KNOWLEDGE TRANSFER BETWEEN TECHNOLOGY-INTENSIVE FIRMS IN CHINA AND INDIA: INVISIBLE BARRIERS, BEST PRACTICES AND NEXT STEPS

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The convergence of size, talent and ambition is creating a dynamic playing field for knowledge transfer in the Asia-Pacific Region. China and India have declared innovation a strategic national priority. Innovation in China and India includes both new knowledge creation and absorption of knowledge that is new to these countries. Today, it is new knowledge absorption that is in the foreground, but the importance of knowledge creation is growing rapidly. Absorption requires knowledge movement. New knowledge creation builds on the knowledge infrastructure enabled by absorption. We examine the evolution of knowledge movement into and between the high technology sectors in India and China and discuss effective and ineffective knowledge flows between these countries. Invisible barriers to successful knowledge movement, stemming from both external conditions and internal factors identified in our field research are presented. Case studies that highlight best practices used by firms studied to overcome these barriers are presented. Finally, implications for managers of offshoring activity are discussed.

Key Words:

Knowledge Transfer, Knowledge Creation, Innovation

1.0 INTRODUCTION

The convergence of size, talent and ambition is creating an interesting and dynamic playing field for knowledge transfer and creation in the Asia-Pacific Region. The importance of China and India is old news. However, combined they account for over 38% of the world's population and both have declared innovation to be a strategic national priority. In 2006 China announced plans to become an innovation-oriented society by 2010 and a global leader in science and technology by 2050. At a 2006 national research and development exposition in New Delhi, India proclaimed itself "The world's knowledge hub of the future." India's investment in building the human infrastructure to realize this claim is extraordinary—they graduate over half a million scientists and engineers each year! Innovation in the China and India context includes both creation of knowledge that is new and absorption of knowledge that is new to these countries. It is the absorption of knowledge that is in the foreground and provides the starting point for this manuscript.

Since economic reforms opened India and China to global markets, the volume of Foreign Direct Investment (FDI) into these economies and its impact on the development of the technology sector has been remarkable. China's net inflow of FDI has increased from $1.65 billion in 1985 to nearly $55 billion in 2004. Over the same period India's net inflows have jumped from $106 million to $5.3 billion (World Development Indicators). The focus of this investment has been driven by the competitive advantages found in each market: China in manufacturing and India in technology services. As Chinese and Indian industries have matured a larger portion of the investment has migrated to high-technology activities. In fact, the technology sector has been a significant benefactor of this investment as China's "high-technology exports as a share of manufacturing exports has risen nearly one-third from 6%" since 1992. Over the same time period, "India's software and information-technology-enabled service exports grew to $17.2 billion in 2004-05 from less than $500 million (Laudicina 2005). Much of the FDI and resulting technology transfer into these economies have originated in the developed Western economies. The largest single investor in the Indian economy

has been the U.S., which provided roughly 25% of India's approved FDI between 1991 and 1995 (McManus et al. 2007: 15). FDI in both China and India has allowed these economies to become more integrated into the global economy while at the same time allowing them to gain access to world-class technology. The resulting development of technology driven industries has also produced a modest, but growing, stream of knowledge movement between China and India.

The evolution of knowledge movement into and between the high technology sectors in India and China is the focus of this manuscript. Semi-structured interviews were conducted with senior managers at sixteen different technology related firms in the telecommunications, computer and information technology (IT) industry ecosystem with activities in both India and China between September 2006 and January 2007. The perspectives shared by these business leaders are the basis of the following discussion of knowledge flows between these two countries. We will first focus on a historical view of knowledge movement in these countries. We then segue to a discussion of invisible barriers to successful knowledge movement, stemming from both external conditions and internal factors identified by these senior managers. We identify case studies that highlight best practices the firms studied have used to overcome invisible knowledge flow barriers. We conclude with a discussion of implications for managers and globally distributed work worldwide.

