneurship as what can be expected in the West. In that sense, infusing a sense of business mindset through the active involvement of the Western multinationals might be productive. Companies such as Google are bringing in their entrepreneurial models while respecting local autonomy in research activities.

Trust in local context

Knowledge creation often requires sharing of ideas and insights among individuals (Nonaka & Takeuchi, 1995). Becoming an insider of the local R&D networks is quite important for the overseas labs to access and understand locally-specific knowledge. And in order to become an insider, the labs must gain legitimacy to be trusted as a member of the local community. As R&D often involves proprietary knowledge, sufficient amount of trust needs to be nurtured to allow knowledge sharing between labs and external research community. While it may appear risky to let overseas R&D lab engage in trust relationship with external parties, knowledge sharing would not happen unless trust relationship is nurtured among local parties.

China What is particularly important about succeeding R&D in China is to become insiders. Unless the firms are accepted as insiders of the research community inside a host country, foreign firms are in a disadvantageous position. As a way to overcome such disadvantage, firms resort to collaboration with local universities and companies. Henkel is one of the leading companies to aggressively launch external collaboration with local universities and companies in China. Collaboration with the leading Chinese universities as well as their spin-off venture firms is critical for the success in China, as the local firms' technological capability is not fully developed yet. In addition to Shanghai, Beijing is becoming increasingly significant for this purpose (Yin, 2004).

Of course, the benefit of being an insider is prevalent in other parts of the world as well. However, what is particularly important in China is the fact that gaining legitimacy of being an insider by the Chinese government is important. Due to the influence of the policy practiced by the former Soviet Union, core R&D resources in China were centralized by the public sector (Fujimoto, 2004; White, 2000). For this reason, accessing core resource requires networking with government officials as well as national universities and labs. More and more foreign companies are putting high priorities on access to key national university labs.

Yet, trusting too much may be problematic. Different cultures have differing natures of taken-for-grantedness. The most typical case is about IPR. Counterfeiting has been a widespread practice in China. Imposing the Western logic of intellectual property may not work. Honda's approach was unique, in that it took such a risk into consideration when investing in China. Honda formed an alliance agreement with one of the local Chinese companies which has illegally copied Honda products and manufactured their products at significantly lower cost. Combining Honda's technology and new product development capability with China's low-cost production capability, Honda created a new business model which applies to China's situation very well: Co-opting its potential enemy.

India Many leading companies are also moving their R&D centers to India. For example, the well known Swedish pharmaceutical company ASTRA has already set up a biotechnology R&D Centre in Bangalore. The fifth laboratory of the multinational giant, Unilever, is being set up in Bangalore. Polaroid Corporation has declared its intentions to start R&D in India as a wholly owned subsidiary. GE feels that although India is a developing country, it is a developed country for R&D considering its superb scientific infrastructure. It is for this reason that GE wishes to shift a part of GE's research and development effort to India. Foreign MNCs including these firms tend to trust the high quality of India's local R&D environment. The high standard of education in science and technology at India's higher education such as IIT receives high recognition, and IPR issue is not a significant problem in India.

Nevertheless, trusting the standard of university education sometimes turns into a sense of disappointment. While the top-ranking universities such as IIT is renowned for the high level of research and teaching, variance among higher-education institutions is also significant. Such a variance is much greater in India than in the Western nations, where one can trust the education standard of top-level universities.

China and India: myth and reality

A quick glance at China and India as host locations of R&D reveals the extent to which conventional wisdom from management of R&D internationalization in the West does not apply to these countries. However, it is equally misleading to exaggerate the stereotypical views on China and India as backward locations for conducting R&D and innovation. The reality shows otherwise: Both China and India are rapidly becoming countries suited for R&D and innovation. As summarized in Table 3, stereotypes and realities of both countries are contrasted in the fields of:

- Learning from abroad
- Low-cost manufacturing
- Role of repatriates
- Standardization
- Only for local innovation

Table 3 Myth and reality.

