

Service Provision for the Global Economy: The Evolving Indian Experience

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Abstract

Since 1995, the offshoring of services to India has rapidly evolved from a curiosity only studied by a few scholars to a phenomenon portending a major shift in the geography of global economic activity. The article examines the evolution of Indian global services provision quantitatively and qualitatively through the use of four case studies. The first case study examines the challenge that the Indian information technology systems integrators (ITSIs) pose to the formerly larger—but now roughly comparable in terms of employment—incumbent developed-nation ITSIs. Because IT systems have become central to nearly every enterprise, the second case study illustrates the wide variety of enterprises that now have significant Indian offshore operations. The third case study describes the rapid growth of offshore integrated circuit design in India, a nation with now commercial-scale integrated circuit production. The final case study describes the emergence of high-opportunity entrepreneurial startups in India and the increasing number of Silicon Valley startups that very early in their lives or even as part of their business model have significant operations in India. The concluding discussion situates India within the global economy and speculates upon its future evolution.

KEY WORDS: services, India, systems integration, IC design, sectoral diversity, entrepreneurship

Introduction

Only 7 years ago the consensus among most observers was that the Indian software industry was characterized by low skill levels, with little prospect of significant upgrading to higher value-added activities (Arora, Arunashalam, Asundi, & Fernandes, 2001; D'Costa, 2003; Parthasarathi & Joseph, 2002). This article describes the current situation in India for offshoring, and finds that in India, firms are rapidly increasing their higher value-added service provision to the global economy (Dossani & Kenney, 2003, 2007a,b; Lewin & Peters, 2006a; McKinsey Global Institute, 2005). In many respects, given the history of other nations and learning-by-doing through international trade, it was remarkable that the pessimists believed the Indian labor force would be incapable of learning and acquiring greater capabilities. As Doner, Hicken and Ritchie (2009) show in this issue, in the case of Thailand, upgrading was certainly not the obvious conclusion either as it necessitated a conducive institutional environment. Our results do differ from previous research that suggested that developed nation MNCs would be the dominant vehicles for this learning (Kogut & Zander, 1993). For India, it has been a combination of indigenous firms, MNCs, and entrepreneurs that were responsible for the learning. In fact, in the case of software services or, what more properly is being termed “information technology systems integrators (ITSIs),” the relocation by the MNCs to India has, in part, been driven by the successes of their Indian

rivals. In other words, Indian success in becoming a center for the export of services is driven by both international inward investment and capacity building among Indian firms.

The importance of Indian growth is that for the first time in history, a developing nation is becoming a factor in the global economy, not through the production and export of physical goods, but rather through the export of the output of services. These exports are almost entirely composed of data streams (and, of course, Indian professionals that are dispatched abroad to work at their customer's premises)—be they the voices of telephone operators answering customers' queries, data entered into a computer, data entry and analysis, sophisticated product designs, or software programming. This is exactly the type of symbolic analysis work that Robert Reich (1991) suggested would grow in importance for the advanced economies. Only a decade ago, it would have been difficult to foresee that this was exactly the type of work that would be the basis of a new globalization wave.

The MNCs did not locate their operations in India to access inimitable local knowledge or markets (Dunning, 1994; Dunning & Lundan, 2009; Malnight, 1995), but rather a capable low-cost, white-collar labor force. The multiplicity of service activities now undertaken in India has ignited a cycle of cumulative causation encouraging exploration of yet further opportunities (on cumulative causation, see Mathews, 2003). This explains the findings by Lewin and Peeters (2006a,b) that increasingly high-value operations are being offshored. This dynamic is outdated previous views of offshoring as being only routinized work (on routinized work, see Levy & Murnane, 2004; for call centers, see Holman, Batt & Holtgrewe, 2007; for an argument stating that there has been a service transformation based on the use of IT tools to allow the routinization of formerly unroutinized work, in which the activity is to be offered as a service, see Kushida & Zysman, 2009).

The impact of work offshoring on developed nations is not explored directly in this article, as there are ample studies whose results conjecture that the impact will range from minimal, to suggesting a shift that could range into the tens of millions of jobs (Bardhan & Kroll, 2003; Blinder, 2006; Blinder, 2007, unpublished paper; Jensen & Kletzer, 2005; McKinsey Global Institute, 2005). If the Indian service-provision industry continues its current evolutionary trajectory, then work that may not initially have appeared offshoreable may eventually become relocatable.² Put differently, work that may have appeared to be place-based could, at least, in part, become moveable.

We adopt an evolutionary perspective because it explicitly recognizes that economic change is the product of forces and generates conditions causing yet further change (Lewin & Volberda, 1999). The article proceeds in the following manner: The first section provides an overview of the quantitative and qualitative changes that have occurred in the Indian economy for supplying services to the global economy. The next four sections illustrate the quantitative expansion and increasing qualitative deepening of Indian service provision through sectoral examples. The first sectoral example describes the strategic competition between Indian and developed-nation ITSIs, which has resulted in India becoming a global center for IT systems integration. The third example illustrates the industrial diversity of global firms that have established service-provision operations in India. The second example is extremely narrow, focusing solely on the field of integrated circuit

design. The final example describes the rapidly growing entrepreneurial environment in India and its connections with Silicon Valley entrepreneurial startups. The concluding discussion draws together the various points in the essay and speculates on the implications for the future of the Indian service-provision industry.

Quantitative and Qualitative Evolution

The current ecosystem is the result of an evolutionary process that has occurred at a macrolevel and at the firm and industry level. One crude indicator of the expansion of Indian service provision to the global economy is through the number of Indians employed providing services to the global economy. As Figure 1 indicates, the aggregate employment growth in all sectors has been from 232,000 in March 2000 to 1,251,000 in March 2007 (Nasscom, 2007).³ The overall compound annual growth rate is greater than 23%, with the business-process portion growing more quickly. This is illustrated in Figure 1 by the category of R&D export employment that has expanded at 15.5% per annum. One gauge of the rising visibility of R&D services is that not until 2006 did NASSCOM begin treating it separately in its aggregate statistics. This reinforces what is observed anecdotally in our interviews.

The evolution of the India ecosystem can be illustrated graphically. Figures 2 and 3 are a stylized representation of this evolution in three dimensions: numbers, quality of work, and industry sectors. In 1995, as Figure 2 indicates, Indian firms concentrated on software programming with the majority of their workers being “body-shopped” to the United States and Europe (Arora et al., 2001; Arora & Athreye, 2002; D’Costa, 2003; Heeks, 1996; Schware, 1987). A few MNCs, such as British Air, Citicorp, and General Electric Capital, had small subsidiaries for software coding and transaction-processing services. For example, British Air transported its used ticket stubs to India where they were processed and entered into a computer. In Bangalore, TI and HP had small technology-development operations. The MNCs were attracted by a large underutilized, very low-cost, but skilled white-collar labor force (Patibandla & Petersen, 2002). The arrival of the MNCs not only accelerated labor force development, but also drove the development in new directions in terms of industrial sectors and skill development paths. Also, because

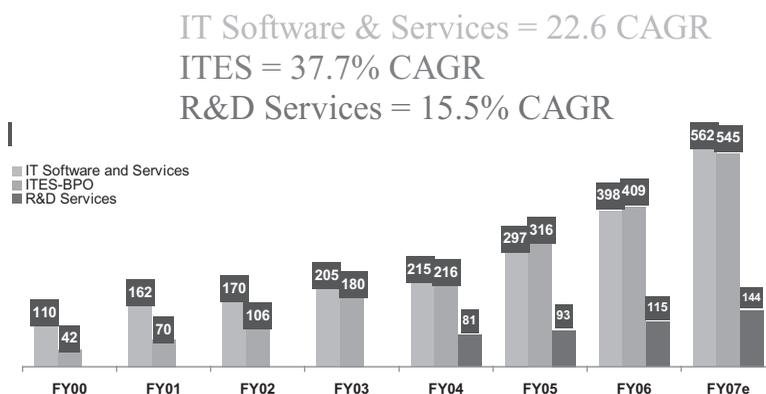


Figure 1. India IT-Related Export Employment Growth, 99-00 to 06-07e in thousands (Nasscom, 2007)