2.0 EARLY KNOWLEDGE MOVEMENT

Knowledge movement through technology transfer into both India and China began when Western companies sought low-cost production opportunities in these countries. Technology transfer began in India on a large scale when technology leaders such as IBM and Texas Instruments capitalized on India's massive IT investment of the late 1990's and leveraged the latent talent pool of engineers to develop significant service operations. This technology has significantly contributed to an increase in the country's GDP, which averaged 6% in the late 1990's and over the least three years has continued at 8% (Dahlman 2007: 46). China, on the other hand, attracted roughly $27 billion in FDI between 1979 and 1992; over 30% of which came in the form of equity partnerships for industrial joint ventures primarily focusing on manufacturing (Chen 1996: 223). During these initial stages foreign companies were motivated by "the cost effectiveness of hiring relatively low-wage Chinese or Indian scientist or engineers" to support low-cost production (Dahlman 2007: 51).

In both cases, Western companies realized low-cost production synergies through the transfer of formal business process or manufacturing technology into India and China. As a result, both India and China gained access to foreign capital, high-end technology and the latest management practices with a focus that was primarily export oriented. The importance of the transfer of management practices should not be underestimated; management practices provided the embedding matrix or people systems and capabilities necessary for high tech absorption (Von Glinow and Teagarden 1988). Through this process, knowledge capital began to develop within these recipient firms. As we will see, this knowledge capital was foundational for the development of domestic oriented production and innovation. However, at this early stage, knowledge movement between China and India was virtually non-existent.

3.0 THE PATH FROM LOCALIZATION TO INNOVATION

Knowledge flows into China and India had different drivers and took different paths. In the China case, most technology firms initially engaged in equity partnerships "to participate in the Chinese market while maintaining some control over business activities" (Chen 1996: 223). For example, telecom firms such as Motorola entered the China market to take advantage of low-cost production and to leverage the opportunity to penetrate the vast Chinese consumer market. The company first entered China in 1992 as a wholly owned subsidiary called Motorola (China) Electronics LTD with a focus on handset manufacturing. Motorola has since invested $3.6 billion in the company's flagship plant, established five different joint ventures and 16 research and development (R&D) centers across the country (Xinhua, 2007). By July 2006, Motorola held more than a 20% share of the domestic telecommunications handset market according to Xinhua Electronics News.

Motorola is not alone in establishing R&D centers in China. Recently, information technology service firms like Google have established R&D operations in China, largely to develop solutions specifically for their customers. Microsoft also has an R&D facility in Beijing. Senior management at such firms recognizing that there are culturally specific aspects to everything a company develops including technology. The fact Google's Asia-Pacific headquarters are located in Beijing with an expected headcount of 300 staff is evidence of the growing need for localized content

and search products (Media 2006). The R&D investment of Motorola, Microsoft and Google in China illustrates the importance of Multinational Corporations (MNCs) doing "R&D locally to adapt their goods and services to the domestic market." (Dahlman 2007: 51). We might think of this as small "r" and capital "D" (R&D).

Indian information technology companies, on the other hand, have largely remained focused on technology services for worldwide consumption. Since India's economic reforms in 1991, FDI has become a significant driver of the local service economy. This can be seen by the fact the "share of the service sector in total FDI inflows rose significantly from 5% in 1990 to 52% during 1991 to 2001" (McManus et al. 2007: 16). One of India's largest service firms to emerge is Infosys, which operates in over 15 countries and has become the country's leading global consultancy and IT firm since its founding in 1981. In spite of the success of technology service firms like Infosys, Wipro or Tata Consulting Services (TCS) it is only recently such firms have begun to explore opportunities to develop technology for the domestic Indian market.

Localization in India and China has taken different paths due to customer and contextual differences. Consequently, there has been relatively little need for technology transfer between firms in these two markets. However, as technology companies have tapped into the local talent pools, first for export oriented production and later to localize their products, they have discovered this talent can and must be leveraged worldwide. These MNCs have begun to look beyond using R&D for localization to how their R&D centers can develop "products and services for the global market" (Dahlman 2007: 51). As technology firms utilize talent in China and India for global product innovation opportunities for knowledge movement between these two countries have emerged. We might think of this as capital "R" and capital "D" (R&D).

As MNCs developed a better understanding of the opportunities in the Indian and Chinese markets, knowledge moved between the U.S. and these countries. What began as low-cost production or low end services has evolved into product localization or service sophistication and is now, in some case, innovation for the global market. Each step in this evolution has enabled MNCs to benefit more from their Indian and Chinese operations while simultaneously requiring more and more complex knowledge to be transferred. Senior management at industry leading firms suggests the primary avenue for technology transfer between India and China is software and outsourcing in particular. Not only has technology transfer increased in the field of corporate IT training, but also in the development of telecommunications equipment. In fact, telecommunications industry leaders report approximately 5% of the software code used in their high-end mobile phones, like Motorola's Ming PDA cell phone recently manufactured and introduced in China, were developed by their subsidiary in India.

