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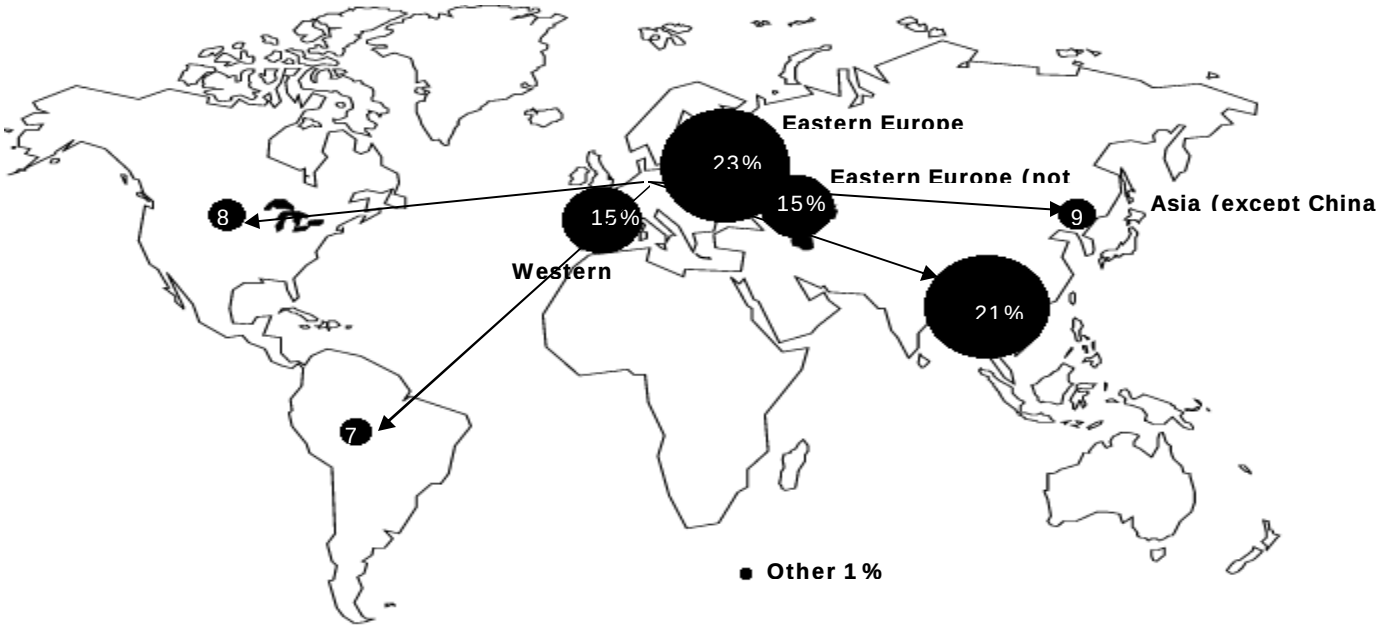
Chapter 3: The Country Perspective

3.1 Introduction

This chapter examines the development and current status of the largest and most dynamic nations in the evolving global software market with particular attention given to offshoring. The focus is on software services and to a lesser extent on software products. In particular, the chapter examines three pairs of regions that have special offshoring relationships with one another: the United States and India, Japan and China, and Western Europe and Eastern Europe/Russia. The selection of these three pairs is not meant to argue that there are not other linkages, for example, between Western Europe and India; there are. Western Europe is not monolithic in its offshoring patterns; it has different geographical patterns, largely based on language capabilities. For example, the United Kingdom sends its offshore work primarily to India, whereas Germany has strong relationships with both Eastern Europe/Russia and India (see Figure 1). Thus the portrayal here of national/regional pairs of offshoring partners, while representing some important aspects of the global software industry, is clearly a simplification of an extremely complicated map of offshoring.

Figure 3-1. Outsourcing from Germany



Source: Compilation from various newspaper articles by Martin Wildemann 2005:19

The decision to focus on only these regions and nations means that we omit some countries that are active in the global trade in software. In particular, we touch only briefly on Ireland and Israel who were among the earliest countries to enter the global market.

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Although their software export markets are significant, they are relatively small and are not expected to grow much especially in comparison, for instance, to India or China. Ireland and Israel also do not appear to have a major effect on the global division of software labor.

We also omit many nations that have smaller software services export businesses such as the Philippines and Mexico. Mexico, which in 2003 is estimated to have exported $30 million of software and software services (Singh 2003), is discussed in Chapter 4 through an examination of one of its leading software export firms, Softtek. Mexico's limited amount of software services exports is typical of many developing nations. Rather than listing all of the nations and the size of their industries (see some data on this topic in Chapter 2), this chapter focuses on the most important ones, but suggests that they are not unusual, just indicative of the larger pattern of globalization.

Offshoring has a long history and continues to evolve. National IT industries and international supplier-customer relationships are part of a co-evolutionary process involving many parties. Factors include government support, education, infrastructure, telecommunications policy, finance, and even national perceptions. These factors interact and gradually produce an environment more or less favorable to accepting relocated work. This is exemplified in the case of China and its manufacturing sector where a sophisticated manufacturing support infrastructure evolved over the past two decades to facilitate the manufacturing of goods for export. In the case of India, higher educational institutions, infrastructure, labor force, and government policies have evolved in a way that encourage and support the production of IT services for the global economy. Each of the nations and international relationships examined in this section is a product of similar co-evolution.

For firms, the decision of whether and where to offshore a certain business function involves a complex calculation that balances a variety of concerns that include labor force availability, government policy, factor costs, various kinds of risk, and comfort level with the location. For each of these nations, this chapter examines both their past experiences with offshoring and their current situation. We also consider their prospects for future growth.

3.2 The History of Software Offshoring

The origins of software offshoring are difficult to determine because large multinationals such as IBM have long had overseas R&D facilities that were conducting software development for the company's global operations at the same time that they were undertaking localization work for their domestic markets. The nations that first emerged as software development sites for the global economy, that is, not for the domestic market, were Israel and Ireland. Notice the distinction made here between undertaking software development for the domestic market, which includes localization and even some development based on unique features of the local market such as different accounting or legal systems, as opposed to producing for the external market. Production for the local market can displace jobs for workers in high-wage countries. However, it is unremarkable that localization would be undertaken in the local market where knowledge of the language and the specifics of the business culture and legal environment are the greatest. With respect to job loss, there is far greater concern about the displacement of labor by a nation producing for another nation's market than for its own.

The United States is the overwhelming leader in the world software industry as the home to such firms as Accenture, IBM, Microsoft, and Oracle. The only firms that rival these giants are SAP (headquartered in Germany) in packaged software and Siemens Business Systems (Germany) and Cap Gemini (France) in software services. Siemens Business Systems is losing money and may be sold.

Let us turn briefly to the small economies, Ireland and Israel, which pioneered software and software services production for the global economy. The Israeli IT industry first emerged in the late 1960s through an excellent educational system, military research, a strong relationship to the United States based on geopolitics, and investment by multinationals (de Fontenay and Carmel 2004). In the 1980s, Israelis began to found new technology firms, many of which specialized in packaged software especially for security. These Israeli firms often had cutting-edge technologies and, as part of their life cycle, very soon established operations in the United States. The most successful of them listed their stock on NASDAQ. Many of these firms were successful, but because of the small size of the Israeli software industry their success is unlikely to lead to a massive relocation of employment from the developed nations to Israel. The total Israeli employment in IT services, including software, was 92,000 in 2000 or approximately 4 percent of the total Israeli workforce (de Fontenay and Carmel 2004, 43). The Israeli Export and International Cooperation Institute (2005) reports Israel as having 13,000 software professionals in 2002, down from an all-time high of 14,500 in 2000. Whichever number is correct, Israel has a much smaller software workforce than larger nations, though it is unusually large in terms of the percentage of its own population. Even if Israel were to double its IT services employment to an unheard of 8 percent of its workforce – amounting to some 200,000 employees – it would still be less than one-third the size of India's 697,000 employees in software and software-related services. Israel's niche in the global software industry is as a center of entrepreneurship at the highest technological level. It draws upon the technical expertise of a highly trained workforce, and its startups almost immediately enter the US market by forming an offshore office.