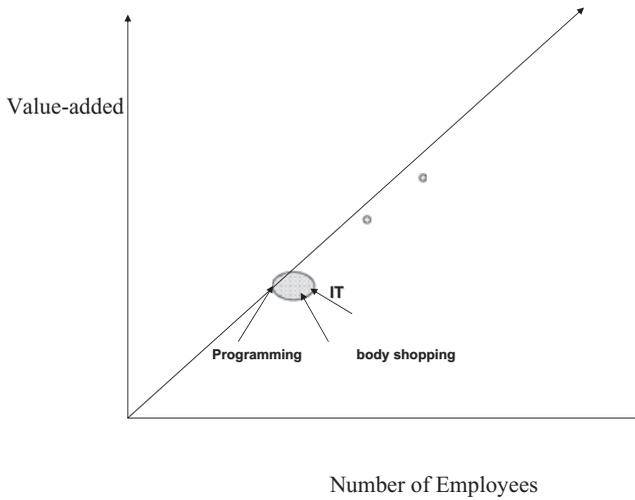


Figure 2. Stylized Representation of Indian Service Provision, 1995 (Authors' compilation)

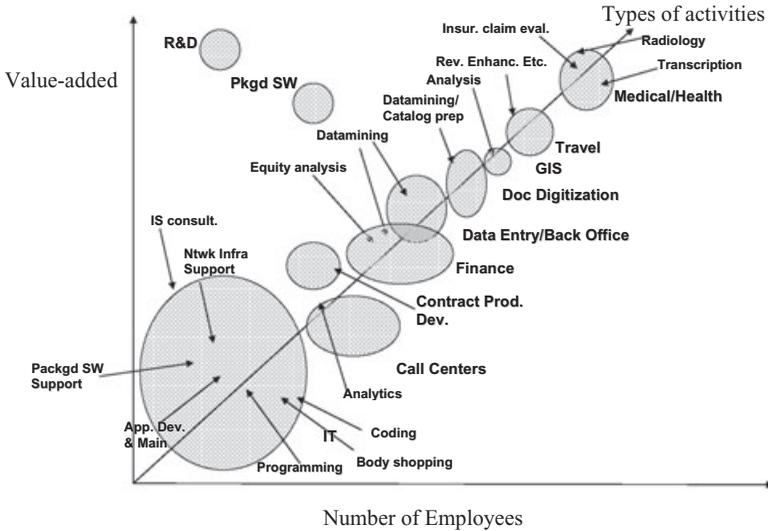


Figure 3. Stylized Representation of Indian Service Provision, 2007 (Authors' compilation)

jobs in large MNCs were prized it further increased the attraction of Indians to the engineering fields. Still, in the mid-1990s, according to Heeks (1996), there were only 27,500 employees providing work to offshore clients. Even if one estimates liberally that there were roughly another 10,000 involved in other offshored service work, the total number of employees cannot have been no more than 40,000. The obstacles to offshoring service work to India were enormous. Telecommunications bandwidth was scarce and expensive. Customers were not willing to trust Indian vendors. Moreover, though changing rapidly, India had a reputation as a difficult environment for foreign investment. Not only was the labor force small and India confined to low-end work, but it also was confined to a small number of activities (see Figure 2). However, offshoring was expanding rapidly, and in retrospect, was on the verge of dramatic expansion.

By 2000 the situation had evolved significantly. India had deregulated telecommunications, there was a dramatic build out in domestic and global telecommunications bandwidth accelerated by the Internet building, and a movement to digitize documents and workflows. This affected the relocatability of service work as data was liberated from physical media. The Internet Bubble created a shortage of IT and software workers in the United States. The Y2K problem encouraged corporate IT users to replace old legacy software with new standardized software packages. This created enormous demand, much of which was routine coding and programming, especially in older languages such as Fortran and Cobol. The Indian software services vendors using low-cost labor offered dramatically lower prices than their developed-nation counterparts. This gave them a foothold in larger U.S. accounts.

Large MNC ITISs, such as IBM and Accenture, were exploring the Indian environment for low-cost software talent, while those already in India embarked upon expansions. For example, GE Capital International Services was a pioneer in relocating to India corporate activities ranging from credit card, back-office operations and call center work to its internal finance and accounting operations. The IT field was the largest and most active, but financial firms, such as HSBC, Citigroup, and American Express, were expanding their Indian operations (Grote & Taube, 2006). Roughly contemporaneously, and, affiliated with the activities of the existing MNCs, Indian firms formed to offer business process services, i.e., call centers, data entry, and medical transcription. This expanded the scope of activities being considered for offshoring.

By 2003, it was recognized that offshoring would change the global geography of work. Key U.S. executives such as John Welch of General Electric, Michael Dell of Dell Computers, and Carly Fiorina of HP had begun hailing India as an excellent environment for various types service work, including R&D. In the business press, this was expressed in the alarming February 3 *Business Week* (2003) headline asking “Is Your Job Next?” Though *Business Week* did not focus exclusively on India, there was little doubt that India was the center of attention. No longer were offshoring concerns confined to the threat to manufacturing labor from China and Mexico, or even coders from India, now the threat appeared to be aimed at U.S. service workers as a group (for an early formulation of this, see Bardhan & Kroll, 2003; with reference to India, see Dossani & Kenney, 2003).

In March 2007, with 1.25 million people employed delivering services remotely, India had developed a variegated capacity to provide services to the global market. For a number of IT MNCs, their India headcount was now greater than that in any nation except their home countries. Whereas previously, firms had transferred selected activities that were parts of larger processes, by 2007 entire processes were being relocated. The Indian subsidiaries had been given global profit and loss responsibility for these processes, and in some cases, Indian managers now managed personnel in developed and developing nations. The scale of these investments meant that the Indian operation became a critical link in global-scale operations. Of all the MNCs, Cisco recognized this change most explicitly when, in 2006, it appointed a Chief Globalization Officer to be based in Bangalore (Cisco Inc., 2006).

The Indian service ecosystem had not only expanded, but, more interestingly, was of greater complexity than ever before (Figure 3). The pioneers were joined by firms from a variety of industries, many of which had not offshored previously. For example, General Motors' first overseas R&D laboratory was established in Bangalore (General Motors, 2005). The Indian SIs reflected the evolution of development in the ecosystem. Although not yet in terms of revenues, the Indian SIs now rivaled the large international SIs in terms of employment—this was quite an accomplishment for firms that less than a decade earlier had earned the sobriquet “body-shoppers.” Also, an increasingly dynamic entrepreneurial ecosystem in India was in gestation. Not only had India become a location of choice for developed-nation and, particularly, Silicon Valley startups, but a startup culture was emerging, even as a cadre of Indians working in developing-nation firms saw opportunities in India.⁴ As in the case of China for manufacturing, India was now in a league by itself regarding offshoring services.

Case Study One: The Competition between the Indian and Developed-Nation ITSIs

During the last 5 years, a serious rivalry has developed between Indian and developed-nation ITSIs that is resulting in a shift in the global geography of IT service provision, and by extension, software production.⁵ The importance of such a shift is clear, as global economic activity is based on the world's IT infrastructure, which ultimately is the software running the system. The IT infrastructure is today's critical general purpose technology (GPT).⁶ In keeping with this importance, information technology, as a portion of the U.S. economy, is significant and growing (Brynjolfsson & Hitt, 2003). According to the research firm IDC, in 2006, U.S. IT spending accounted for \$660 billion, thus placing it among the five largest service sectors in the U.S. economy.⁷ Any discussion of reform of healthcare, the financial system, or any other sector invariably has an IT component. At the end of 2006, employment was estimated at 1.8 million.⁸ Of the IT spending, 30% was spent on IT services, 27% on business process outsourcing, 14% on packaged software, and 29% on hardware. The annual growth rate in spending averaged 11% from 1995 to 2002, but declined to 8% between 2003 and 2007, which was still significantly faster than GDP or employment growth. As a GPT, IT has become the basis of the U.S. innovation system and, increasingly, is the key sector for transformative entrepreneurship—be it the Internet, telecommunications, or nearly all new products.