Software development is an example of knowledge innovation which provides transfer opportunities. India's software development industry has been a beneficiary of technology transfer from the West in addition to its significant internal development achievements. According to the U.S. Chamber of Commerce in India the Indian IT sector grew 42.4% (CAGR) between 1995 and 2000 with MNCs accounting for nearly 22% of the country's software exports. At the same time, the IT sector in China has begun to ramp up from its status as a low-cost manufacturing location to focus on product localization and most recently has focused on producing innovation for the global market. These trends have led to an increasing amount of high tech R&D effort in China that is focused on software development. For example, the senior manager of an R&D center in Shanghai reports that less than 20% of his team's efforts are focused on hardware development; the vast majority is focused on software, which is thought of as an area of expertise for Indian firms. In the broader picture, the Chinese government has encouraged the expansion of the software development industry and found willing partners in large Indian firms such as Infosys and TCS. A prime example is the decision by TCS in the fall of 2006 to partner with three Chinese IT parks and Microsoft to "build China's first software and IT services venture of global scale". The Chinese government hopes this venture, which is expected to employ 5,000 people in four years time, will serve as "a role model for the entire Chinese IT industry" (Vandrevala 2006).

4.0 INVISIBLE BARRIERS TO SUCCESSFUL KNOWLEDGE MOVEMENT

The world is not as flat as the popular writer, Thomas Friedman (2005), would have us believe. As knowledge movement between India and China is examined in finer detail, identification of invisible barriers to the successful transfer of knowledge between these two very different countries is possible. Differences in *interaction distance*, the combined drag effects of culture, language and geographic distance between the knowledge donor and the knowledge recipient, and *interaction intensity*, the degree to which the knowledge donor and the knowledge recipient must interact and engage in this transfer create invisible barriers to successful knowledge movement (Stringfellow et al.

2007). These invisible barriers impede effective knowledge movement through the unintended consequences of structural barriers and through interpersonal barriers such as cross-cultural communication "noise" and increased interpersonal "transaction costs".

Senior managers in industry-leading service firms provide insight by pointing out China's reputation as a "technology thief". Using an example from the manufacturing sector, managers would suggest that under a scenario where a Chinese firm lags the technology expertise of an Indian firm, the Indian firm would be very reluctant to transfer their technology into China. The Indian firm would fear that if their technology is transferred to China, the Chinese manufacturers will be able to ramp up production at a scale that will soon lead to their own diminished competitiveness. This is an example of one factor, distrust, among a litany of invisible barriers that severely limits knowledge movement between India and China.

As discussed above, *interaction intensity* is the degree to which service industry workers must involve or engage customers, or knowledge recipients, directly. In order for manufacturing outsourcing to benefit from low-cost manufacturing, the early Chinese case required relatively little *interaction intensity* as most of the labor involved manufacturing goods that would, in turn, be exported back to the U.S through large MNCs like Toshiba, IBM or Wal-Mart. When knowledge transfer can be codified in scripts and training protocols, as in the case of manufacturing with well understood processes and procedures, the knowledge movement process is relatively simple. The process of transfer may require many steps, but these can be explained and followed. However, when we consider intangibles, specifically tacit knowledge transfer, the degree of transfer complexity increases significantly compared to that of tangible or explicit knowledge transfer like the manufacturing examples.

Again, *interaction distance* results from the combined effects of culture, language and geographic distance between knowledge donors and knowledge recipients. India's rise to IT service prominence is attributed in part to their large numbers of university graduates in engineering fields and to their proficiency in English. English language skill enables a higher level of *interaction intensity* between Indian engineers and their U.S. clients which was essential in solving Y2K challenges and partnering in the evolution of 24-7-365 help desk support. Nevertheless, China and India are characterized as having high *interaction distance* due to language acquisition-related issues, as well as a myriad of socio-cultural and work culture differences. Company executives not only indicate the need to bridge these communication and cultural barriers, but also identify these barriers as threats to the future growth of each country's stake in the IT market.