Another early location for software offshoring was Ireland. In the 1990s, both Irish indigenous firms and multinationals rapidly increased their software-related activities in Ireland. For the multinationals, Ireland was a convenient low-cost, English-speaking nation that had strong European language skills. The multinationals adopted Ireland as an offshore platform for Europe. In 2000, the total number of employees in the Irish software and computer services firms, counting both indigenous and multinational firms, was 30,000 (Arora et. al. 2004). It is difficult to fully reconcile the various statistics as O'Riain (2004) believes that in 1999 there were over 50,000 employed in the software industry. The larger number may be misleading because O'Riain finds that the multinational firms that make up approximately two-thirds of total software industry employment include among their activities disk reproduction, packaging, language localization for Europe, and porting (O'Riain 2004).

Ireland's software industry includes two kinds of companies. There are some indigenous firms that produce packaged products, although they have not been as successful as the strongest Israeli firms. Ireland is also a packaging and localization platform for foreign, particularly US, multinationals supplying the European market. Ireland has experienced robust growth in its software industry but, like Israel, the global impact has been limited. Recently, the Irish press has expressed concern that India might be a threat to the growth of the employment in the Irish software industry (Weckler 2004).

Israel and Ireland were pioneers in entering the global software business without a significant home market. Israel's entry was at the high end of the industry, both in terms of multinationals operating there and the local entrepreneurship. Because Israeli firms quickly built strong business units in the United States, they are often treated as being the same as US firms. In fact, the growth of a successful Israeli firm often occurs as much in the United States as in Israel. In the Irish software industry, startups have produced software for the world market but they typically remain small players, while multinationals located there are fixed on one aspect of the global market, meeting the multinational's localization needs for

the European market. The software industry is a significant economic contributor to Ireland even though it remains quite small in global terms.

Due to their small size and strong relationships with the rest of the developed world, the Israeli and Irish software industries were successful without disrupting the software industries in other nations. Wages in Israel and Ireland were slightly lower than the markets they serviced, primarily the United States and Europe. Israel competed not on cost, but instead on the high quality of its workforce. Ireland had a wage advantage and special subsidies from the European Union but operated on only a small scale. What these two countries showed was that a nation that did not have a large local market could nevertheless perform software work at a distance from the final market if it had a skilled workforce and access to good telecommunications infrastructure.

The next set of entrants could disrupt existing software industries. The largest and most sophisticated of these national entrants was India. By the late 1990s, software programming was no longer a skill that was highly concentrated in the developing nations. People in low-income nations could afford an increasingly powerful personal computer and had access to inexpensive, high-capacity data communications networks. Not surprisingly, these countries could and did begin offering programming services in the global economy.

Today, it is possible to benefit from labor cost savings for programming services from a large number of developing nations. Although the pattern is peppered with many exceptions, there is a global division of labor emerging with India serving the English-language market, Eastern Europe and Russia serving Western Europe, and China serving Japan. Developing nations around the world have been eager to capture the wealth and jobs associated with software offshoring.

From the inception of the computer industry in the 1950s, the United States was not only the leading center for software but also defined the global software environment because of its technology leadership, enormous market, and massive investment in IT R&D. Other national markets were, for all intents and purposes, local markets having their own software firms that were always under threat from being submerged by global firms. If local firms wanted to expand significantly, then the US market was critical to their success. This was something the Israeli firms understood from their inception. For this reason, the first two nations to be discussed are the United States and its principal offshoring destination, India.

3.3 The United States

US-based companies continue to dominate the software and services industry. Of the roughly $285 billion in total revenues of the global industry in 2004, only about $50 billion was generated by non-US companies.[1] [2]

History of the US Software and Software Services Industry

From the inception of the modern computer industry, the United States has been the leader in both the hardware and software industries. The United States has also been the source of many of the software standards such as Windows, Microsoft Office, and Unix,

[1] This was calculated from the 2004 SoftwareMag.com *Global Software 500* ranking.

[2] This accounts for only the traded software and software services. So, for example, if a firm writes software internally for only Internal use, then this is not included because it is untraded. This is an enormous category and is likely to be even greater than the amount traded. Chapter 4 examines firms that have large internal software operations whose work is being offshored even though it is not traded.

providing US firms with an important first-mover advantage.3 Although today some might dispute US leadership in hardware due to the growth of East Asian producers, few would dispute US leadership in software and software services. Software and software services as an independent business has been practiced in the United States for more than fifty years, since the founding of the computer services firm Automatic Data Processing (ADP) in 1949. Computer Usage Corporation (CUC), founded in 1955, was the first company formed specifically to provide software development services to computer users. Its first project was a program written for a customer to simulate the flow of oil. Computer Sciences Corporation (CSC), founded in 1959, is now a $10 billion company. EDS, one of the most important computer services firms, was founded in 1962. Since then, thousands of companies that provide software and software services have been formed.

The growth of independent software and services firms was assisted by the decision by IBM in 1969 to unbundle its application software and tools from its hardware. IBM did not unbundle its operating systems from the hardware; the control system was included in every product IBM sold for many years after 1969. By 1969, there were already approximately 2,800 independent software product and services firms, and they had combined revenue of $600 million (Steinmueller 1996). At the same time the software and software services industry was emerging, large firms, especially in the financial and defense sectors of the economy, were introducing computers into their operations and building internal software competencies. For most firms, the building of internal IT expertise was both a potential competitive advantage and a necessity because computers were becoming key devices for managing the increasingly complex corporate operations they made possible. By the end of the 1960s, the combination of government funding of engineering and computer science research in the open university environment, early adoption by sophisticated lead users, and the United States' role as the largest economy and market in the world meant that the United States gained what appeared to be an insurmountable lead in the software arena.

The US software and services industry was affected by other developments as well. Drops in prices of semiconductors and data storage, driven in part by Moore's law, led to continuous price-performance increases in computers. The big mainframe of the 1960s was complemented by the arrival of the minicomputer in the 1970s and the personal computer in the early 1980s. The PC drove the cost of a computer down to a level that permitted an installed base of millions of computers, not the hundreds of computers of the 1950s or the thousands of the 1960s. This growth in the installed base was accompanied by a huge growth in the demand for packaged software for these computers. The early independent software companies developed applications and later computer tools. Originally the operating system software was provided by the hardware vendors (IBM, Digital Equipment, and others), but in recent years, independent software houses have emerged that also develop operating systems. (For a discussion, see Baldwin and Clark 2000).

The introduction of a commoditized personal computer in the 1980s and the spread of the Internet in the mid-1990s led to the creation of many new US companies, not only companies such as Netscape, providing software to facilitate the use of the Internet, but also the service and shopping companies such as Yahoo! and Priceline.com. The market leaders, for instance, Google, Yahoo, Amazon, and eBay, weathered the dot-com stock collapse beginning in 2000, and, in the process, they have transformed the way business is conducted.

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[3] It is possible that the relative strength of US firms might eventually be eroded by widespread adoption of open source software.

US firms benefited the most from the new business models and software that drove the Internet, and these firms continue to be globally dominant. They were created from the research and private sector capabilities that were uniquely resident in the United States (Kenney 2003). The dot-com crash led to severe employment loss in the IT/software sector. It was also a watershed event for the global software industry. During the height of the boom, US companies could not find enough US workers and sought extra capacity from overseas, especially Indian workers (both imported to work in the United States and working in India). After the crash, the role of the Indian workers was more as a replacement than a supplement to US workers. The Internet has also contributed to creating a more global labor market, making it easier to access technical talent in any location with good telecommunications linkages.