Given the complications and the cost of IT, there has been a long-run tendency for non-IT firms to contract out the development and maintenance of their IT infrastructure to specialist firms (see, for example, Cusumano, 1991). Traditionally, because of their intimate relationship with the firms' outsourcing work, the developed-nation ITSIs, such as Accenture, ACS, CapGemini, EDS, HP, IBM, and others, worked directly with the customers to scope and define unique outsourcing propositions, and had direct access to top executives. Often, they cowrote the request for proposal (RFP) with the customer, thus placing themselves in an excellent position to win the contracts (personal interviews, 2006). This situation placed the developed-nation ITSIs in an excellent position, as they could charge high

prices and have excellent margins. There were few competitors. The Indian ITISIs, at this time, provided low-margin programming and had few connections with the customers. For the largest and most sophisticated customers, the largest developed-nation ITISIs with their global operations could offer global solutions, while the Indian ITSI solution was to dispatch Indians to wherever their customers wanted them. Given international visa issues, sensitivity to outsiders, and other issues, this simply was not the global coverage the largest firms and the largest contracts required. Finally, during the early years of the twentieth century, the Indian firms were simply not large enough to bid on the largest and most sophisticated contracts. As a result, the Indian ITISIs were relegated to responding to RFPs. In other words, they bid on projects with defined tasks and success based on price. To move up the market and secure greater profits, the Indian ITISIs would have to build their reputations and learn to deliver more sophisticated services.⁹

Low-cost software programming was the initial service that India offered to the global economy (Dossani, 2006; Heeks, 1996). In an effort to move upstream, the Indian firms developed strong process skills to prove themselves to foreign clients. To increase client confidence, they conformed to independently developed foreign quality standards such as Capability Maturity Model standards for software process maturity and various International Standards Organization initiatives. In India, the influence of GE's Six Sigma program is pervasive. Acceptance of such standards forced Indian vendors to carefully examine their service production processes and standardize them. This meant that they were constantly experimenting with improvement methodologies. The result was to inculcate metrics for measuring efficiency and quality. This ethos has an uncanny resemblance to the Japanese adoption of the Deming/Juran Total Quality Control ethic after World War II. To use Paul Adler's terms (1996), they resemble learning bureaucracies in that they are constantly benchmarking their processes, and examining them for potential efficiency gains. This contributed to Indian firms establishing new market expectations for software quality.

The Indian vendors have, through their superior performance metrics, placed pressure on other firms to implement metrics (M. Frank, 2006, personal interview). And yet, even if Indian firms demonstrate superiority in performance metrics, in the fast-changing software and in IT-enabled space, producing yesterday's solutions or just undertaking the production portion of services is not where the greatest value-added is created. A systems integrator must be both prepared and trusted sufficiently to become an advisor or, in the vernacular of this world, an order maker. Indian SIs have a number of weaknesses, one of which is that they are Indian firms, and in many respects, are not fully internationalized, in part as a result of their current competitive advantage being based upon their Indian cost structures. To become global corporations, one challenge Indian firms face is to globalize their management thinking. This is not impossible; however, it will require migrating the firm's perspective from one seeing the world from an India-centric perspective to a global perspective. The benefit from such a transition is that Indian firms will then be able to supply customers with globally aware solutions. This transition may not be as smooth as it was for Japanese leaders, who had one of the most sophisticated markets in the world from which to learn. "Becoming global" may be the most serious challenge Indian firms will face in their drive to be ranked among the global leaders.

From low-cost programming and systems maintenance the Indian firms have evolved to offering IT systems integration. The initial successes of the large Indian programming firms opened the way for them to evolve into providers of a wide variety of information technology and even broader services, and this has shifted the global geography of the services portion of the IT industry. It is in IT services where Indian firms, and India as a place to do this work, are forcing the developed-nation ITSIs to respond.

One way of illustrating the competitive challenge developed-nation ITSIs face is to compare financial results. In FY 2006–2007, TCS, the largest Indian firm, continued its rapid growth, announcing a 42% growth in net profit and a 40.9% growth in revenues. Employment increased from 62,000 in April 2006 to in excess of 100,000 in December 2007. Infosys, the second-largest Indian firm, announced FY 2006–2007 a 45% growth in revenues and a 48% profit growth. To illustrate, at the end of FY 1999, i.e., March 2000, the largest Indian service provider, TCS, had 17,000 employees and Infosys and Wipro had approximately 10,000 each. In October 2007, TCS had 100,000 employees while Wipro had 75,000 and Infosys had 81,000. A similar pattern could be observed with the other Indian ITSIs, Cognizant, HCL, and Satyam. Profit margins for the large Indian ITSIs are roughly 25%, while those of developed-nation ITSIs is less than 10%.

The growth of the developed-nation ITSIs is slower despite the fact that, as we will show later, their employment in India is growing very rapidly per annum. For example, in 2000, EDS had 122,000 employees, and India was not even mentioned. In 2006 it had grown to 131,000, of which 32,000 were in low-cost locations, particularly India—a doubling from the previous year (EDS, 2007). Over those 6 years, sales were roughly stagnant. IBM Global Services (GS) had 190,000 employees in December 2007, but revenues, although still five times larger than those of TCS, had been growing at approximately 6% per annum. Global revenues and headcount for the developed-nation ITSIs was growing slowly.¹⁰

The relative difference in growth is not surprising as the developed-nation ITSIs had much higher cost bases—a situation that was justified because they retained the higher-end services. This was not so threatening as long as the Indians were unable to bid on the largest, most sophisticated contracts. However, if the Indian ITSIs could overcome their handicaps, the developed-nation ITSIs would be directly threatened.

Four important events changed the landscape for the Indian ITSIs. The first event was the labor shortage caused by the Internet Bubble. The second event was a corollary of the first: the Internet Bubble collapse and the ensuing recession that placed enormous pressure on firms to bring costs, in particular IT costs, down. The third event, which was also a result of the Internet Bubble, was the dramatic improvement in global telecom infrastructure and significant reductions in costs of transmission making communication much cheaper. The final event was the Y2K problem, which Indian firms exploited to secure contracts with large customers. This allowed the Indian ITSIs to prove their merit to their customers and built trust and confidence. This allowed them to overcome what some have called the liability of foreignness (Zaheer, 1995) to develop closer relationships with customers.

The rapid and profitable growth of the Indian ITSIs meant that since 2000 the Indian firms have grown in size and financial strength (Athreye, 2005; Dossani & Kenney, 2007b). If sheer size was an obstacle to securing the largest contracts, it is no longer the case (Shah, 2007). The Indian firms have the experience and competencies to handle much larger contracts, and recently have begun winning larger contracts.

Until recently, most Indian firms did not have a strong global delivery capability, and thus found it difficult to provide a complete solution for the world's largest firms. For example, banks like HSBC, JPMorgan Chase, Barclays, Credit Suisse, and Deutsche Bank have global operations and desire integrated IT systems. These firms have no doubt that an Accenture, HP, or IBM can provide such solutions. Regardless of price advantages, Indian firms whose only delivery centers are in India cannot credibly claim to be able to provide global support.

TCS was the leader in recognizing this obstacle. In 2001 it established a delivery center in Hungary, then in 2002 it established a Latin American delivery center in Uruguay, and delivery centers in Hangzhou, China, and in Yokohama, Japan. In 2007, TCS created a joint venture to serve the Chinese market with three Chinese software firms and Microsoft, and planned to expand it to 5,000 employees in 5 years (Powell, 2007). It has already won \$50 million contracts with Chinese banks including the Bank of China. East Asia, which was formerly the sole preserve of the U.S. ITSIs, is now becoming a competitive battleground.

The most impressive initiative by any Indian ITSI is TCS' efforts in Latin America. The Latin American operations include a global delivery center and a regional training center in Montevideo (Uruguay), as well as a center in Buenos Aires employing a total of approximately 850 professionals. In December 2007, in non-Indian global delivery centers TCS employed 5,500 people in Latin America, 1,100 in China, 400 in Hungary, and 300 in Japan. In early 2008, it announced plans to hire 1,000 people in a new Cincinnati, Ohio, delivery center. TCS was the pioneer in building a global delivery capacity, but the other Indian ITSIs are following its lead.

These investments did not immediately have significant returns, but it began capturing business utilizing these new capabilities. The first significant contract came in 2005 as part of a contract shared with IBM and Infosys. TCS was contracted to provide application support and enhancement services for the Dutch bank ABN Amro's European and Brazilian operations using its fledgling global delivery centers in Hungary and Latin America.

The global footprint is important in another way as it provides a base for the Indian ITSIs to market their services in Latin America and Asia. Previously, contracts in developing nations were small. In 2007, TCS signed a \$200 million, 4-year contract with the Mexican social security system to provide IT services including application maintenance and support, custom software development, business analysis services, management of strategic IT programs, and other value-added. This contract is a landmark, for not only is it large, but if successfully executed will increase TCS' ability to compete for large contracts throughout Latin America. Also, in 2007, TCS signed a \$60 million contract with the Chilean national registry and with an Ecuadorian bank for \$140 million.¹¹ While building a presence in Latin America, TCS was also expanding in China. In 2007, TCS announced a 5-year, \$100 million contract to provide its banking software to the Bank of China, and has

won a number of other contracts. In fact, IDC, a large consulting firm, ranked TCS' banking software as one of the top two available for Chinese banking. This success in developing nations is important, as it extends competition into what was formerly the exclusive preserve of the developed-nation giants. TCS is the Indian leader in building a global delivery capability, and the other Indian ITISs have only begun their globalization.