According to industry sources, Chinese employees find it difficult to communicate with their counterparts from India. Not only do the Chinese staff struggle with heavy Indian accents, but also find it difficult to interpret the cultural nuances of their communication. Chinese managers report that speaking to Indian colleagues is very tiring as they must make a concentrated effort to pay attention to and completely track what their Indian colleagues are saying during a virtual meeting or conference call.

Cultural distance, "the extent to which cultures are similar or different", is a summary measure of the differences between cultures (Shenkar 2001: 519). Cultures that are very similar to one another are said to be low in cultural distance from one another. However, to truly understand the impact of differences between cultures, it is helpful to consider the underlying dimensions of culture. A number of dimensions have been found useful in organizational contexts. These include individualism-collectivism (Hofstede 1980); power distance, also referred to as equality-hierarchy (Hofstede 1980; Trompenaars 1993), universalism-particularism (Trompenaars 1993), time orientation (Hall 1983; Trompenaars 1993), and communication style (Hall 1976). It is the differences between these countries on any one of the five dimensions that is the driver of "noise" in the cross-cultural communication channel. The cumulative effect of differences across these five dimensions contributes to knowledge flow "drag" because of "noise" amplification. A summary of these dimensions for the U.S., India and China is provided in Table 1.

Table 1: Cultural Dimensions for Selected Countries

	Collectivism	**Power Distance**	**Particularism**	**Polychronic Time Orientation**	**Communication Style**
U.S.	**Low**	**Low**	**Low**	**Low**	**Low Context**
China	**High**	**High**	**High**	**Medium**	**High Context**
India	**High**	**High**	**High**	**High**	**High Context**

Adapted from: Stringfellow et al. 2007

The cultures of India and China differ not only along lines of national identity, but also those of professional and corporate expectations. Thought leaders often characterizes the Chinese corporate culture as one that has difficulty crossing boundaries since Chinese businesses have been dependent on direction from the Chinese central government for such a long time. This creates what has been called an '*ayi* [nursemaid] phenomena' where someone always looks after the company. In the end, this broader corporate environment leads to a professional culture that keeps individuals from owning up to their mistakes. When it comes to professional culture, Chinese managers describe their Indian colleagues as articulate and outspoken. In fact, they report Indian staff members are frequently the first to vocalize their opinions resulting in Chinese staff feeling disadvantaged or excluded in the communication process.

Even the culture of specific IT professionals varies between these two countries. Indian software engineers are frequently described as being reliable and able to provide high quality work. Chinese coders, on the other hand, are often seen as mavericks that like to show off their ability to create complex code, but don't have the patience for coding details. If these perceptions were to grow among MNC managers, they would increase the likelihood that this "invisible costs of outsourcing" might threaten the success of collaboration between Chinese and Indian work teams. Mavericks do not usually work well with others and can be threatened by articulate and vocal colleagues. Indeed, how long can the quality of work remain high when such barriers exist between mavericks and their reliable, vocal co-workers? These differences have the potential for eroding the willingness to share information necessary for successful knowledge flow.

National cultural barriers between Chinese and Indian firms expose not only the political opportunities and threats to collaboration but also the infrastructural disconnects that prevent talent synergies from being fully realized between these two nations. The treatment of intellectual property is one such issue. Leading IPR experts in China indicate the reason China has encountered such troubles with the IPR issue is due to the country's legal system. Enforcement is further complicated by the fact most consumers in China are unable to articulate the difference between material that has been pirated and that which is genuine. Senior managers go on to indicate such conditions imply companies must therefore be able to demonstrate the superior value of genuine products. This asymmetry results in mistrust that inhibits the flow of knowledge.

Similarly, intellectual property in India, particularly in software patents, is subject to the most stringent protocols in the world, although none of its provisions "provide any protection against reverse engineering." (McManus et al. 2007: 52) "Under the Indian Copyright Act of 1957, making or distributing copies of copyrighted software without proper or specific authorization, except for temporary back-up, is considered illegal." (McManus et al. 2007: 52) Because of this loophole, software piracy and IPR violations are common, primarily due to the fact that enforcement of these laws has not been effective. This also results in mistrust that inhibits the flow of knowledge.