The Current Situation for US Companies in Software and Services

As mentioned earlier, US firms receive about 80% of the revenue available in software and services. Of the top fifteen firms in this industry, only four – SAP (Germany), Hitachi (Japan), CapGemini (France), and NTT (Japan) - are not from the United States, and these firms occupy the bottom rungs of the top 15.

In 2004, US firms made up 16 of the top 20 packaged software firms when measured by revenue. All of these firms have factories, development labs, and sales scattered across the globe. But where is the employment? Of the approximately 595,000 workers in packaged software, the United States employs 50 percent of the total global employment, while US firms sell 84 percent of the packaged software purchased globally (McKinsey Global Institute 2005).

US firms have been remarkably successful. For example, Microsoft's fiscal year 2005 profits of over $12 billion were comparable to the $12 billion in fiscal year 2005 revenue of the entire Indian software and services export industry. Microsoft's profit was also approximately equal to the sales of the largest European firm, SAP. IBM's software and services revenues in 2004 were in excess of $61 billion. The point is that US packaged software firms, by any measure, are still globally dominant. In terms of influence, the importance of this dominance is even greater than simply sales; the United States is the global hotspot for packaged software.

The McKinsey Global Institute (2005) reports that US jobs in the packaged software industry are at risk of being offshored. McKinsey finds that 60 to 78 percent of the jobs at risk are professional engineers and associated middle-level managers, that is, the heart of the packaged software industry. Other occupational groups in the packaged software industry have lesser but very significant numbers of jobs at risk. As shown in Table 2, it is exactly in the more highly educated employment categories that US firms are recruiting actively in India and, to a lesser degree, in China. Notice that the position announcements are not confined to low-end college graduates but also include doctoral-level positions for sophisticated development projects. The beginnings of this process can be seen in Table 1 which shows the number of employees the software and software services firms currently have in India. In every case, these numbers are increasing at double-digit rates.

Table 3-1: Indian Employment by Non-Indian Software and Software Services Firms

	Nationality	Services only	Employment in India (date)	Global Employment*	% in India	Locations
Oracle	U.S.		6,900 (2004)	41,658	16.6	Bangalore, Hyderabad
Microsoft	U.S.		1,250 (2004)	57,000	2.2	Bangalore, Hyderabad
SAP	Germany		2,000 (2005)	38,802	5.2	Bangalore
IBM[4]	U.S.		23,000 (2005)	369,277	6.2	Bangalore, Delhi**, Kolkota, Pune, Hyderabad
HP	U.S.	Yes	15,000 (2004)	150,000	10	Bangalore
Veritas	U.S.		900 (2004)	17,250	5.2	Pune
Adobe	U.S.		500 (2005)	3,142	15.9	Delhi
Symantec	U.S.		0 (2005)	5,300	0	n/a
EDS	U.S.	Yes	2,400 (2004)	117,000	2.1	Chennai, Delhi, Mumbai, Pune
Dassault Sys	France		0	4,088	0	n/a
Cap Gemini	France	Yes	2,000 (2004)	59,324	3.4	Mumbai, Bangalore
Siemens Bus Sys	Germany	Yes	4,000 (2004)	36,000	11.1	Bangalore
Getronics	Netherlands	Yes	n/a	28,000		
Atos-Origin	France	Yes	750 (2004)	46,583	1.5	Mumbai
Tietoenator	Finland	Yes	120 (2005)	14,000	.9	Pune

** Hoover's 2004*

***Delhi includes Noida and Gurgaon which are suburbs in other states*

All bolded firms include large non-software based employment
Source: Internet searches

[4] This includes the 6,000 BPO employees when IBM acquired Daksh and also includes those working for the domestic market.

The United States leads in software services as well as in packaged software, and this lead in services is also attributable in part to the early software development in the United States. The United States is the largest single software services market in the world, accounting for approximately 41 percent ($198.6 billion) of a total 2004 global market of $484.3 billion (McKinsey Global Institute 2005). US vendors are the global leaders in the global software services industry (11 of the Top 20 globally are headquartered in the United States) with IBM Global Services at 2004 sales of $46 billion by far the largest. Software services employment in the United States is approximately 1.7 million, of which 42 percent are engineers (McKinsey Global Institute 2005). In other words, software services is a large industry and the United States supplies about 32 percent of the total global workforce (McKinsey Global Institute 2005: 158).

The occupational categories in IT services that McKinsey finds most amenable to offshoring are software and hardware engineers and associated middle-level managers, of which 47 to 56 percent could be offshored. Analysts working on software/IT architecture or market research are similarly vulnerable (45 to 55 percent). It is in software services where the most aggressive competition from Indian vendors is to be found, and where the US leaders, such as IBM, Accenture, and Hewlett Packard, are rapidly increasing their offshore and particularly Indian presence.

One can expect the number of available jobs, job tenure, and wages throughout the software and service-related industries to be pressured by offshoring during the next decade. This pressure will also be felt in the internal IT shops across all industries as management considers options ranging from establishing offshore subsidiaries to outsourcing the work to either a US firm operating abroad or an Indian firm. Routine software production and services work appears to be increasingly susceptible to offshoring.

Conclusion on the United States

During the past five decades the dominance of the US industry has been a given. What is changing is where the work will be undertaken. What has been an enormous export to the world and a well-paid source of employment for technically well-trained Americans is now in question as sufficiently well-trained individuals in much lower-wage nations are becoming participants in the global economy and will be competing for those jobs. As Chapter 7 on education discusses in greater detail, the US higher education system will have to address the question of what their students should learn to prepare for these changes. At the national level, there has been a dramatic underinvestment in engineering education and research over the last two decades,[5] and the recent decisions by the federal government to reallocate research funds from universities to industry will further weaken engineering. This is likely to contribute to an erosion of the cutting-edge research that makes the United States a desirable place to undertake software innovation and development and which has made the US high-technology industry a global leader.

3.4 India[6]

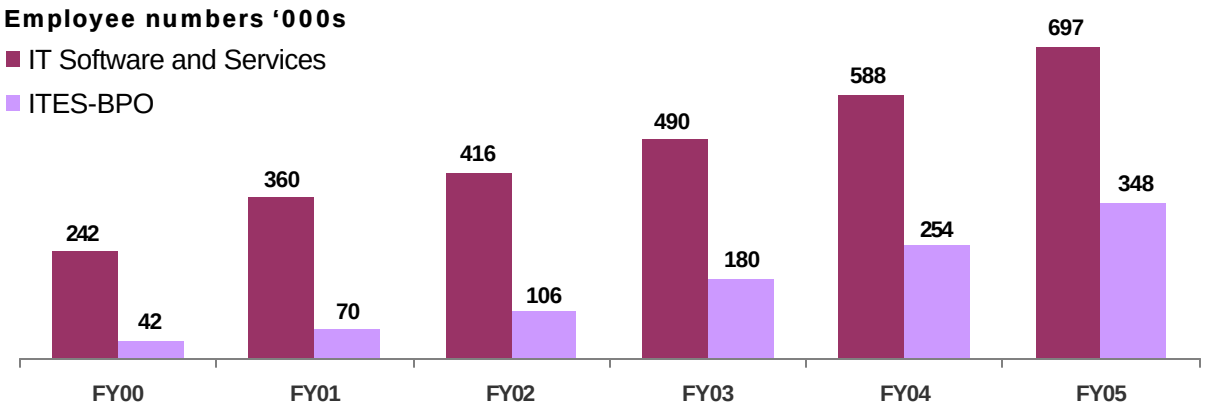
Software services have become India's largest export, and the emergence of India as a source of software service exports is attracting great attention in the developed world. India has only recently attracted attention for its software service exports despite the fact that

[5] For example, since 1970, U.S. federal spending in physical science research declined as a percentage of Gross Domestic Product - an indicator as the rate of investment relative to growth in the economy - from just under 1% of GPD to .5% in 2004.
Source: http://www.aaas.org/spp/rd/disc04tb.pdf

[6] This section draws heavily upon Dossani (forthcoming 2006).

the industry has grown relatively steadily for three decades. Employment reached 697,000 (approximately 50% working for the domestic market) at the end of March 2005 (see Figure 2), a growth of 19.8 percent from the year earlier (Nasscom 2005). If the industry grows at 20 percent per year in 2005-2006, then the number of employees added in India would be the equivalent of all the software workers in Ireland and Israel combined. India is emerging as the single most important destination of software services offshoring.