	Myth	Reality
Learning from abroad	Advanced technology comes from the West; India and China are adopters of the Western technologies	Not always. Joint collaboration with the Western companies is rapidly increasing in quantity, both in India and in China
Low cost technology development	Technology development in India and China is very cheap	Not always. Especially in China, overcoming the difference in custom and standard is sometimes even more costly
Role of repatriates	The returnees from the West with higher education and excellent working experiences play a major role in enhancing the technological standard and entrepreneurial spirits in India and China	Not always. The role of the repatriates is quite important in both countries, but also sometimes exaggerated. In both China and India, repatriates also include second-class scientists and engineers who cannot survive in the US. In China, local managers complain that even low-quality repatriate engineers often demand high salaries
Standardization	China is more interested in setting its own local standard rather than conforming to the international standard	Not always. China is increasingly interested in participating in setting both local original and international standard.
Only for local innovation	The purpose for conducting R&D in Asia is only for local adaptation rather than global innovation	Not always. There are quite a few examples of global innovation originated from R&D in India and China. For example, just to name a few, Adobe's PageMaker 7.0 was entirely developed in India by Indian staff and is widely used in the entire world. As for China, Nokia's N2100 and N6108 were developed locally and introduced to the global market

Learning from abroad

In spite of the general belief that advanced technology comes from the West, Chinese universities have begun to conduct high-standard research in certain areas. For this reason, collaboration with Chinese universities has become critical in certain areas. For example, Henkel is actively engaging in R&D collaboration with local Chinese universities in basic research as well. Henkel engages in R&D collaboration with six leading research groups from five leading universities, with an initial investment of $500,000 in two recent years.[6] The selection criteria for these universities are the expertise of the professors, the reputation and R&D facilities of the universities. Henkel has a policy of R&D collaboration with universities in the world, and the company's R&D collaboration in China makes Henkel a leading global firm engaged in basic and applied research. Another example is Nokia, which plans to cooperate with ten universities in China and provide knowledge transfer through training, seminars and coursework. The collaboration with various

[6] Jinmei, F. 2005. Henkel cooperates with top Chinese universities, *China Chemical Reporter*, Jan 6: 4.

universities has already started. Another example would be Du Pont in China, whose level of fundamental science in physical chemistry and polymer physics was already perceived strong in 1995.[7] Through such collaborations, Western companies are seeking to tap into the potential innovation capabilities of Chinese universities (Peng & Wang, 2000).

In the fields of electronics and engineering, China is not always behind Japan. For example, when Japanese universities shifted their research focus away from certain areas, such as air conditioning, Matsushita set up its R&D center in Suzhou, China to work on air conditioning. Apart from the local adaptation need, the company also decided to collaborate with Chinese universities to work on air conditioning research.[8] According to an R&D manager at Matsushita, "as Japan shifted its research focus on much more advanced areas, there are not enough engineers inside Japan who can work on the old technologies." In other words, due to Japan's technological disruption (Christensen & Raynor, 2003), the nation may have to rely on Asian countries to supply human resources in the relatively less advanced fields.

In the case of India, Nicholas Piramal (NPIL) has secured a licensing agreement with a US biotech firm Genzyme, giving NPIL rights to market Genzyme's best-selling Synvisc (Hylan G-F 20) product. It is thought that NPL's deal with Genzyme will significantly boost NPL's financial performance. The deal followed NPIL's strategic alliance with US biotechnology firm Biogen Idec. These agreements come amid a marked increase in the number of multinationals seeking to increase investments in India. It is also because of the growing international confidence in the country's changing regulatory environment (Bowonder & Richardson, 2000), with government-backed initiatives to develop the domestic biotechnology industry. The deal with Genzyme[9] boosted NPIL's medium-to-long term outlook by placing it at the forefront of the rapid trend towards partnerships in India's burgeoning biotechnology sector.