Other thought leaders have taken the issue of national cultural a step further. Many identify nationalism in India as a significant threat to Sino-Indian investment. However, there is mutual suspicion between Chinese and Indian colleagues that largely stems from pre-existing cultural prejudices. On the other hand, as senior managers at multinational firms have discovered, it is a challenge to remove a Chinese employee from a purely Chinese context and enable them to consider anything but a Sino-centric mentality. In the knowledge driven global economy there is an increasing need to find employees who are internationalist, not nationalist. Employees with global mindsets are necessary for global competitiveness. Firms competing in this space need to consider decisions based on a business case only, which may require suppressing personal or national interests. Unfortunately, what we know about workers in multinational settings is that home culture is accentuated and amplified when they work with colleagues from other cultures (Laurent 1983). The Indian will be more Indian. The Chinese will be more Chinese. The intensity of these beliefs, values and behaviors result in additional invisible barriers to knowledge flow.

4.1 Language Differences

Language differences, the fact that the sender and receiver do not share a common mother tongue, present a barrier to effective movement of knowledge. Language distance has two components: (1) the meaning of the message itself, referred to as the propositional content and (2) the more abstract meaning conveyed by the manner in which the message is delivered, referred to as the pragmatic message (Thomas 1992). Individuals' voice characteristics, such as speaking rate, intonation, and intensity, convey "direct, subtle, or implied meanings and feelings along with the language message" (Myers and Herndon 1988: 439).

Accents interfere with the reception of the message content. A Dell customer relates frustration in PlanetFeedback.com,

a web site devoted to customer service problem, "The techs I had the privilege of dealing with were unintelligible due to heavy East Indian accents compounded by speaking much too quickly for me to understand." (Harrison 2002). Accents represent a barrier to effective communication and therefore contribute to interaction distance. Differences in language proficiency and ability to communicate, particularly in English as a common language, are an invisible barrier for collaboration due to the fact they inhibit knowledge movement effectiveness between employees from Chinese and Indian firms. This is intensified when the collaboration requires the transfer of tacit knowledge.

4.2 Talent and Knowledge Resource Availability

In conditions not too different than those faced by Silicon Valley firms throughout the dot-com boom a talent shortage is common among IT firms in both India and China. Another significant obstacle in China identified by senior leaders, is the hyper-competitive recruiting market where firms have to compete against well-known international firms such as Google and Microsoft—who are often seen as having more cache in terms of desirability and who have deeper pockets for compensation. What is more, senior leaders report there is a significant shortage of experienced senior managers. In the near-term, the challenge will be recruiting more top talent from within China and assigning them to jobs in the global marketplace. This growing scarcity of high level knowledge talent is yet another invisible barrier to knowledge flow.

4.3 Temporal Differences

Although industry leaders in both India and China are only two and a half hours apart with respect to time zones, they have learned valuable lessons regarding successfully managing globally distributed work teams. For example, to conduct team meetings and virtual work sessions, team members will need to adopt temporal flexibility, be it while holding conference calls outside the traditional 8 to 6 workday or fast-tracking a software project in shifts. Temporal differences, combined with differences in polychromic time orientation between India and China, have the potential to continue to be challenging, however. The concept of "Indian time" will no longer hold water on project teams now that they are the ones in leadership positions.

4.4 Contextual and Structural Barriers

Other challenges to resource availability exist in India's quest for capital and equipment resources. In China technology parks provide an invaluable network, allowing member firms to leverage these related and supporting industries when competing for projects against rivals. India's technology parks, as confirmed through executive interviews, have yet to lure enough hardware and related industry suppliers, to take part and viably compete in the software and telecom industry, but that day is not far off

China's multifaceted network of secondary and tertiary suppliers in the hardware manufacturing industry foster a healthy and growing set of research clusters within the country. Three such clusters exist in China: Shenzhen, Jiangsu and Beijing's Zhongguancun. These clusters thrive not because of one firm, but because of value each of the associated small and medium-sized enterprises brings to the entire cluster.

Shenzhen, home to China's "Electronic Information Trade Corridor," attributes its success to its immigrant demographic, generous support from national government to attract multinational foreign direct investment, and ties to Hong Kong service sector businesses. The success of Zhongguancun in Beijing can be attributed not only to the presence of a diverse SME base and government assistance, but also to the degree of collaboration between SMEs and the local universities that promotes technological innovations. Jiangsu's success comes from its well-developed transportation network connecting it to nearby high-tech industrial centers in Shanghai, Wuxi, and Kunshan. These various science park models are presented in Table 2.