Figure 3-2: Employment in the Indian Software Services and ITES-BPO Sector



Source: NASCOMM

As a large developing nation, India has many shortcomings including high rates of poverty, corruption, and illiteracy; a substandard infrastructure; excess government regulation; and various other problems typical of a poor nation. These obstacles are offset by a number of strengths especially for software and services production. It has a long history of producing capable mathematicians. It has a large population with adequate English language capability. There is a large cadre of Indian managerial and technical professionals working in North American and, to a lesser degree, in European high-technology occupations and organizations. For those who can afford it, India has a strong and highly competitive K-12 educational system emphasizing science and mathematics. Although India has a democratic socialist tradition with high levels of bureaucracy and over-regulation, it does have a market economy. These are all advantage that India has over China in establishing a software services industry.

History of IT in India

The roots of India's entry into the global IT industry can be traced to its initial highly protectionist regulatory environment (Heeks 1996). As in many other nations, India's national policymakers focused on manufacturing. Protected from the global market and with a domestic orientation, Indian hardware producers never became global competitors. Because US firms established facilities in East Asia and homegrown Japanese, Korean, and Taiwanese firms became subcontractors and later producers, the IT hardware industry became concentrated in East Asia. Eventually, Taiwan emerged as the center for PC assembly and India became largely irrelevant for electronics manufacturing (Dedrick and Kraemer 1998).

The Indian software industry was established to serve the local market. Prior to the decision in 1969 by IBM to unbundle its software from its hardware that spurred the growth of an independent software industry, the only private Indian software firm was Tata Consultancy Services (TCS) which had been established in 1968 to serve the in-house data-

processing needs of the Tata Group. Using a Burroughs mainframe, TCS began offering electronic data processing services to outside clients and also became Burroughs' exclusive India sales agent in 1970. India's first exports occurred in 1974 when Burroughs, recognizing the competence and cost advantage of the TCS personnel, asked TCS to install its system software at the offices of its US customers (Ramadorai 2003 quoted in Dossani 2006). Aware of the profitability of providing such contracts, other domestic firms were formed to offer similar services. Sending these programmers overseas to work on the client's premises became a common phenomenon, and was pejoratively known as body-shopping.

Factors Contributing to Bangalore, India as a Principal Site of Offshoring

Bangalore is considered by most observers to be the hub of the Indian IT industry. In fact, the United Nations Human Development Report has ranked Bangalore as a global hub of technological innovation. The city of Bangalore is the largest employer of software professionals in India, employing about 160,000 people in the technology sector of which IT services accounts for 100,000 employees, with the remainder in business process outsourcing and call centers.

The general context. Bangalore has had a number of advantageous events, some historical and some recent, that have contributed to the rapid development of its IT industry. These include the IT boom of the 1990s and the subsequent world demand for IT products and services, the rapidly falling price of hardware, the technological progress that enabled ever larger volumes of data to be copied onto disks of the same physical size, the explosion of the Internet and the rapid reduction in costs of sending data, the liberalization of the Indian economy in the 1990s, and the Y2K problem which came at the right time and showed that Indian IT professionals could deliver.

High-tech center. From 1945, when Nehru became the prime minister, Bangalore was considered to be the science city of India. The state of Karnataka, of which Bangalore is the capital, is home to a large number of engineering colleges that provide a steady supply of highly educated, skilled workers for the IT industry. Bangalore also is the home to a number of large public and private sector organizations that employ many specialized skilled personnel working in high technology occupations. Though these organizations, such as the Indian Space Research Organization (ISRO), the Hindustan Aeronauticals Limited (HAL), Bharat Electronics, and Indian Telecom industries (ITI), are located in Bangalore and were important for creating the technology-oriented environment, they have not provided large numbers of technical personnel to the IT industry (D'Costa and Sridharan 2003). Among Indians, Bangalore has a reputation as the technology capital, though other cities such as Pune and Hyderabad are intent upon challenging this perception.

Local government policy incentives. Policy liberalization was the tool used by the Karnataka state government to create the environment that facilitated the growth of the software industry. In the early 1980s, state officials made their first move which was to establish a Software Export Processing Zone in Bangalore. Since then the state government has acted to promote the industry's growth in many ways such as providing preferential treatment on land allocation, provisioning electrical supply, and (until recently) providing a better infrastructure than most other Indian cities. These incentives reduced the costs of setting up and operating an IT company. (See Chapter 8 and later in this chapter for a discussion of the national policy environment.)

Telecommunications infrastructure. Texas Instruments had set up an office in Bangalore in 1984 and petitioned the Indian Government for permission to lease a 64k line to be used for transferring data from India to the United States. The Indian Government, both at the

national and state levels, was worried what would happen if they provided a 64k line to a foreign company, and it took three years for them to approve the petition. Connectivity was through a local telephone exchange in Bangalore that connected to the government-owned long distance monopoly, BSNL. Service quality remained an issue.

By the early 1990s, both Western and Indian firms were demanding better connectivity. Understanding the difficulties that business experienced when interacting with the government bureaucracy, the government established the Software Technology Parks of India (STPI). This organization was given permission to provide last-mile connectivity, establish free trade zone status parks, and generally facilitate the export software business. Bangalore was the first STPI and has continued to be the most successful. STPI solved the connectivity problem in Bangalore by installing a satellite dish antenna on its property (more recently replaced by fiber optic cable). Despite the liberalization of telecommunications in the late 1990s which led to drastically improved telecommunications service and lower cost, there remains a role today for STPI Bangalore that now serves at least 1300 companies.

Bangalore's rise to prominence was due to a confluence of factors. It was endowed with an excellent climate, a large pool of universities and governmental research institutions, and a relatively robust physical infrastructure. In the 1980s, it attracted US high-technology firms, such as Texas Instruments and Hewlett Packard, to establish operations there by offering them international telecommunications bandwidth. When these operations were successful, they had a demonstration effect that attracted other multinationals. Significant political support at the state government level ensured that the growth of the IT industry was facilitated. These factors combined to make Bangalore the leading IT center in India.

The Indian scene changed in 1978 when IBM decided to withdraw from India, following the passage of a law imposing joint ownership on all foreign subsidiaries. With IBM's withdrawal, the government formed and operated its own software firm, CMC. Though CMC proved to be only moderately successful,[7] it was in software and IT services that India would become globally competitive. At the time, the Indian firms did little more than recruiting, while an overseas intermediary secured the contract and the overseas client decided on the work for the programmers who were sent to the client's site. The initial focus of this body shopping was on systems installation and maintenance. Later, the conversion of clients' existing applications software into (primarily) IBM-compatible versions began, but this still operated on the basis of sending Indian workers to the client's premises. By 1980, the Indian industry earned $4 million in export revenue, shared between 21 firms, of which TCS and a sister firm (Tata Infotech) accounted for 63 percent (Heeks 1996).

At the beginning of the 1980s, the Indian software industry was small, but it was earning much needed foreign exchange. To encourage the growth of the IT industry and recognizing India's economic difficulties and foreign exchange shortages, Prime Minister Rajiv Gandhi's new government liberalized IT imports in 1984 through the New Computer Policy. Import duties on hardware were reduced from 135 to 60 percent and on software from 100 to 60 percent. The software business was recognized as an industry, making it eligible for loans from commercial banks. It was also delicensed, that is, permits were no longer needed to enter the business. Delicensing was very significant because government licenses were required in most of the Indian economy. Given that most sectors of the Indian economy were off limits to new entrants, entrepreneurial energies were drawn toward deregulated

[7] TCS purchased CMC in 2001.

sectors. In addition to creating space for new Indian entrants, wholly-owned foreign firms producing software for export were once more allowed, though on a licensed basis.