The change in capabilities of the Indian ITISs, and in particular TCS, coalesced in a \$1.2 billion, 10-year contract TCS signed with A. C. Nielsen in late 2007. Previously, such contracts had always gone to the U.S. IT consultants. In this contract TCS agreed to integrate Nielsen's entire IT system including IT services, business process outsourcing needs, back-office services, transformation, innovation, and tech infrastructure management. As part of the contract, TCS was to build a software platform which Nielsen would pay for with a subscription model. Moreover, the contract allows TCS to provide the platform to other users. In other words, TCS became Nielsen's software-as-a-service provider and TCS could own the asset.

The contract was not only comprehensive, but was complicated in its scope. For example, TCS absorbed Nielsen's 350-person analytics reporting and reference data management operation in Baroda, India, and would cater not only to Nielsen, but also other customers. Through this transfer, TCS acquired a knowledge process outsourcing capability in high-end analytics. The Nielsen contract signals a qualitative change demonstrating that TCS is no longer confined to software services. In truth, it is a multifaceted supplier of services. The most important point is that, if TCS is successful, it will prove that there is no contract too large or complicated to undertake. Moreover, if, as TCS claims, the contract enables it to retain its profit margins, there can be no doubt that this will increase the competitive pressure on the developed-nation ITISs.

The developed-nation ITISs have responded to the market inroads of the Indian ITISs. The most obvious measure has been a rapid increase in the number of employees they have in India. The scale and rapidity of this response can be seen in Table 1. The growth has been through hiring and acquisition. IBM, which had left India in protest in the 1980s, reestablished an operation in 1992, to service the domestic market. However, it was only after 2000 that it began to grow in earnest. At the end of 2007, IBM had in excess of 70,000 Indian employees and expected to employ 100,000 by 2010. In 2004, IBM acquired Daksh, a leading business process outsourcing firm with 6,000 employees. By 2008, the newly acquired Daksh had grown to 20,000 employees in India and the Philippines. The Daksh acquisition broadened IBM's product line and, as important, allowed IBM to fulfill more of its customers' needs and occupy space that rivals might use to enter its customer's accounts. In 2004, it acquired the 1,400-employee Network Solutions, which specialized in IT infrastructure services. In effect, IBM has in terms of employment in only 8 years become the fourth-largest ITSI in India. This suggests the importance IBM attaches to blunting the cost advantage of the Indian ITISs.

For the developed-nation ITISs integrating their Indian operations into a seamless global strategy is a challenge. Because most of these firms are firmly rooted in their home nation environment, many overseas managers see India as significant only for its ability to cut costs. The larger developed-nation ITISs, by definition,

Table 1. Employment in India by Selected Large Non-Indian Systems Integration and Software Services Firms

Firm	Year of Entry	Nationality	Employment in India (2007)	Global Employment (2007)	Percent in India	Acquisitions (Name, Year, # of Employees)
Accenture ¹	1987	U.S.	35,000	175,000	20	
ADP	1999	U.S.	2,000	46,000	4	
CapGemini	2003	France	17,500	82,000	22	Kanbay, 2006, 5,000
CSC	1991	U.S.	15,500	91,000	17	U.S. firm, Covansys, 2007, with 5,500 in India
EDS ²	1996	U.S.	20,000	134,000	15	MphasiS (52%), 2006, 11,000; RelQ, 2007, 700
IBM ³	1992	U.S.	70,000	190,000 (IBMGS) 360,000 (TOT)	32 19	Daksh, 2004, 6,000 Network Sol., 2005, 1,400
Oracle	1994	U.S.	22,000	74,674	29	I-flex, 2007, 11,000
SAP	1998	German	4,500	43,800	10	

1. In 2007, Accenture employed more people in India than anywhere else in the world.

2. In 1996 served GM India from India.

3. Reentered India 1992 for domestic market and includes total employment not just IBM Global Services.

Source: Compiled by authors from various news reports and corporate Securities and Exchange Commission filings.

have a long history managing offshore operations and although we cannot answer the question, it is possible that earlier globalization initiatives may have been easier to manage, because, in general, they were smaller and, in large measure, devoted to meeting their national market. Their smaller size meant that the operations were not as costly in terms of resources and especially senior management time, while the lack of temporal pressure provided greater opportunity for experimentation and recalibration. In contrast, the developed-nation ITSIs must manage their Indian operations well because of the scale of resources that have been invested. In addition, botched service delivery can cripple their clients and the withering competition they are facing. Successfully managing their offshore operations may be a determining factor for which firms survive.

Most other developed-nation ITSIs, with the exception of Accenture and HP, were slower than IBM in understanding the competitive dangers from the Indian ITSIs. For example, EDS, which had entered India in 1996 as a GM subsidiary, as late as 2005 had only 3,000 Indian employees. In 2006, EDS management decided to rapidly build its offshore operations, so it acquired the 11,000-person Indian business process firm MphasiS, and then followed this in 2007 with the acquisition of the 700-person firm RelQ. Simultaneously, it rapidly expanded its existing Indian facilities. U.S. ITSIs responded more rapidly than those in Europe, but, as Table 1 indicates, European ITSIs are also rapidly increasing their presence in India. The French ITSI, CapGemini, only began building an Indian presence in 2003. To accelerate its growth it purchased an Indian BPO firm, Kanbay International, in 2006. All of the developed-nation ITSIs are continuing to hire in India and also in other developing nations.

Assessing the state of competition between the Indian and developed-nation ITSIs is beyond the scope of this article; however, we believe the developed-nation firms have not yet halted the market penetration by their Indian rivals. Lynn and Salzman (2006) argue, and we suspect, that the Indian ITSIs may not only have lower labor costs than their rivals, but they also may be more efficient. The U.S. ITSIs have a certain resemblance to the Big Three automakers that faced the

Japanese threat beginning in the late 1970s, however it can be said for them that they are more aware of the threat.

There is no easy method for comparing ITSI employment by nation, but there can be no doubt that the two world leaders are the United States and India. It would not be surprising if India now has greater numbers of ITSI employees than does the United States, given that the largest developed nation firms now have nearly as many employees in India as they do in their home nations. Employment in India by Accenture and CapGemini is now greater than in their home nations and it is likely that IBM will soon follow them. Further, the Indian ITSIs have enormous numbers of Indian employees. The sheer concentration of people in the industry could ignite a process of cumulative causation that would draw yet more activity to India.

The work quality undertaken in India is also improving. As an example, Accenture in its Life Sciences Center of Excellence in Bangalore employs medical doctors, PhDs, pharmacists, mathematicians, and statisticians to plan and handle pharmaceutical clinical trials. In India, Accenture software programmers design databases and algorithms for storing and analyzing clinical data. They distribute electronic forms to physicians in developed nations conducting the trials and then review the data to spot errors. They then analyze the data for safety and effectiveness and write the reports. Recently, Accenture Japan signed a contract with the Japanese pharmaceutical maker, Eisai Medical Research, to manage their clinical data collection, processing, preparation for analysis, and archiving for operations in Japan, the United States, and Europe (Evalueserve, 2008). This movement of the Indian subsidiary to higher value-added work suggests that capabilities in India are improving rapidly, and that this is recognized at corporate headquarters.

More employees and higher value-added work are important indicators of success, but there is another final indicator that may be the most important of all. A number of developed-nation ITSIs are transferring profit and loss responsibility for divisions with global mandates to India. For example, Bangalore is the headquarters for Hewlett Packard GlobalSoft, which is a globally focused software development and IT services division with offices in Eastern Europe and Mexico. Put differently, the Bangalore headquarters has profit and loss and management responsibility for the global operations. The business process outsourcing (BPO) division providing financial and other services, H-P Global eBusiness Operations, with approximately 6,000 employees worldwide, is also headquartered in India. Another example is SAP Labs India, which employs over 4,500 people, "it boasts of the largest production team outside Germany providing assembly, validation and test services, and is credited as being the largest testing center within SAP. Accounting for close to 50 percent of SAP custom development, [it] also provides remote maintenance services to roughly [80 percent] of North American customers" (SimplySAP, 2007). It is also the largest SAP laboratory outside of Germany and "has complete ownership of delivering solutions for industries such as Hi-Tech, Apparel and Footwear Solutions (AFS) and SAP CRM for Pharmaceuticals, along with a significant contribution to SAP's Oil and Gas Downstream solution" (SimplySAP, 2007). These examples illustrate that not only the lower end assembly, maintenance, and testing are being done in India, but also responsibility for entire business sectors.

Accenture India offers services in supply chain management, software system upgrading, high-end analytics such as data mining, and has capabilities in using cutting-edge technologies such as NetWeaver. Accenture's Indian operations develop and maintain software; handle call centers; discharge human resources, IT help desks, finance, and administrations functions; and analyze clinical trial data, to name only some of the activities. The Indian operation took the lead in creating a services product, Accenture Communications Solutions, for the communications and technology industries (P. Vaish, 2005, personal interview). Accenture's efforts typify the current phase of experimentation and growth that nearly every large U.S. ITSI has underway in India.