Table 2: Chinese Resource Attraction Models

Development Model	Source of Funding	Technological Content	Quality of Human Capital	Leading Mechanism
Southern Jiangsu	Government	Low	Low	Government Participation
Shenzhen	Foreign Capital	High	High	Market Pull
Zhongguancun	Bank Loans	High	High	Technology Push

Source: Xianping, Ron, 2007: pp. 7-18.

Senior executives at leading Indian IT firms acknowledge, it will take Indian firms a number of years to develop manufacturing capabilities on the scale and with the sophistication of Chinese firms. On the other hand, China's software industry is still in its infancy compared to India, thanks in part to India's fast growth in software and lessons learned through Y2K. The presence of these knowledge clusters is a driver of knowledge flow. They contribute to the social infrastructure needed for an adequate embedding matrix though which knowledge can be absorbed. Underdevelopment of knowledge clusters is another invisible barrier to effective knowledge flow.

4.5 National Policy Barriers

Among the frustrations identified by executives interviewed, one that was frequently mentioned is the difficulty experienced in registering a business in India. Fortunately for Chinese and multinational executives, these barriers to entry are being addressed by national legislators in many ways. "Before the economic reform in the 1990's, FDI was heavily concentrated in manufacturing activities, which was due to import-substituting industrialization that encouraged tariff-jumping investments to capture the protected domestic market. The trend in recent years has changed towards an increase in foreign investment in the tertiary sector that encompasses mainly services activities." (McManus et al. 2007: 15).

Transitioning from import-substituting industrialization to market liberalization, India's economic development landscape has become more responsive to lowering the burdens that have prevented FDI to spread in India. Other policy initiatives underway in India include liberalizations of the telecom industry – such as reduction in long-distance call tariffs, establishment of a unified licensing regime, and low-cost, high quality bandwidth. These initiatives are projected to increase corporate FDI up to 74%, up from the former limit of 49%. India's upcoming legislation promises that MNCs actively investing in the Software Technology Parks of India (STPI) initiative will be able to enjoy relief from income tax starting again in 2009. National policy has a role in providing conditions that foster knowledge flow.

5.0 BEST PRACTICES FOR KNOWLEDGE FLOW

An array of barriers to the successful transfer of knowledge between China and India has been identified. Nevertheless, some firms have successfully developed practices to overcome these invisible barriers and succeed in the movement of knowledge. The following section examines these best practices that include leveraging local competencies, globally distributed team development, socialization and building "knowledge bridges"—all "soft technologies." We cannot avoid the importance of these best practices, especially in light of the fact that 3.4 million "white collar" jobs are forecasted to move from the US to India and China by 2015 (Stringfellow et al. 2007: 2). The impact of India and China on the software, computer and telecom industries simply cannot be ignored. The three cases below offer insights into best practices.

5.1 Leveraging Local Competencies

In a one year period beginning in May 2005, Motorola's share of the domestic Chinese mobile phone market jumped from 12% to more than 21%. Business Week reports this "remarkable market share grab" in "one of the most competitive [mobile phone markets] on the planet" has been significantly assisted by the introduction of the high-end Ming PDA mobile phone (Bremner 2006). The introduction of such high-end devices provides an example of how companies whose knowledge base has been developed in China through interaction with the West, can partner with similar parties in India to create innovative products.

Senior leaders involved in the development process for such phones indicate their team's knowledge grows throughout the life of the project. At the beginning of such projects, teams often lack deep knowledge in, for example, hand phone design. Nevertheless, they are able to gain from the experiences of the company's employees in other countries. In the process, local engineers often become world-class and are able to take technology beyond localization to make it optimally applicable to the China market. In essence these teams remove the unnecessary aspects of the recommended design from the U.S., and introduce technology that will be utilized in the high-end segment of the China market.

Following this example, when such a high-end phone's architectural software is developed, however, industry experts estimate approximately 5% of the code comes from the MNC's Indian subsidiary. While this portion of the code is utilized for specific applications servicing such high-end phones, it has broader implications for the internal knowledge movement between China and India at these firms. In fact, industry experts report this process enables the Indian

subsidiary to understand the company platform and play an active part in the development of the software code into the platform of the company's China operations. Industry leaders believe this development represents a general trend where Indian software and code designs are utilized to meet the needs of the company's operations in China. Such work utilizes India's competitive advantage in software code production to ultimately bring about a unique product. In the end, such high-end phones have been designed by Chinese engineers to meet the specific requirements of the Chinese consumer. However, the company has tapped into the software production resources in India to increase the product's quality and speed to market.