Electronics export processing zones were expanded to include software. TCS located in the first of these that was opened in Mumbai in 1973. Rentals in the zones were set below market levels and procedures to establish a business were simplified; power and water were guaranteed. Most importantly, in 1985, all export revenue from these zones was exempted from income tax (an exemption that is scheduled to end in 2007). These favorable policies encouraged additional entrants.

These privileges, particularly the tax exemption, had a significant effect on the structure of the Indian industry by making the domestic market comparatively less attractive; the combination of a tax exemption and foreign currency earnings was irresistible. Thus the Indian software industry was built on satisfying foreign demand for software services, not products. India was on the verge of bankruptcy during the entire period, and the rapid growth of the software industry and the fact that it was generating much needed foreign reserves meant that the government developed a strong interest in encouraging its growth. An important initiative to encourage growth was the creation in 1990 of the Software Technology Parks of India system which was authorized to further simplify procedures and enable exporters to import equipment against their export dollars without licensing or customs tariffs.

These liberalizations were providentially timed because they coincided with an important technical change in the software world, namely, the replacement of mainframes by workstations that generally used the Unix operating system and C programming language and were commonly linked together in a local area network (Dossani 2006). The adoption of workstations as a work platform facilitated a gradual shift in the location of work from the customer's premises to remote production in India. Further, the adoption of these standards generated work for Indian firms in converting clients' installed applications into Unix-compatible programs. The growth of this activity contributed to an increase in the number of Indian firms from 35 to 700 by 1990 (Heeks 1996).

Even as the Unix-workstation standard became more prevalent, a number of multinationals, including Texas Instruments, Hewlett Packard, and Digital Equipment Corporation, opened wholly-owned subsidiaries in Bangalore to take advantage of low-cost, high-quality Indian programmers to do various kinds of software-related development work. As part of the recruitment package, the government agreed to supply them with then scarce satellite bandwidth. Not much later, a few global banks with long-established Indian operations, notably Citibank, also began producing custom software in India. By 1990, Indian custom software developers were responsible for over 80 percent of all software exports.

Despite obstacles, the Indian software industry grew and accumulated a number of competencies. In 1991, the Indian government launched another wave of deregulation. There were 700 firms, including several multinationals, operating in India at the time. Most of these firms were small by international standards. The two Tata companies, TCS and Tata Infotech, continued to dominate the industry capturing 48 percent of total revenue. Most firms usually had just one client and so were vulnerable to that client's fortunes and disposition. Two-thirds of the typical firm's exports were to a single US client (Heeks 1996).

By the 1990s, the Indian government had become cognizant of the growing significance of software exports and the need to encourage this one bright spot in a bleak industrial climate. It now accepted that the industry required input from abroad. After the earlier rollback of duties, by 1991 the duties on software had again risen to 110 percent. In 1993, they were reduced to 85 percent; in 1994, they were further reduced to 20 percent for applications software and 65 percent for systems software; and, in 1995, to 10 percent for

all software (Heeks 1996). Hardware duties ranged from 40 to 55 percent in 1995, but by 2000 had been lowered to 15 percent for finished goods such as computers, and eliminated entirely for components.

The global software business was also changing as revenues in custom software overtook product software. The custom software business was driven by the increasing size of software programs that firms were using for their internal operations. Growing demand, coupled with a shortage of US programmers, provided opportunities for the Indian IT industry to offer its services. The Indian industry focused primarily on assisting in the writing of the enormous software programs that were used inside large firms to control their various business functions.

Indian sales efforts were handicapped by government regulations preventing them from investing foreign exchange abroad. In the early 1990s, legislation was passed that allowed firms to invest foreign exchange earned from exporting in order to establish offices overseas. Previously, the Indian firms had only learned about their client's needs from their programming staffs on contract overseas, supplemented by occasional senior staff visits to the United States (and occasionally to other high-wage countries) and client visits to India. Operating a foreign office strengthened relationships with existing clients and provided access to mid-sized firms. Some firms established dedicated centers at customers' sites (Dossani 2006). At that same time, the Indian government changed its regulations to allow multinational firms to establish wholly-owned subsidiaries.

The Indian industry continued to evolve and find new software work. One important opportunity was the Year 2000 (Y2K) problem that became a serious issue in 1998. In itself, Y2K business was not so attractive as it was mostly unsophisticated work done at the client's site, but the Y2K business was important in other ways. It introduced additional foreign companies to the abilities of Indian firms and programmers, thereby expanding the Indian firm's potential customer base and increasing awareness of India as a destination for software work. Y2K prompted many firms to replace their legacy systems with standardized software platforms such as Oracle and SAP. This meant that Indians could train on global standard platforms and receive globally recognized certifications, raising client confidence.

The Current Status of the Software Industry in India

The Indian software and software services industry has experienced remarkable growth over the last thirty years. The Indian software services industry is based on the use of global software platforms and thus must purchase software licenses from foreign vendors. There is little available data on Indian software imports, however. Heeks (1996) cites Dataquest reports that in 1994-95 these imports were in excess of $96 million, and they have almost certainly grown many times over as the Indian software industry came to operate on standard platforms provided by US-based multinationals such as Computer Associates, Microsoft, and Oracle. To provide some idea of the number of software-capable people there are in India, according to Oracle (2005), India is the home to more than 220,000 members of its 3-million-strong online developer community, Oracle Technology Network.

Though this study concentrates on software offshoring, today not only software but also a great range of services are being offshored to lower-wage-cost environments (Dossani and Kenney 2003). Major software firms such as IBM, Microsoft, Oracle, SAP, and Veritas have relocated work to India. Because of the way the data is reported, it is impossible to separate the software work from the back office operations. However, as Table 1 indicates, a number of these firms have large workforces in India. In the case of Oracle and Adobe, approximately 16 percent of their global employment is now in India, and the number continues to grow. Other major software firms, all of whose Indian facilities were established far later than Adobe and Oracle, are also growing rapidly.

One myth about offshore facilities for multinationals is that their employment is limited to relatively low-skilled programmers. February 2005, Oracle was advertising for 199 positions in its two facilities in India. Approximately 30 percent of these positions were for workers with Masters or Ph.D. degrees. Microsoft, newer in India, had a relatively less highly skilled recruitment profile, but they, too, were recruiting highly credentialed workers (See Table 2). Hiring such qualified employees, these Indian firms are likely to be capable of innovation in the future.