As the Indian operations become central parts of these firms' global strategies, and are assigned higher value-added activities, a challenge will be to ensure effective management of the Indian operations. Placing so much responsibility for global success on the Indian operation will require greater participation by India-based executives at the global strategy level or it will be difficult to take full advantage of the skills being built in India. This will entail more than having random board meetings in India and high-profile visits by the top executives. Given the importance of the Indian operation to the overall competitiveness of the developed-nation ITSIs, the representation of Indians at the firms' highest levels is largely absent. For example, at IBM there are none in the top 16 executives, at EDS none in the top 10, ADP one of top 27, Accenture none in the top 22, CSC none in the top 7, and CapGemini two in the top 26.¹² The effective integration of these large Indian operations into the global delivery systems of the ITSIs, and retention of key Indian personnel, may require a pathway for upward mobility. An important executive challenge will be to effectively integrate the large Indian operations and create a seamless global firm.

When these corporate locational decisions are viewed individually, it appears as though a few individual firms are deciding to site certain activities in India. However, our interviews indicate a pattern of learning and increasingly high value-added work being offshored to India by the ITSIs. Whether this pastiche of decisions by the developed-nation ITSIs and the clear penetration into higher value-added areas by Indian ITSIs are leading to the development of an ecosystem for IT services delivery in India is difficult to answer definitively. What is certain is that the ITSIs, Indian and developed nation, now employ approximately 400,000 people in India, and that there is significant evidence that these operations and their employees are maturing.

Case Study Two: Integrated Circuit (IC) Design

Semiconductor design is an ideal activity to illustrate the rapidity of the rise in Indian capabilities in providing services to the global economy. To introduce India's importance in IC design, two significant conditions should be mentioned. First, India has no significant commercial production of semiconductors and no important fabrication facilities. Second, IC design is entirely software-based, there is no longer any physical layout involved. In other words, as a result of the use of computers and software, IC design is purely a mental activity.

India's entrance into IC design has a long history that began with Texas Instruments' decision in 1985 to establish a design facility in Bangalore. Motorola opened its first R&D facility in India in 1991. In 1998, Motorola's semiconductor operations were spun-off as Freescale Semiconductor, and in 2007 it employed 250 IC design engineers, but had announced plans to increase the number to 1,500 by 2010 as it shifted more research offshore (Krishnadas, 2007). However, the real expansion in offshoring semiconductor design to India began after 2000. By 2007, nearly all semiconductor firms from Europe and the U.S., both the large integrated firms, such as Intel, ST Microelectronics, AMD, and Analog Devices and the generally smaller, but far more numerous, IC design firms such as Broadcom, nVidia, Qualcomm, and many others were operating in India. Also, a number of Indian firms, also large and small, such as einfochips, Portal Player, Sasken, Wipro, and TCS offered semiconductor design services to various customers. Finally, there are a number of Indian and U.S.–Indian startups designing proprietary intellectual property that would be sold as products. This section briefly reviews the history of the Indian IC design industry and suggests that it illustrates the rapidity with which India has been able to expand the size of the work it is receiving and increase the quality of the work it provides.

The number of Indian IC design engineers is in dispute. For example, C. Brown and G. Linden (2006, unpublished paper) estimated that in 2004 there were approximately 4,000 design engineers and this was growing at 400 per annum. On the other hand, In-Stat, a major semiconductor consulting firm, found that there were 12,352 in 2005 and estimated that this would expand to 40,000 in 2010. The wide disparity in estimates may be a result of methodology or the fact that the industry has expanded employment far more rapidly than Brown and Linden anticipated or it may be that the definitions of designers differ.

As a general rule, it could be hypothesized that the most sophisticated work being offshored is being undertaken in the large MNCs such as Texas Instruments, Motorola, and Intel, which have established R&D-like advanced facilities in India. The following job description from the Intel India website provides some insight into the most sophisticated IC design work being done in India.

CAD Engineer: As a CAD (Computer Aided Design) Engineer with the Intel Hardware Engineering team, you'll work on teams designing, developing and implementing solutions. As a CAD Engineer, you will be involved in developing new very large scale integration (VLSI) CAD tools and methodology solutions for design for testability (DFT) and test generation for high volume manufacturing of next generation microprocessor products. You will be responsible for development, deployment and maintenance of in-house fault simulation and test generation tools. This position will be based in Bangalore, India.

You must possess a Ph.D. or Master of Science degree in Electrical Engineering or Computer Engineering with five to ten years of related work experience. Additional qualifications include: Extensive knowledge of Digital Design and Design-for-test principles, digital circuit/fault simulation and automatic test pattern generation.

This job description indicates that Intel conducts high-quality work in India. For example, in 2007 the Intel India Development Center's 2,900 engineers designed chips and chipsets, reference designs, system software, and packaging technologies

and full ownership of several key chips for the server and mobile market (Ribeiro, 2007). Intel is not unusual among IC firms in undertaking high-quality work in India.

In addition to the large MNCs, a number of Indian firms are offering IC design services. The largest of these is probably the IT services firm, Wipro, which is an important IC design contractor that is growing rapidly and had 3,000 IC design engineers in 2006. In 2003, 90% of Wipro's IC revenues were confined to the two lower value-added steps of verification and physical design, and of production and silicon production engineering. By 2006, 30% of revenues came from higher value-added services such as digital/analog design and even architecture. The importance of being able to move into more challenging higher value-added areas is that it receives higher rates, and its Indian employees are able to improve their skills. Another interesting firm is Sasken, which describes itself as an "embedded communications solutions company," and has 3,500 engineers mainly in India but also in Finland, Japan, and Mexico. It supplies IC design services to nearly all the large cell phone producers.

Application-specific integrated circuits are now critical parts for almost every manufactured product including toys, telecommunications equipment, and sophisticated machinery. For this reason, IC design takes place not only in IC firms, but also in manufacturing firms ranging from auto and machine tool makers to medical device and scientific instrument firms. Firms as diverse as Agilent, Alcatel, Cisco, and General Electric Medical Systems design semiconductors in India. The size of the design operations is likely to be smaller than that of the largest IC firms, but for telecommunications equipment and scientific instrument firms such as Cisco or Agilent IC design operations are large. These IC design operations are sophisticated because they integrate vertical industry knowledge with semiconductor design, and for many of these firms are an important competency. When considered together, they signal a proliferation of design operations and are significant contributors to the demand for IC design engineers.

These established firms are being joined by a number of entrepreneurial IC design and intellectual property development startups. The spatial division of labor for the startups is remarkable in its variety and the relative centrality and importance of the Indian operation to the overall firm. We use illustrations merely to highlight the complexity and diversity of business models.

Many Silicon Valley IC design startups are building substantial engineering operations in India. To illustrate, Tensilica, a Silicon Valley startup, began in Pune, India with an overseas design center, and in 2007 invested further to establish an R&D operation in Bangalore. In the case of Tensilica, India is becoming an important adjunct to the main Silicon Valley operation (A. Dixit, 2006, personal interview). There were also a number of firms that were established in Silicon Valley, but who have their largest engineering operations outside the United States, in India. For example, HelloSoft has its headquarters in San Jose, where it has marketing and sales, but substantially all of its R&D is done by 120 digital signal processing engineers in Hyderabad, India (S. Kumar, 2007, personal interview). The common assumption is that these firms divide their operations between India and the United States. Our interviews found that though this was often the case, there were also more complicated cross-national operations being formed. For example, two firms,

Telsima and Insilica, had their headquarters in the Silicon Valley and largest operations in India, but they also had European operations. Telsima, a startup established in 2004 to develop WiMAX-based broadband wireless access software for data-intensive, mobility applications, had its main development center in Bangalore, but also employed 35 people in Trzin-Ljubljana, Slovenia. Insilica purchased a Flextronics semiconductor design group located in Slovenia for system-on-a-chip expertise. In yet another case, Athena Semiconductors recently purchased by Broadcom, was headquartered in Fremont, California with a 40-engineer design team in Bangalore, India and another 23 engineers in Athens, Greece. In these cases, the Silicon Valley headquarters were responsible for overall coordination; but the Indian operation had the most employees and interacted directly with the European operations. The Indian operation is often a node in a globalized organization, but for a number of these firms, India is their primary engineering center.