5.2 Integration through Globally Distributed Teams

In many medium sized global IT consultancies, employees begin their career with a training course at the company's training center. Some of the more forward-looking firms have even located their training centers in emerging market cities such as Bangalore, India. The vision of senior leadership at these companies is to create firms where there is not one national culture that dominates the firm. The result of these visions is that the employees are socialized to hold similar values and utilize similar practices to build the business.

Mutual learning is one of the primary purposes of such training as the new hires learn company best practices while company managers are also able to initiate mentoring with less experienced hires. One of these best practices is the free flow of ideas and suggestions throughout such companies. These practices are made possible when networking within the company is encouraged and each employee's voice can be heard throughout the development process.

Another purpose of such training is to give new employees exposure to cultures in the developing world. This experience is not for the faint of heart; however, as staff members are typically immersed in the local culture from the time they arrive at the overcrowded airport and make their own way through the lively city streets to campus. The time at the training center develops two major assets that each employee needs throughout their career: cross-cultural communications and inter-company networking.

However, the significance of such training is not simply the fact everyone receives similar training, but that it is delivered in the same location. The single location enables employees to gain a better interpersonal sense for their co-workers while at the same time creating bonds of friendship. These bonds will become the essential fabric that empowers integration of globally distributed teams among a company's numerous employees worldwide. The power of these networks is unleashed when firm's have flat organizational structure systems that encourage free-flowing communication and a rotation practice whereby significant percentages, at least 30%, of the staff in a given location are expatriates. Is it any wonder companies with such practices report little problem in carrying out knowledge movement between their Indian and Chinese operations?

5.3 Socialization: The Salad Bowl Staffing Affect

However, the successful use of training to create a single organizational culture is not limited to medium sized firms operating in these markets. Many of the largest providers of global consulting and IT services also utilize similar practices in the socialization of their staff. Such firms intend to grow organically and build a global employee base in each of their subsidiaries, which requires everyone is taught the same set of values. In such firms the Chinese employees interact with their Indian colleagues because they are both part of a single organization. The company's workforce is never relegated to a single location or product, but instead they are intermingled on products. In the end this produces a very heterogeneous employee make up that is similar to a salad bowl which implies the company is able to act more like a single organization.

Even in the larger firms, the salad bowl effect of socialization typically begins at training facilities where thousands of employees can be trained at one time. Most importantly firms have found this training draws the employees into a larger organic cultural fabric not simply the culture of the company's operations in China. In addition, as part of such trainings a number of virtual teams are often formed to work on the same type of projects. The end result is typically heterogeneous teams that carry out homogeneous projects. In essence, the salad bowl of a single company engenders socialization that encourages knowledge movement between India and China.

6.0 NEXT STEPS: BUILDING KNOWLEDGE BRIDGES

Both the challenges that come from *interaction distance* and *interaction intensity* need to be addressed as first order

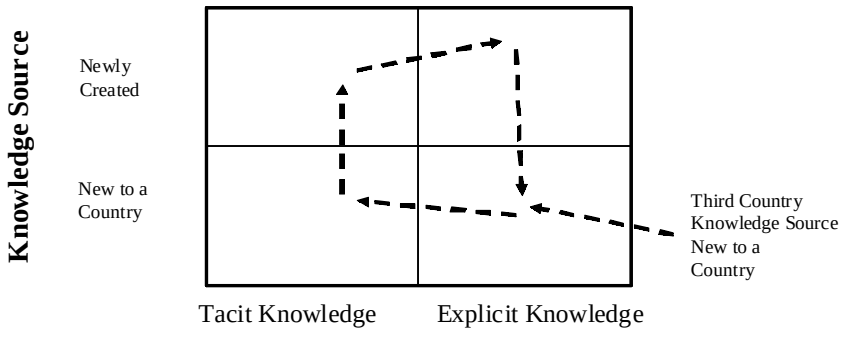
impediments to successful knowledge movement. China must develop ways to bridge the language divide, the customer service divide and the innovation divide. By bridging the language divide, Chinese firms can pursue collaboration opportunities, as opposed to outsourcing, where they can reduce the interaction distance of the services they provide while presenting themselves as less of a corporate risk to multinationals. In order to tap into the complimentary knowledge in IT and telecommunications hardware, Indian firms must encourage participation in networks like those of global IT consultancies with training centers in Bangalore where firms leverage the talents and capacities of their workforce instead of replicating them at lower degrees of quality. Additionally, U.S. and other multinational firms must begin to engage these knowledge communities in order to capitalize on the knowledge and skill sets that are being nurtured in both China and India.