Low-cost manufacturing and technology development

Both China and India have been historically thought to be low-cost manufacturing destinations. But not always. Unexpected cultural and bureaucratic barriers as well as the fragility of intellectual property right can neutralize a part of the cost advantage (Armbrecht, 2002; von Zedtwitz et al., 2007). As an example, Kaga Denshi delegates part of its development tasks to its Chinese R&D center, but makes every effort to cope with security concerns. The company splits the intra-firm information system completely between the Japanese and Chinese operations. It also separates Chinese operating systems (OS) from Japanese OS completely. This is a costly proposition that has enabled Kaga Denshi to maintain security in its operations.[10]

[7] Rotman, D. 1995. Western firms look to tap into China's R&D, *Chemical Week*, 157(8): S10.

[8] "Kenkyu Kaihatsu Kyoten no Setsuritsu Rush" (Rush in setting up R&D facilities). In Japanese. *D&M Nikkei Mechanical* 2002.8 no.575: 85.

[9] *World Markets Analysis*, August 9, 2004.

[10] "Kenkyu Kaihatsu Kyoten no Setsuritsu Rush" (Rush in setting up R&D facilities), in Japanese. *D&M Nikkei Mechanical* 2002.8 no.575: 87.

In India, Suzuki has chosen the R&D center of its JV partner Maruti Udyog, headquartered at Gurgaon, to act as its own global R&D hub for Asia by 2007. This R&D center will be responsible for localizing existing models and designing new compact cars. Suzuki plans to make significant investments in this facility by hiring software engineers and technical staff and upgrading its Gurgaon-based R&D center. The R&D team is being sent in batches of 20–30 people to Suzuki's R&D headquarters in Japan for training spells of 12–18 months. After the training, the Indian team has the task of upgrading and modernizing the Maruti Alto, Zen and Maruti 800 models of cars.[11] Such an operation shows how India has gone beyond the more low-cost producers.

Role of repatriates

Repatriates from the developed nations, especially the US, has been considered to be major driving force for technology development in India and China. This is mostly true but not always. In China, repatriates are thought to be valuable because of their commercial and technical experiences, communication and leadership skills (Armbrecht, 2002). But they can command salaries three times the level of local hires. If repatriates do not demonstrate outstanding performance, resentment between two groups can be serious (Armbrecht, 2002). In the case of India, foreign firms, especially from the US and Europe, are involved in challenging R&D projects. For example, Intel is designing its latest chip, and GE its latest aircraft engine. With these developments in the R&D scenario in India there has been a reverse brain drain. Many have returned to India since 2000 to start business or help expand R&D labs for the likes of Oracle, Cisco systems, Intel, Sun Microsystems, Microsoft etc. The "brain drain" has taken a full circle and has turned to be "brain circulation" in the Indian context.[12] This also gave a good reason for those who could not survive in the US to return home.

Standardization

There is a general belief that China is more interested in setting its own local standard rather than conforming to or creating the global standard. But this is not always the case. China is increasingly interested in participating in setting both local and international standard. A typical example is the unique experience of creating an international standard called Audio Video Coding Standard (AVS).[13] The standard is not just Chinese standard but is meant to be the global standard with a strong initiative by multinational firms such as Intel, Microsoft, IBM, Sony, Matsushita, Sharp, Samsung, and LG Electronics. At the same time, following the request by Chinese local firms, the Chinese government (Ministry of Information Technology) agreed to pursue an international standard. International standard can emerge out of China based on the active involvement of the multinational firms as well as the Chinese local firms.

[11] "Regional: Company News Analysis" *South Asia Monitor,* 10(1): 8.

[12] Hof, R. and M. Kripalani. 2003. "India and Silicon Valley: Now the R&D flows both ways." *Business Week*, 3861:74.

[13] Gao, W (2004). "Sekai Hyojun ha Chugoku kara" (Global standard from China), in Japanese. Nikkei Electronics, 7(19): 226–228.