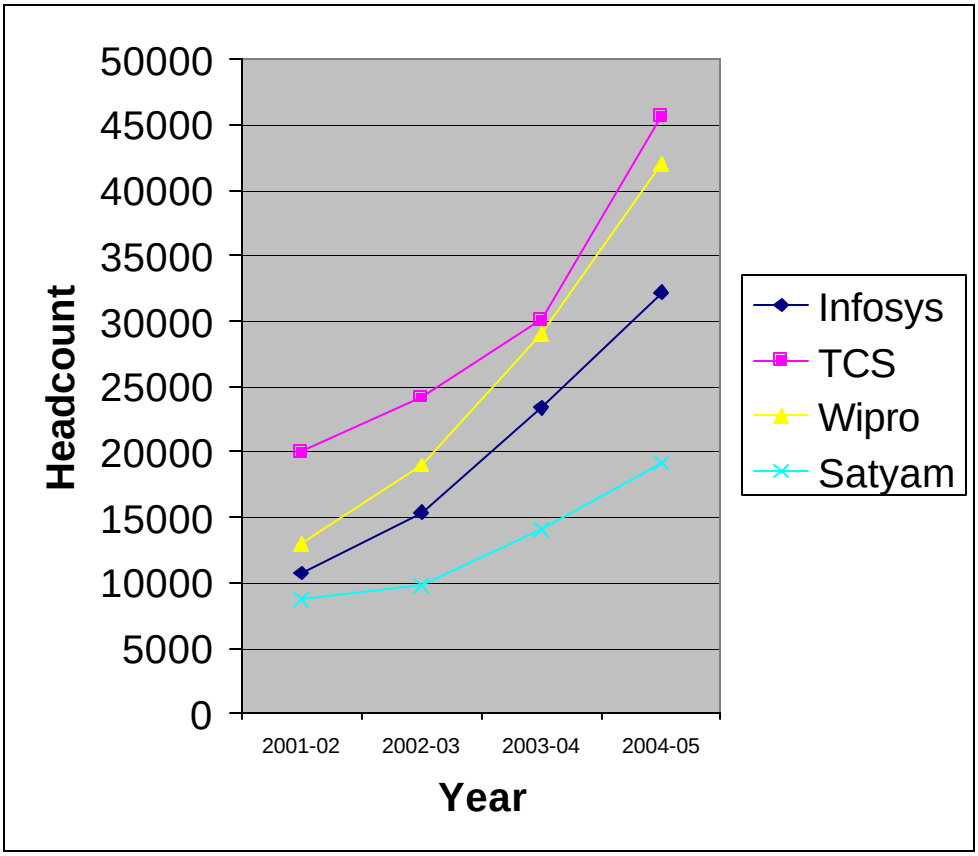
Table 3-2: Educational Requirement Posted for Job Openings for Microsoft in India and China by Highest Degree (Feb. 2005)

			MICROSOFT			
	None	**Technical**	**Bachelors**	**Masters**	**PhD**	**Total**
Beijing	2	0	0	1	0	3
Bangalore	2	0	13	5	0	20
Hyderabad	17	3	57	14	3	94

Source: Martin Kenney's compilation from various corporate websites (2005)

Like the multinational software firms operating in India, the Indian-owned software services firms are growing rapidly. They offer their services on outsourced software projects. As Figure 3 indicates, the major firms are large. Headcount at TCS and at Wipro, another major Indian firm, have already crossed 40,000 and are continuing to grow at 20-25 percent per year (CAGR). The stock market believes in these companies and places much higher values on them than on comparable US firms (Hira and Hira 2005).

Figure 3-3: Total Headcount at Major Indian Software Firms by Year

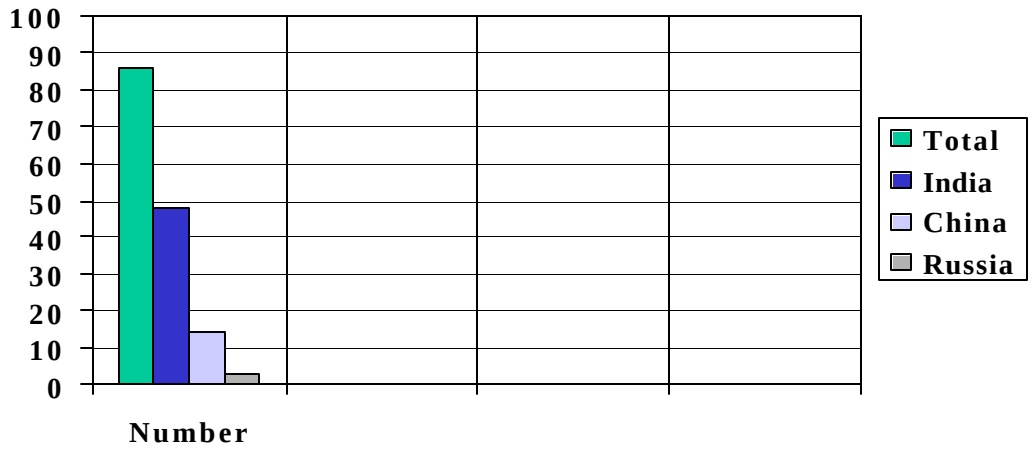


Source: Heng 2005:7, Compiled by Martin Kenney from corporate sources

The prices offered by Indian firms place enormous pressure on management in developed-nation firms to decrease costs so as to remain competitive. This resolves itself into a single issue, namely, getting costs per employee down. The way to do this is to move work to India or some other low-wage country. However, as Table 1 shows, many firms such as EDS, IBM, SAP, and Cap Gemini have relatively low percentages of their workforce located in India. From the of competitiveness perspective, this is no longer viable, and their Indian headcount is expected to increase significantly over the next few years.

There is significant evidence that a movement to higher value-added activities is occurring in both the Indian firms and the multinationals. In an Internet survey of the Top 86 U.S. software firms as identified by Software Magazine and conducted in December 2004, 48 firms had R&D facilities in India, while 14 had facilities in China, and only three were present in Russia (see Figure 4). There is also significant anecdotal evidence that US software startups are establishing facilities in India to save money and increase their headcount at low cost. (For further discussion, see Chapter 4.) This may have an indirect impact on the future growth of US software employment.

Figure 3-4: Number of R&D Operations in India, China, and Russia Operated by Top 86 U.S. Software Firms



Source: Internet searches by Martin Kenney

The Future of the Indian Industry

The Indian software industry is likely to grow in scale, scope, and value-added ability. There is little reason to believe that offshoring as a process will end in the foreseeable future, but it could slow down. The enormous investment by leading software multinationals will expand the number of Indian project managers with global-class managerial skills. This, plus the relocation of portions of startup firms to India, is likely to result in greater levels of entrepreneurship and enable firms to sell their skills on the global market at global prices. As a generalization, it is safe to say that this has not yet occurred, though I-flex, a former Citibank custom software firm recently purchased by Oracle, is now selling proprietary packages around the world (I-flex 2005). Other Indian independent firms may soon follow.

The offshoring of IT services and software for export will dominate the near future of the Indian software industry. There are several possible trajectories. Custom projects could

become more complex and large, leading Indian software professionals to move from programming into systems integration, systems specification and design. The average size of projects Indian firms are undertaking has grown from 5 person-years in 1991 to 20 in 2003 (Krishnan 2003). As multinationals deepen their Indian operations, domain skills will develop in India so that managed services are likely to become more important. This will match global trends in the outsourcing of applications management and business processes.

Despite the fact that India's software production for the US market exceeds that of any other nation, it holds only a small share of the global market for all software value-added work. The only part of the software value chain in which India has made substantial inroads is in applications development where it has captured 16.4 percent of the world market. But applications development is only approximately 5 percent of the entire global software services market (see Table 3). This implies that there is much room for growth.

Table 3-3: India's Share in Various Sectors of the Software Services Industry (2003)

	Global software services spending ($ bn)	**Indian software services export revenues ($ bn)**	**Indian service constituents by percentage (%)**	**Indian global market share of services (%)**
Consulting	41.5	0.11	1.9	< 1
Applications Development	18.4	3.02	54.5	16.4
Managed services	124.9	1.94	35.0	1.6
System Integration: Hardware/Software Deployment and Support	91.7	0.37	6.7	< 1
System Integration: Applications, tools and O/S	62.4	0.10	1.8	< 1
IT education and training	18.5	0	0	0
Total	357.6	5.54	100	
Product software	200	1.66		<1

Source: Dossani from Nasscom 2004, p. 36 and 106. Indian figures are for 12 months ending March 2003. Indian figures do not include product development and design of $ 0.56 bn and embedded software of $1.1 bn.

The Indian software and software services industries are booming. In 2004-2005, the entire software and services industry grew at 18.5 percent and reached an all-time high of $16.8 billion of which $4.8 billion was in the domestic market. The export earnings increased at an annual rate of 30.4 percent from $11.2 billion in 2003-04 to $12.0 billion in 2004-05 (Nasscom 2005). All projections for 2005-06 indicate that it will be yet another banner year.