One criterion for deciding whether an ecosystem exists is whether ancillary industries are also located nearby. Silicon Valley not only has large concentrations of semiconductor firms, but is also one of the prime global centers for IC design software and manufacturing equipment firms. Interestingly, India also is the location of the largest overseas development operations for U.S. IC design software firms such as Cadence, Magma Design, Mentor Graphics, and Synopsys. These firms also have significant marketing and support organizations in India. For example, Cadence, the world's largest IC design software firm, employs 600 people in its Indian operation, which was established in 1987. Given that India does not manufacture any semiconductors, one would not expect that equipment suppliers such as Applied Materials or KLA-Tencor would have large Indian operations. However, semiconductor equipment is R&D and software-intensive. So, for example, in 2005, Applied Materials employed 700 people (of a total of 14,000 globally) in India to do product and software development, information technology and business process solutions (Krishnadas, 2007). Moreover, even while it has a development center in India, in 2007 Applied Materials signed a long-term \$200 million contract with Satyam for services delivery. The other large U.S. IC equipment makers are also expanding their engineering Indian operations, which are now among their largest. What is significant is that many of the U.S. semiconductor industry supplier firms have development centers in India.

This section does not argue that India has a highly interactive semiconductor ecosystem such as the one that is found in Silicon Valley. Rather our goal is more modest, it is merely to substantiate that nearly every semiconductor firm in the Silicon Valley ecosystem has its largest development center outside the U.S. in India. Undoubtedly, the Indian labor force has significant skill levels that because of the high levels of activities are rapidly deepening. Indian IC design engineering capabilities have evolved and improved over the last decade through a learning process partially driven by MNCs, but also by Indian service providers that have been learning through their customers. Nearly all of the major firms are actively involved with local universities through providing computers and software so that students can have state-of-the-art training on the firm's preferred technologies. Finally, all of these firms are drawing upon Indians that have trained in U.S. universities, worked

in U.S. high-technology firms, and then became entrepreneurs in Silicon Valley. This confluence of forces indicates that India (or, more properly, the Indian cities of Bangalore, New Delhi, Chennai, and to a lesser degree, Pune and Hyderabad) will become one of the primary global semiconductor design centers, despite India having virtually no production facilities.

Case Study Three: Sectoral Diversity

The sheer diversity of service work being offshored to India is remarkable and suggests polyvalence in the capabilities of a well-educated motivated work force. Whereas in the previous two sections where information technology sectors were examined, this section utilizes brief case studies to demonstrate the broad spectrum of activities being offshored, as illustrated in Figure 3. This diversity indicates the sheer magnitude of the offshoring phenomena suggesting that enormous managerial talent is being invested to consider ways to increase the use of capable lower-cost labor. In many cases, these decisions may be difficult to reverse as the geographical concentration of skills in certain processes may atrophy in the home nation, while the Indian recipient organization may progress to even higher value-added processes.

Software-related work has a long history in India, but what Indians term “IT-enabled services” or “business process offshoring” has expanded even more rapidly. The diversity of activities included in this category is remarkable. Both Indian firms and MNC subsidiaries undertake this work in India. The sheer scale of some of the Indian firms doing this work is worthy of note. Genpact (a General Electric spin-off), Exl Service, FirstSource, and WNS Global Service employ in excess of 10,000 people each.

These firms initially concentrated on call center services, but have shifted to activities providing greater opportunity to move up the value ladder. For example, with 17,000 employees, WNS Global Service (2008) provides procurement, finance, human resource, transactions processing, legal, supply chain, and accounting services. In effect, WNS and these other firms are willing to provide a wide variety of services. Although much of this work is mundane, there are opportunities in each of these sectors to create higher value through process engineering and capturing a greater portion of the production chain.

There has also been a proliferation of providers of specialty services. For example, Evalueserve (2008) employs more than 2,000 people specializing in a wide variety of sophisticated services, including equity analysis, patent research and application preparation, and proprietary market research. In addition to larger specialty service providers such as Evalueserve, there are smaller ones specializing in a wide variety of niches. The proliferation of niche providers of high-end services suggests that the variety of profitable niches for exploiting labor cost arbitrage are many.

The diversity of MNCs operating service subsidiaries in India is even more remarkable. In addition to IT, the pioneers concentrated in finance and travel. While firms in finance remain the leaders, many others are joining in. For example, major retailers such as Target Corporation and Tesco have Indian subsidiaries. According to Robert Kupbens, the Vice President for Technology at Target Corpo-

ration (2007), in August 2006 Target Corporation opened its Bangalore subsidiary, and in mid-2007 employed 500 people, but planned the Indian operation to grow to 3,000 by 2009. The India team even does photo retouching and newspaper circular layouts for the United States. Also, Target India undertakes financial analysis and marketing using CAD systems. Operational responsibility for Target.com was transferred to India. Target India provides support to the U.S. operation, and if it is successful is almost certain to gain experience and be able to provide even higher value-added services in the future.

The role of China as a manufacturing center for the global economy is well-established. At this time, the Indian manufacturing industry, although growing, is still not considered to be globally competitive. And yet, industrial firms such as General Motors, Caterpillar, and Delphi have R&D and design laboratories for their global operations in India. The General Motors (GM) Indian laboratory was its only one outside the United States. In 2004, the Indian laboratory employed approximately 240 professionals, increasing to 400 in 2006, and announced an employment expansion to 800 people in 2008. In July 2005, the laboratory advertised jobs for individuals with master's degrees or, preferably, PhDs, in aerospace, computer, industrial, mechanical, and software engineering and computer and materials science. In the materials laboratory, GM sought candidates with master's and PhD degrees in metallurgy, polymer science, materials science, materials processing, and math-based analysis of materials. In the material process modeling group, the work included validating microstructural models, designing high-performance materials, and molecular modeling of nanocomposite/TPO exfoliation and fuel cell membranes (General Motors, 2005). These job descriptions illustrate GM's intention to undertake high value-added research in India.

The greatest commitment by a U.S. MNC to research in India has been by General Electric (2008a), which has four research locations globally. General Electric has established a global research organization. In terms of size, as of 2007, the global headquarters in New York employed approximately 1,900 people, a new Munich center employed 150 people, and the Shanghai center employed 150 people. The Bangalore center employed nearly 3,000 researchers, i.e., more than the other three centers combined (General Electric, 2008a). The Bangalore facility conducted research in "electromagnetic analytics, composite material design, color technology, additive technology, non-destructive evaluation, corrosion technology, MEMS, molecular modeling, power electronics, analysis technologies, computational fluid dynamics, and engineering analysis" (General Electric, 2008b). Although GE is the largest MNC laboratory in India, it still is an important indicator of the growing investment by many U.S. MNCs in establishing and expanding their Indian R&D operations.

Indian MNC subsidiaries undertake a wide variety of offshore activities. For example, established in 2001, Agilent Technologies India (AGI) has rapidly matured and provides both back office and engineering services. AGI began by providing data entry for engineering services work. Within a year, it began providing CAD support followed by product development quality assurance. In 2003, electronic design automation software development commenced in India. In 2006, an application specific integrated circuit (ASIC) design center was established in India. In addition to engineering services, AGI provided global accounting,

finance, and human resources services (Dossani & Manwani, 2005). From its inception, AGI grew to 1,200 employees in November 2004 and in 2006 employed over 2,000. AGI matured in terms of size, numbers of activities, and the skill level required for those activities. Although the AGI case is an illustration, it is quite indicative of typical MNC subsidiaries in India.

Yahoo! is also growing rapidly in India. In 2003, Yahoo! India Development Center (IDC) was established with 150 engineers (Seth, 2006). In December 2006, it had grown to nearly 1,000 employees. More interesting is how its work evolved. Initially, the IDC operated entirely as a back office. In general, the work transferred to India was low value-added and mundane. The result was high attrition-sapping cost savings. To address this, in 2004 Yahoo! moved first-level project management to India to give the IDC employees a greater feeling of ownership, but this resulted in conflicts with Palo Alto-based managers. The solution was to move global responsibility for activities such as data mining to India. Now the Indian functional manager reports directly to a senior VP in Palo Alto. With the increasing success, functional responsibility not only for data mining, but also for mobile applications and iPod broadcasting, was relocated to the IDC (Seth, 2006). In 2008, Yahoo! experienced difficulties and announced the layoff of 1,000 workers around the world including 40 in India. Even with these cutbacks, Yahoo! announced the establishment of a new R&D operation in India initially employing 100 engineers and scientists and a plant to expand to 500 people (Ribeiro, 2008).