Knowledge flows through a variety of mechanisms including trade, foreign direct investment, technology licensing, copying as well as reverse engineering foreign education and training and accessing foreign technical printed material (Dahlman 2007: 48). This manuscript focuses on foreign direct investment and licensing. Knowledge that flows through foreign direct investment can take two forms, tacit or explicit. Much of knowledge is tacit, embedded in organizational processes—a fact that makes knowledge movement difficult (Davenport 1998). It is challenging to articulate tacit knowledge since it is highly personal, context specific and subjective. Tacit knowledge is gained through action, experience and interactions between people and processes (Nidumolu 2001; Nakano 1991,1994). Explicit knowledge, in contrast, is codified or codifiable in data, mathematical expressions, words, sentences and files. Knowledge movement is called many things including transfer, sharing (Huber 1990), and diffusion (Rogers 1995). It occurs when a recipient can use the knowledge directly or in a modified form. The source of knowledge can be new to a country (absorption) or newly created (innovation). Porter (1990) found that innovators are often outsiders from a different industry or a country seeking new expansion opportunities.

Knowledge takes two forms: tacit or explicit. Knowledge has two sources: it may be newly created, which we call innovation. Or it can be new to a country which can be acquisition or absorption. The combination of knowledge form and knowledge source enables us to identify four states through which knowledge can flow which are illustrated below. Using this framework, knowledge is transferred from outside the India-China dyad into one of these countries and then transitions through four states in the following manner: (A) Explicit knowledge that is new to a country whose source is from a third country; (B) Tacit knowledge that is new to a country; (C) Tacit Knowledge Innovation; and (D) Explicit knowledge innovation.

The flow of knowledge from explicit to tacit (A to B) begins to lay the foundation for innovation. Firms move from "know what" or acquisition represented in A to "know-how" or absorption represented by B. Tacit knowledge is required for absorption. Absorption provides the technology platform upon which innovation can occur (B to C). Once a firm has "know-how" they can develop novel applications or extensions of that know-how that produce tacit knowledge innovation represented in C. Tacit knowledge innovation can be encoded (C to D) and this can be transferred to another country or setting (D to A). The ability to encode the knowledge facilitates the transfer. This provides an opportunity for the development of a virtuous cycle of knowledge flow between China and India or India and China. The high-end mobile phone example above illustrates this point. This movement happens through a series of knowledge bridges. This virtuous cycle dynamic is illustrated in Figure 1.

Figure 1: Forms and Sources of Knowledge: The India-China Virtuous Cycle



7.0 CONCLUSIONS AND IMPLICATIONS FOR HIGH TECHNOLOGY MANAGERS

Business leaders we interviewed from U.S., Indian and Chinese firms have identified invisible barriers to effective knowledge transfer that are based in cultural, interpersonal and structural dynamics. They have also shared best practices for encouraging the flow of knowledge between India and China and vice versa. Through their experiences, we have seen the hint of a ripple of knowledge movement that promises to become a tsunami. Through the best practice examples we have seen the dynamics of a virtuous cycle of knowledge movement in action. Understanding these dynamics will be important to companies actively engaged in knowledge creation in India and China. It will be equally important for companies around the world who compete in high tech industries. The combined knowledge share of these two giants, if harnessed, promises to generate increasingly powerful virtuous cycles of knowledge creation.

Asia in the 21st Century holds great promise and presents great challenges. As India and China grow in importance so will the importance of knowledge transfer between firms located in these giant economies. Companies that develop competencies that build robust knowledge bridges between India and China will capture the promise of the 21st century marketplace. Leveraging the asymmetries and complementarities of India and China will be critical. This begins with understanding the similarities and differences in these two markets. It will require embracing and emulating knowledge sharing best practices, mastering "soft technology" transfer and leveraging lessons that deliver customer value.

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