A key issue for India is the future of applications development in the value chain. Applications development may become commoditized just as systems maintenance has, either due to automation or the development of products that are as good as custom applications. Applications development has been losing global market share to consulting and is slipping down the value chain. However, since information is a source of competitive advantage, it is unlikely that customized application work will disappear altogether. In order to grow, the Indian industry will have to shift to more complex activities by securing larger projects, undertaking engineering services, integrating and managing services, or bidding on projects that include transforming a client's entire work process.

Increasing the value-added and IP components of Indian software services is difficult. For example, Cognizant CEO Narayanan argued that India did not yet have the capability to develop intellectual property, pointing out that R&D's contribution to overall growth is minuscule, and multinationals generally use their Indian R&D operations to upgrade existing products, not develop new ones (Economist 2004). Sarnoff India head, Satyam Cherukuri, argues that India has two of the three requirements for innovation, technical skills and access to capital, but lacks an "indigenous business model" (Economist 2004; D'Costa 2003).

Despite the assertion of many, it is plausible to argue that there is a significant entrepreneurial movement emerging in India. It could be said that there have been two clear waves of entrepreneurship already. The first was the establishment of firms such as Infosys, HCL, and Hexaware who created body-shopping businesses that evolved into the offshore programming model. Though entrepreneurial in genesis, they were pure labor-cost arbitrageurs. More recently, that situation may be changing.

The second wave of entrepreneurs consists of a few startups that are producing their own IP and marketing it globally. One of the most successful is I-Flex which was established by Indian executives who spun out of Citicorp's Indian software subsidiary. I-Flex developed a banking software package that is now being used by more than 50 medium-sized banks around the world. Today, there are only a few other examples, but given that an increasing number of Indian managers and researchers are acquiring experience in the Indian R&D laboratories operated by US firms, there is the potential for more of these startups.

Software offshoring to India is likely to grow not only through the continued growth of indigenous Indian firms, but also because foreign software firms feel compelled to increase their employment in India in product development and particularly in software services. Including not only software and software services but also other services, Accenture hired 1,600 employees in May 2005 in India and has announced that it will be hiring 50,000 more workers in India, China, and the Philippines in the next three years. IBM, which had 6,070 employees in India in 2002, saw the number rise to 24,150 in 2004. The company has a target of raising this number to 38,196 in 2005, an addition of 14,000 employees in just one year. CapGemini India plans to grow to 10,000 employees by 2007. Large multinationals, such as IBM and CapGemini, are competing with Infosys, Wipro, and TCS for offshore supremacy. As Indian companies move to global markets in their quest to expand the offshore model, these large multinationals are moving to low-cost destinations, taking the big Indian firms head on. The Indian firms are likely to face tough competition in the near future.

The cost advantage in India may diminish as labor costs increase and the rupee appreciates against the US dollar. However, interviews conducted by Rafiq Dossani and Martin Kenney indicated that costs were generally increasing rapidly only for experienced managers (15 to 20 percent per annum), while wages for beginning college graduates were increasing more gradually (5 to 10 percent per annum) (Private communication, 2005). Today, the cost of an Indian college graduate is $6,000-7,000 per year, while a US graduate

is in excess of $40,000 per year. In addition to wage costs increasing among the more experienced managers, there is a generalized phenomenon of high turnover due to a supply-constrained labor market. This turnover affects projects and may have a detrimental effect on capability development both at the individual and corporate level.

There is much discussion of the high quality of the Indian IT labor force, but this may be deceiving. NASSCOM indicates that only about 27 percent of the employees in the Indian IT industry have an undergraduate or graduate degree in computer sciences or electrical engineering. In spite of India having 247 universities and 11,549 colleges in 1997, only 7 percent of the student-age population attends a university (Nasscom 2005). India has 0.3 scientists and technicians per 1000 population, ranking 42 out of 62 countries as ranked by the World Bank in 1998, below China at 1.3 (ranked 25th) and Ireland at 2.0 (ranked 20th). This lack of highly educated workers may slow India's advance into higher value-added sectors of the software industry.

Despite much improvement in the value-added per employee, India continues to trail the United States in this regard. In India, revenue per employee in software services has risen from $16,000 in 1990 to $33,000 in 2003. However, this is far behind the US average of $142,000. This differential suggests that US workers are still more productive than those in India, probably because a significant portion of the US revenue is in software products where revenue per employee is much higher than in software services.

Improvement of the value-added per employee will require a continued upgrading of the Indian workforce. The leading Indian software firms are investing in their workforces, but there is only so much training an individual firm can undertake particularly in the high turnover environment that characterizes the Indian labor market. Thus much of the responsibility falls on the central government which is the main financier of tertiary education. While India has greatly expanded the university system, problems with quality appear to have deterred enrollment.

The interaction between university and industry is minimal. There are few academic-industrial research partnerships as well as few consultancy assignments for faculty in industry. On campus, little independent research is undertaken. Until recently, faculty (even at the Indian Institutes of Technology (IITs)) have not been expected or funded to do research. Only in 2005 did the Indian government appropriate $250 million to establish a National Science Foundation. For example, at IIT Delhi, the value of sponsored research and consultancy assignments in 1998 was only $4.5 million (Parthasarathi and Joseph 2002). Faculty salaries are low, and NASSCOM concluded, "Over the years, there has been a general decline in the quality of faculty in Indian universities" (Nasscom 2002). The average number of citations over a five-year period for a faculty member at the Indian Institutes of Technology is less than three. This compares with 45 per faculty member at MIT and 52 per faculty member at Stanford University (Nasscom 2002). The country produces only 300 master's degree graduates and 25 Ph.D.s in computer sciences each year, compared with US numbers of 10,000 and 800, respectively. (For more information on the Indian educational system, see Chapter 7.)

The Indian subsidiaries of multinationals are perhaps even more important than the independent Indian firms. The reason is that the multinationals are more willing to undertake high value-added activities such as software product development within their own captive firm in India than they are to send the work to an Indian independent firm. It is within these subsidiaries where the highest value-added activities, such as globally directed research and development, take place. For at least the medium term, India should be able to retain its position of primacy for software offshoring from the English-language world. In the longer term, unless India makes an even greater effort to upgrade its

universities and the technical capabilities of their graduates, China may become an important alternative destination.

3.5 China

China is one of the fastest growing economies in the world and is now the seventh largest economy in the world in terms of gross domestic product and the second largest economy in the world when the GDP is corrected by purchasing power parity. During the last two decades, it has become a manufacturing powerhouse. In 2004, the United States had a $162 billion trade deficit with China, the largest trade deficit with any single nation in US history.[8]

China manufactures a broad range of goods, including IT products such as personal computers, routers, monitors, cell phones, and handheld devices. The manufacturing of IT products in China is growing more rapidly than China's overall industry. From 1990 to 1999, the Chinese IT industry grew at a rate of 32 percent per annum (Dong 2004). From 2002 to 2003, sales increased at approximately 34 percent to reach $235 billion, and China became the third largest IT equipment producer in the world (STAT-USA 2004). IT exports continue to grow rapidly. For example, in the first seven months of 2003, China exported $80.6 billion, representing approximately 50 percent of its total production (China Venture Capital Research Institute 2004). The strength of the Chinese IT hardware industry is shown by the purchase in 2005 of IBM's PC division by Lenovo. There is ample reason to believe that China may soon become the largest IT product exporter in the world.

China and IT Software and Services

Much less is known about the Chinese software industry than is known about the Indian software industry. The Chinese IT and software and service industries (ITSS) do not appear to be having an important impact on the global economy, though as we shall discuss later in the section on Japan, there are Chinese ITSS exports, and they are expanding rapidly but from a far smaller base than in the case of India. According to the Chinese Software Industry Association, there are 300,000 workers employed in over 6,000 firms, of which approximately 160,000 are software professionals, approximately 25 per firm (Tschang and Xue 2005, 133). According to the Ministry of Commerce, the revenues of the Chinese ITSS industry increased from $7.17 billion in 2000 to $19.35 billion in 2003. During the same period, software exports increased from $250 million to $2 billion in 2003 (China Software Industry Association 2005). A recent report (Krishnadas 2005), notes that China's IT services revenues are rising but are barely half of India's $12.7 billion. Growth is driven by internal demand, and exports make up only 10 percent of total annual software service revenues. The Chinese Software Industry Association indicates that 60 percent of Chinese software exports in 2003 went to Japan and another 21 percent went to Southeast Asia to nations using Chinese characters (Liu 2004).