The diversity of opportunities to utilize low-cost Indian service employees is difficult to describe because IT is an integral part of nearly all nonphysical work within organizations be they traditional service firms or manufacturing firms. Software, databases, electronic interfaces, and so on are IT-enabled and thus are either partially or totally potentially rootless. In principle, this would facilitate their transfer to anywhere with the proper electronic linkages, but, of course, every industry has industry-specific knowledge that may not be present in a poorer developing nation like India, although it may be possible to build that knowledge. So, for example, Target began with work that was IT-intensive such as accounting, which is rule-based, and only recently has been absorbing tasks that require better understanding of retail. In many respects, it is not surprising that the IT and financial industries were the first to exploit the Indian white-collar employees, because much of their work can be abstracted from the less transferable industry and geography/culture specific aspects of economic activity. While initially Indian employees may not understand the specific industries, it is apparent that through learning-by-doing and with investment in training they should be able to learn.

Case Study Four: High-Opportunity Entrepreneurship¹³

In the current era, dramatic technological change is recognized as a catalyst for high-opportunity entrepreneurship (all references to entrepreneurship in this section are to high-opportunity entrepreneurship). Less recognized is the role of new resources in encouraging entrepreneurship. For example, the discovery of the New World in the fifteenth and sixteenth centuries integrated new resources into the global economy creating new opportunities and encouraging entrepreneurship. The integration of low-cost, skilled Indian labor has also created a new resource,

and has encouraged entrepreneurship. The integration of low-cost Indian white-collar workers has encouraged entrepreneurs in India and abroad to experiment with new business models predicated upon new spatial divisions of labor. At this time, there is sufficient evidence to suggest that India is, at a minimum, assuming an important role early in the life cycle of Silicon Valley startups. There are IT-enabled service and even some IT and software product startups being formed in India (Singh, 2007).

A critical input for many of these startups is the willingness of Indian nationals in U.S. firms to manage the Indian subsidiaries of Silicon Valley startups and the technology-based startups in India (Saxenian, 2006). These returnees have U.S. networks that can be used to mobilize resources such as venture capital, key customers, and other professionals that can assist a startup. Moreover, the entrepreneurial support network that exists to support startups in Silicon Valley has increasingly globalized. The returnee to India imparts the Silicon Valley ethos of rapid execution to the lower-cost Indian engineers (Saxenian, 2006). They are both the carriers and the translators of socio-cultural values.

The most successful entrepreneurial regions in the United States are endowed with established firms that can be tapped for experienced management and engineering talent. As late as 2003, such talent was scarce in India. Our interviews suggest that the MNC subsidiaries promoted Indians to positions of responsibility in which they learn global-class management and R&D skills (for a general discussion of this phenomenon, see Kogut & Zander, 1993). This sophisticated work is training a cadre of Indian managers that will have the capability to establish and manage startups. With the overseas Indians returning home and the training Indian managers are receiving, a key requisite for creating an entrepreneurial ecosystem, high-quality entrepreneurs and executives that understand global markets and have the execution ethics necessary for success on a global playing field, is emerging.

Until recently, few global class venture capitalists deeply knowledgeable about technology markets operated in India (Dossani & Desai, 2006; Dossani & Kenney, 2002). This is changing, as major Silicon Valley venture capital firms establish Indian operations. In addition, there are an increasing number of domestic venture capital firms, although these have yet to become important actors. If Indian entrepreneurs continue to create firms that have successful exits either through listing on Indian markets or merger and acquisition, then investment will continue to grow. There already have been successful exits on the Indian markets, such as Sasken, a fabless semiconductor contract services firm, and a few on the U.S. exchanges such as Exl, which is a BPO firm. However, acquisition has been the favored exit path. Examples of acquisition include IBM and the BPO startup Daksh (\$160 million), IBM and an older Indian IT infrastructure maintenance firm, Network Solutions (undisclosed), EDS and the BPO startup Mphasis (\$380 million), EDS and the software testing firm RelQ (\$40 million), the Indian BPO firm WNS and Marketics (\$60 million), and R. R. Donnelly and the high-end BPO firm Office Tiger (\$250 million). Foreign and Indian firms are likely to continue to acquire as they pursue expansion in India. Previous success and the large number of recent startups suggest that technology-based entrepreneurship is growing in India and, particularly, in Bangalore.

The role of Indian universities in this development is limited but evolving. The average Indian university graduate is a motivated worker, while the graduates from the elite universities and Indian institutes are as good as any in the world. In terms of research, the elite Indian institutions are improving, but they are far from the Tier One U.S. research universities in terms of research. Thus far Indian professors have been involved in only a few global-class startups. An exception is Tejas Networks where one founder was a professor at an Indian Institute of Technology. The role of Indian universities is unlikely to change in the short term. The most important contribution of the Indian higher education system will continue to be a graduate that can be trained to work in the global economy.

Until recently, most startups were offering services and thus largely dependent upon labor cost arbitrage, and not unique skills. The emergence of firms creating technology-based products (as opposed to service-based) startups for the international and domestic markets is recent. This suggests a deeper and richer labor market has evolved. If these initial indications are borne out, then global-class firms may emerge in India.

The extant assumption that the Indian subsidiary must necessarily undertake lower value-added work than is done in Silicon Valley should be qualified. In certain respects, this is correct as most of the top executives are in the United States. And yet, our interviews suggest that this characterization fits many, but not all, firms. For example, Insilica's Silicon Valley headquarters has approximately 15 employees, including the chief-level executives (all of whom are NRIs), marketing, sales, and operations, the functional heads of imaging and the ASIC System on a Chip groups, and two customer support engineers (K. S. Raghunathan, 2006, personal interview). The other employees are located abroad. On the other hand, consider the case of Sasken, which was established by a group of NRIs in Fremont, California in 1989 and later relocated to Bangalore, India from where it has grown to employ over 3,000 people around the world (K. Swaminathan, 2006, personal interview). These illustrations suggest that a variety of business models are in use. A growing number of Silicon Valley startups have an Indian operation as an integral part of their business plan.

There are a number of U.S.-headquartered startups that have their entire engineering and product development in India. For example, Arada Systems, a startup providing Wifi software solutions to the telecommunications, industrial, outdoor, and automotive markets, has its entire development team in India and only nine people in the U.S. (P. Singh, 2006, personal interview). Another firm, TutorVista, which was conceived and launched in India, offers online tutoring to students in developing nations using Indian and Filipino teachers. The firm's venture investment came from the U.S. firm Westbridge Capital (now Sequoia Capital). TutorVista's operations are located in India, but its market is international (R. Kannan, 2006, personal interview).

At least one startup, Tejas Networks, which designs and markets optical telecommunications switches, is using growing Indian markets to establish its products prior to advancing into global markets. Established in May 2000 in Bangalore, by 2006 Tejas had grown to 300 employees with 85% of its revenue coming from India. In 2007, it expects to grow by a further 100 employees and double its revenues. Tejas plans to increase its foreign sales and make an initial stock offering on the

Indian market (S. Nayak, 2006, personal interview). The rapid expansion of Indian telecommunications, and particularly wireless markets, offers Indian firms an opportunity to reach significant scale prior to entering the international market.

There are also startups for the Indian market. These resemble the successful Chinese startups that have listed on the U.S. and other markets. There are a wide variety of business models. Many are simple translations from the United States, such as travel, auction, and job listing sites. While not original, given the burgeoning, computer-literate, middle-income strata in India, these can be successful firms. Other startups serve the burgeoning local cell phone market through offering applications such as ring tone downloads. As was the case with China, the rapid increase in consumer income is creating a massive, relatively underserved, market with enormous pent-up demand for services of all sorts. Also, a large underserved market unable to speak English, or, in certain areas, even Hindi, exists. This provides opportunities for voice recognition/translation software. For local and international venture capitalists, these changes offer investment opportunities requiring small capital investments, but offering respectable returns.

India has some significant advantages for startups. The most important of these is a deepening talent pool, though labor costs continue to increase. The cost differences are remarkable. One prominent example is Tejas Networks, a venture capital-financed data switch designer. In Silicon Valley building such a firm would have cost between \$100–150 million. In contrast, Tejas, which in 2006 was on the verge of positive cash flow, cost only between \$30–50 million (Nayak, 2006). In software/ASIC design, the cost of an engineer in Bangalore is almost \$40,000 per year, so for a team of 50 engineers the annual cost is \$2 million per year. In Silicon Valley where the average salary would be \$180,000 per year, the cost is \$9 million per year. Since labor costs are such a great percentage of a startup's costs, India is an attractive option. The drawbacks for a startup establishing operations in India are increased coordination costs and far less experienced personnel, both of which retard development speed.