In the case of India, as many as 1200 in-house R&D units are functioning today and some of them like the Hindustan Lever Research Center, national subsidiary of Unilever, have achieved significant results in import substitution, such as profitable utilization of non-edible oils in soap manufacture, which correspond to global standards. MNC giants such as Du Pont, GE, and FMC have reposed confidence in Indian National Labs by sponsoring important long term research assignments through cost-effective contract research. There is an endless dilemma in the minds of companies, especially Indian ones, about this type of standardized global research, though MNC's are slowly gaining confidence in this area and are investing on an average US$10 million to set up R&D facilities in India.[14]

Only for local innovation

Finally, the general belief is that innovation in R&D in China and India are only for local adaptation. Not always. For example, Nokia intensified its collaboration with the local universities, through which its Beijing Product Development Center succeeded the development of N2100, N6108, and applied them to Asian and other regions. Also, Sanyo, for example, set up a joint venture company with Haier, named Sanyo Haier, to innovate its products in China and launch them back to Japan. Sanyo's R&D in China then had to modify the washing machines to accommodate the Japanese washing custom, such as setting the washing machine in the humid place near bath, and to change the instruction board into a much colorful one, which is the global standard.[15] As such, foreign companies are also gaining benefits for their home markets through local (China- and India-based) innovations (Wright et al., 2005).

In India, Adobe Systems had scored a number of firsts in setting up global standards. It is the first company to establish a specific, stand-alone R&D center in India. Established as a part of the corporate research group, Adobe India was set up in 1998 and within four years had grown from one employee to more than 100 and soon might expand to over 400. It is Adobe's largest R&D facility outside the US. It has ten patents to its credit and many more are in the pipeline. Adobe India recently came out with PageMaker 7.0, which was a great success globally. This latest version was extremely credible due to its innovation and catering to strict global standards of Adobe.

Conclusion: Balancing conventional wisdom and Asian specificity

This paper started out to explore and understand the research question about the uniqueness of MNCs in managing their R&D in China and India. It tried to understand the conventional wisdom and the unique opportunities and challenges of managing foreign-invested R&D in China and India.

We summarize from prior work that there is some conventional wisdom that does not necessarily apply for R&D in China and India. Our discussion has also pointed

[14] Rao, U.B. (1996). "The right attitude to R&D in India" *Chemical Business*, 9(8):13.

[15] "Kenkyu Kaihatsu Kyoten no Setsuritsu Rush" (Rush in setting up R&D facilities), in Japanese. *D&M Nikkei Mechanical*, 8(575): 87.

out that there are myths which might not match realities in China and India. Overall, we suggest that MNCs should not forget the conventional way of managing their innovative R&D policies, but learn and combine their approaches, styles of management, and their capabilities in Asia (particularly in India and China). We propose that there is no either/or solution but an orchestrated strategy that might bridge the gap between the different strategies that MNCs are focusing today, which might affect their own rule of the game.

This paper contributes to the literature by articulating the differences between conventional wisdom guiding international R&D and realities of actual practices in China and India. These differences present challenges to theory. These challenges in internationalization of R&D are part of the larger challenges that emerging economies present to conventional management research and practice, which used to explain the strategies of mature and developed economies (Wright et al., 2005). The challenges deriving from cutting-edge practices in China and India are beneficial as they help inform the next round of theorizing, for example, regarding the characteristics of internationalization of Asian MNCs—"Dragon multinationals" (Mathews, 2006; see also Dunning, 2006; Narula, 2006). These challenges also facilitate the development of indigenous Asia-specific theories, which, in the long run, would be integrated to the global scholarly discourse (Meyer, 2006).

What has been left behind in this paper includes the impact of the foreign firms' R&D investment in China and India on the development of local companies in these countries (Feinberg & Majumdar, 2001; Kathuria, 2001; Manral, 2001). Interestingly, China and India are not just hotspots of R&D investment by foreign firms. According to a survey by Booz Allen Hamilton, R&D spending growth of companies from China and India are much higher (21.1% in 1999–2004) than their Western counterparts (6.6% in North America, 6.2% in Europe, and 4.8% in Japan) (Jaruzelski, Dehoff, & Bordia, 2005). This implies that the firms headquartered in India and China is increasingly spending their money on R&D.

A further research question is to investigate the way foreign firms' R&D investment in China and India contribute to the enhancement of R&D capability of the local firms, and vice-versa. As the foreign firms gradually upgrade their R&D activities in China and India from mere local adaptation to local innovation, the level of the local laboratories is enhanced as well due to the transfer of advanced technology from the parent companies and training of local scientists and engineers (Feinberg & Majumdar, 2001; Kathuria, 2001; Manral, 2001). What we do not know much yet is the way and the extent to which R&D investment by foreign MNCs and the R&D activities of the local firms are related (Nagesh & Aggrawal, 2005).

Another implication for further research concerns institutionalizing new ways of organizing R&D in China and India. Foreign MNCs, when running the overseas R&D in China and India, need to overcome the following kinds of inertia: (1) conventional wisdom regarding the way a firm manages R&D abroad; (2) a stereotype view of R&D environment in China and India. The challenge of overcoming the inertia has strong implications for institutional theory, in that the way institutional inertia and path-dependence can be overcome (Peng, 2003; Robertson & Langlois, 1994). By crossing the boundary of institutional constraints (Meyer & Peng, 2005), foreign MNCs are likely to alter the way R&D activities are

organized, both at the firm and the national levels. Further study can shed light on this point.

Overall, this paper supports the trend that more innovation is required by firms and managers to strategize about their R&D investments in Asia, particularly in China and India. As technology mobility is shifting at greater speed across borders, there is no one *conventional rule* that can be applied for R&D investments, especially in this region. R&D experts need to establish willingness and mechanisms to explore advanced knowledge in emerging economies while sufficiently understanding the peculiarities of each. It also becomes crucial that organizational routines be set up for these R&D locations so that its research and the knowledge can be integrated back into the firm's overall knowledge process. This perhaps will increase and secure worldwide competitiveness, thereby creating a corporate culture that allows knowledge brokers to take active roles—whether within or outside the company—all around the world.

The paper touches upon some issues of public policy for increasing innovative R&D capacity of regions and harps on the assumption that MNCs should synthesize their option without forgetting their nationally-rooted experiences, but look forward to creating and leveraging second innovation centers for better orchestrating their resources in Asia. This, in turn, would enhance innovativeness of Asian regions in the long run.

To increase innovativeness, some policy implications for MNCs might be to: (1) lobby for increasing government spending on R&D and scholarships for graduate science and engineering students, (2) encourage dissemination of information and transparency while taking actions against sources of information asymmetries within these economies, and (3) strengthen the willingness to take risks while being involved and engaged in these emerging markets. These measures, such as commitment to invest in innovation and education and willingness to take risks, will go a long way in developing these economies. Active involvement and engagement in China and India, in their R&D centers with strong metrics and processes is a continuing activity.

In conclusion, we can suggest that foreign companies, when launching and conducting R&D activities in India and China, (1) need to acknowledge that it is no good to try to blindly transfer their R&D management based on the common sense from experience in developed countries, (2) must divest themselves of their deeply rooted prejudices about India and China, and only then can they, (3) think of how to extract the maximum potential of their local operations. These steps are crucial for MNCs, particularly for Japanese MNCs, as they are beginning to shift emphasis on their global R&D from the US and Europe to Asia.

Success in global innovation requires new organizational strategies for R&D. An international effort with different countries excelling at different stages in the innovation cycle can go a long way in developing localized world-class R&D standards in Asia. These global research networks create substantial challenges as well as exciting opportunities for organizations. Developing strategies that enable diverse, multicultural teams to collaborate effectively against common research goals—and that also protect the fruits of their efforts—is a challenge that will distinguish consistent innovators from the "me-too" companies of global R&D.

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