Because of their experience and work ethic necessary to deliver a product, the startups with global ambitions draw upon NRIs from Silicon Valley as executives and development team leaders. When asked to compare Indian engineers and Silicon Valley engineers, the NRIs interviewed stated that Silicon Valley teams, with their greater experience are superior, but not sufficiently so as to justify the cost differential. There are significant cost advantages to operating in India, but these are predicated upon being able to lead them with trained, "battle-hardened" managers with deep experience and understanding of the United States and, in technology, the Silicon Valley management style.

Entrepreneurial activity is growing in India in two ways. First, it has developed an operational function for many entrepreneurial Silicon Valley firms. Indians are gaining direct experience with how Silicon Valley operates. This experience is likely to make India even more attractive to yet other Silicon Valley startups. Second, Indians and returning Indians are establishing startups in both IT-related services and IT fields such integrated circuit design and data communications equipment. If some of these firms are successful, then undoubtedly more Indians will be encouraged to undertake new ventures. India has become a recognizable location on the global map of entrepreneurship.

Discussion and Conclusion

Often when a new empirical phenomenon emerges an appreciative description is a first step toward comprehension. This essay was deliberately descriptive, providing a brief historical overview of India's growth in providing offshore services and then anecdotal case studies to illustrate the diversity of service activities being at least partially fulfilled from India. This concluding discussion reflects upon India's insertion into the global economy and reflects upon the fact that it is the first large but extremely poor economy that has entered global competition on the basis of the labor power of its middle-class white-collar workers. India's entrance into the global economy challenges previous notions of globalization based on low-cost manufacturing.

Consider the phenomenon of building an export economy solely on the basis of providing services to the global economy. Smaller nations, particularly Ireland and Israel, built their vibrant service export economies initially on investment by MNCs in manufacturing, which evolved into providing services to the global economy. In the case of Israel, this included many entrepreneurial startups that were specifically linked to Silicon Valley (Breznitz, 2007). What is remarkable about India is that the evolution was entirely confined to providing mental labor to the global economy. Only 25 years ago the real-world refuted the argument that developing nations, such as Korea and Taiwan, entering the global economy on the basis of low-wage assembly would never be able to move to higher value-added activity. The success of India is even more remarkable because it never had a significant export manufacturing base.

Consider the implications of entering the global economy on the basis of offering IT-enabled services. By all accounts, an increasing proportion of the value-added and profits in every industry including manufacturing is in the software and services it produces. Machine tools, automobiles, and even mundane consumer devices are given their value by their integrated circuits, software, design (now all done with software), their logistics chains, and affiliated services. The firms and their relationships with other organizations are utterly dependent upon their information systems for every corporate function.

The number of industries relocating IT-enabled activities to India has expanded dramatically. The earliest sectors to offshore services were information technology and finance. More recently, this has grown to include manufacturing firms such as General Motors and Caterpillar that have established global-class R&D. This is indicative of the wide variety of industries that now have parts of their services needs delivered from India. The scope of what might be offshoreable is limited by the ability to reengineer processes to separate location-specific work from that that does not require in-person interaction or that is legally or institutionally proscribed from relocation. This suggests that even more work activities will be reengineered for relocation.

The most important phenomenon, however, is the sophistication of the work that is offshoreable. The rapidity with which Indian workers have been able to move up the value ladder is remarkable. Whether it be technical R&D, sophisticated equity analysis, reading X-rays, statistical analysis of Internet click stream data, or the preparation of patents, the Indian workers are not competing with low-waged

developed-nation workers. The opportunity to ascend the value ladder so rapidly is without question the most remarkable aspect of the services offshoring phenomenon.

India's ability to mature in terms of scale, scope, and sophistication is path dependent. Through this growth, India has become an important center from which mental labor is delivered to the global economy. This increasingly diverse ecosystem allows and even encourages innovation and further relocation. Consider the wide variety of organizations active in the ecosystem. There are MNCs, large and small, and from a wide variety of industries undertaking many different activities. There are Indian firms ranging from the large Indian software integrators such as TCS and Wipro and the business process outsourcing firms to small specialty providers of all sorts. This variety is significant in and of itself.

Having said this, it is important to keep in mind that today's movement to India is not, despite what Maskell, Pedersen, Petersen, and Dick-Nielsen (2007) appear to suggest, knowledge-seeking investment in the sense that firms are searching for inimitable knowledge fixed in India. To illustrate, financial firms from around the world locate offices in the vicinity of Wall Street or the city of London, because of the dense and deep reservoirs of knowledge about arcane financial matters. As a generalization, with a possible exception discussed in the next paragraph, firms are locating in India because there is a capable, low-cost work force that can be trained to undertake mental work. The attraction has been their general capabilities at the right price, and not that India is the only place where there are workers capable of undertaking these specific tasks. Though this may change soon, this observation is important, when we consider claims that the move to India is driven by the need to access "talent."

One exception to our general statement that India does not yet seem to be a globally significant site for inimitable skills ironically may be the skills it has developed in managing remote service provision. Consider that the Indian ITSIs are now among the largest in the world even while developed-nation ITSIs now have enormous service delivery operations in India. The developed-nation ITSIs are transferring global responsibility for entire service practices to their Indian centers of excellence. In other words, their Indian operation would be responsible for managing service delivery not only from India, but as is the case with HP from Eastern Europe and Latin America. Predicting the future is difficult, but in the IT and IT-enabled services India may be in the process of developing a set of global-leading skills at managing offshore delivery. These are powerful positive feedback forces that are reinforcing India's advantages.

Despite India's increasing advantages, future growth is not guaranteed. There are global political and economic forces that might disrupt optimistic scenarios. These include developments such as large-scale protectionism in the developed nations, massive financial disruption from a global economic collapse, and the outbreak of war on the Indian subcontinent. Because approximately 65% of Indian offshore service provision is for the U.S. market, the rapid depreciation of the U.S. dollar against the Indian rupee is an issue. Internally, the integration of the well-educated Indian middle class into a much higher paying global economy is dramatically worsening income disparities with the uneducated that are trapped in the labor surplus domestic economy. This might have been tolerable originally;

however, if global prices of basic commodities such as wheat, rice, and oil continue at the elevated levels of early 2008, this contradiction may lead to domestic unrest. Recently, in the offshore services sector there has been a rapid rise in labor costs, although in early 2008 wage increases abated according to news accounts. There are obstacles to continued Indian growth; however, as of early 2008 most of these can be considered potential obstacles, and at least some of them can be addressed by government policy.

Technical and business model changes allowing the remote delivery of services created an opening for educated Indians to enter the global labor market from India. Though initially their entrance was through dispatching workers to the developed nation job sites, today it is increasingly through remote work. From this humble beginning there has been an evolutionary learning and upgrading process resulting in the current situation in which India is a global hub for this activity. We have shown that the Indian ITSEs are now bona fide global competitors increasingly even for the most sophisticated outsourcing projects, even while virtually every major IT firm world has a significant offshore Indian service operation. Since IT and IT-enabled services are now a critical and growing portion of every firm's business, India is particularly well situated to continue to become more central to the global economy.

Notes

- 1 The authors would like to thank Frank Mayadas and Gail Pesyna, the Alfred P. Sloan Foundation, and the BRIE-ETLA joint collaboration for their generous support of our research and two anonymous reviewers for helpful comments.
- 2 For two papers in this issue that argue that there are other dynamics that will work to keep certain activities "on-shore" because of a strong need to co-locate high level R&D and production, see Cohen, Di Minin, Motoyama, & Palmberg (2009) and Ketokivi & Ali-Yrkkö (2009).
- 3 The Indian fiscal year runs from April 1 to March 31. So statistics announced on March 31, 2007 of fiscal year 2006-2007 refers to 9 months of 2006 and three months of 2007.
- 4 Israel's experience with entrepreneurial spinouts from Silicon Valley subsidiaries is instructive here. For more, see Breznitz (2007).
- 5 See Cusumano (1991) for a provocative analysis of the shift in the global software industry from package production to service provision.
- 6 On general purpose technologies, see Bresnahan and Trajtenberg (1996).
- 7 The others in the top five are finance (and related services), education, health care, and retail.
- 8 <http://www.bls.gov> (computing, scientific and technical services). The number is likely an underestimate. Arora et al. (2001) put the number at 3 million (p. 297).
- 9 This strategy is remarkably similar to what Barley and Kunda (2004) describe for individual contractors in Silicon Valley.
- 10 There is anecdotal, but unsubstantiated, information that suggests that IBM Global Services' job performance in terms of quality and punctuality has not been excellent.
- 11 For a discussion of services offshoring to Latin America, see Dossani, Kenney, and Mullan (2008).
- 12 Compiled from each firm's website.
- 13 High-opportunity entrepreneurship refers to Schumpeterian entrepreneurship to separate it from the vast majority of firms that are established in traditional sectors and have little opportunity or inclination to grow large.

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