Despite the impressive growth, the Chinese software export industry faces many obstacles. It is extremely fragmented, and few firms are capable of undertaking large projects (Krishnadas 2005). As of 2003, only six Chinese firms had received certification through the Carnegie Mellon Software Engineering Institute's Capability Maturity Model Integration, and most of these had not achieved CMMI Maturity Level 3 (China Venture

[8] These statistics can be found at
http://en.wikipedia.org/wiki/List_of_countries_by_GDP_%28nominal%29;
http://en.wikipedia.org/wiki/List_of_countries_by_GDP_(PPP);
http://www.economywatch.com/world_economy/china/;
http://www.census.gov/foreign-trade/statistics/highlights/top/top0412.html#total.

Capital Research Institute 2004). In contrast, all top 30 Indian software outsourcing firms had already received CMMI Maturity Level 5 (Krishnadas 2005).

Given China's role as a manufacturing center for the global economy, many manufactured products it exports contain embedded software. Programmers preparing embedded software often need to work closely with designers and manufacturers, and there is some evidence that a portion of this work may be relocated to China (Linden and Brown 2005).[9] At the moment, there are no estimates of the size of this market, but it could be significant.

The Chinese firms providing IT services to Western nations vary by size, but most are relatively small. There are Chinese firms offering offshore software services for the US market. At this point, the Indian firms dwarf them but, over the longer term, Chinese firms may provide competition to India in providing service to US businesses. A number of the large Indian software offshoring firms have established subsidiaries in China for the purpose of capturing business in China and servicing the Asia-Pacific market. Meanwhile, the Chinese networking equipment firm, Huawei, employs nearly 800 engineers in India and has announced plans to increase the number of engineers to 2,000 by 2006 (Press Trust of India 2005). Although the outsourcing relationship between China and India remains tiny, given the growth both nations are experiencing, it is possible that they could eventually become significant.

In contrast to India where exporting is the goal of both the India independents and the multinationals, much of the IT and software services growth in China is in the domestic market. Multinationals have developed large operations bent on localizing their products and software for the Chinese market. China is the largest developing country market in the world, and, for certain products, it is rapidly becoming one of the overall largest markets in the world. Many foreign goods must be localized to meet the special requirements of the Chinese market. For this reason, China is becoming an increasingly important location for R&D facilities in a wide variety of industries, including software and electronics (Zedtwitz 2004). In an effort to tap the Chinese market and utilize Chinese production prowess, a number of US software firms as well as US, European, and particularly Taiwanese electronics firms have established R&D facilities in China. The Shanghai area is an important stronghold not only for computer machinery assembly, but also for semiconductor manufacturing and, on a slower track, semiconductor design (Reuters 2005). Most of these operations are geared to adapting products for the local market or doing production engineering; however, some are developing global product mandates or are doing research for the firm's global operations. One of the most celebrated of these is the Microsoft research laboratory in Beijing which as of November 2004 employed approximately 170 scientists and planned to add 80 more (Heim 2003). According to Huang (2004), "more than 70 technologies developed [there] are already used in Microsoft products, including software for Windows operating systems and graphics packages for X-box video games. More of the lab's latest software is slated for the next version of Windows due out in 2006." Global software leaders such as SAP, Oracle, and Adobe are also establishing or expanding their Chinese operations.

Given the general economic growth in China, the Chinese market for software is expanding rapidly. Today, US packaged software firms are having some difficulty in the Chinese market due to uncompensated software copying. Though China has joined the World Trade Organization, it seems likely that these difficulties will continue. One possible answer to the uncompensated copying is the current Chinese effort to move to open source software (Marson 2005). Were this to come to fruition, it would dramatically decrease the

[9] India also is developing a strong embedded software design capability, both at the multinational and Indian firms.

problem of uncompensated copying, but it would also have a significant impact on the future prospects for growth of the US packaged software industry.

Conclusion on China

Given the past growth record, the apparent opportunities, and the importance given to the software industry by the Chinese government, the Chinese software industry is likely to continue growing more rapidly than the rest of the Chinese economy, and probably faster than the software industry in the rest of the world. In the short term, the Chinese software and software services exports are focused on Japan (see Section 3.6). In the long-term, China could possibly emerge as a competitor to India in the general software export market. More easily predicted is that China will become an enormous market. Given the relative paucity of data, it is difficult to predict when China will become one of the largest software markets in the world, but given the number of Internet and cell phone users, the rapid roll out of broadband networks, and the gadget orientation of Chinese consumers, it might happen quickly. However, it seems unlikely that Chinese firms will be able to compete with the major Indian IT and software services firms in the near-term.

3.6 Japan

The Japanese software and software services industry had sales of about $140 billion in 2004 and is the second largest single-country market in the world, accounting for 10.8 percent of the world's IT industry. Further, IT and software services is the fastest growing industry in Japan. In 2003, there were 5,482 information service companies employing 567,060 workers in Japan. Of these, technical positions included 240,096 system engineers, 114,479 programmers, and 7,398 researchers. The number of software engineers in all industries is about 800,000. Thus, more than 40 percent of software engineers are working in the information/service industry (JISA 2004a).

As Table 4 indicates, Japanese software imports were $2.9 billion in 2003.[10] The type of software imported is specific to the nation from which it was imported. The United States is the largest source of software imports, and it overwhelmingly provides system and applications software. In contrast, the imports to Japan from China and India are mainly custom software. Japan imported $102 million worth of custom software from China and $38 million from India. Japan also received $262 million in software services from China and another $63 million from India (Umezawa 2005a).

Table 3-4: Japanese Software Imports in 2003 (US$ millions)

	Basic Applications	Applications	Custom	PC Games	IT Outsourcing	Total

[10] The true value of the imports is much larger because all major foreign software package firms have subsidiaries in Japan. For example, Microsoft's Asia-Pacific earnings in 2003 were $3.437 billion (Microsoft 2004), and Japan is as large as the other markets combined so Microsoft alone probably earned more than $1.5 billion in Japan.

U.S.A.	686	1,874	47	6	49	2,606
China	1	1	102	0	262	104
Ireland	0	45	0	0	0	45
India	2	0	38	0	63	40
Australia	0	0	26	0	26	26
Others	6	27	43	0	91	76
Total	695	1,947		6		2,901

The Japanese software industry differs significantly from that of the United States. Outside of a few fields such as game software, Japanese software firms develop custom software for the Japanese market. Few Japanese companies produce packaged software products. For those firms that do prepare packages, their market is almost exclusively domestic, and the entire industry, not counting game software, exports only $93 million.[11]

There is no authoritative data on offshore software development for the Japanese market. The most reliable data comes from surveys conducted by the Japan Information Service Association (JISA). According to Tsukazaki (2002), 19,000 foreign engineers were working in Japan in 2001, and, during that year, 3,943 foreigners acquired the status of engineer. Of these, 61.8 percent were estimated to be software engineers. In the JISA sample, Chinese professionals were by far the largest group represented, followed by Koreans, and a relatively small number of Indians.

The typical pattern in the past has been for Japanese firms to import Chinese or Indian software engineers to work on projects in Japan. This has changed because the cost of dispatching Chinese software engineers to Japan has increased to the point where it is no longer attractive (Umezawa 2002). The more typical pattern in 2005 is that a Japanese customer identifies a need for custom software and engages a Japanese software firm. The Japanese software firm then contracts with a Japanese subsidiary of a Chinese firm to have the work done either by Chinese programmers in Japan or, increasingly, by programmers located in China.

Another mode of offshoring has emerged in which Japanese firms invest in China to form a wholly-owned subsidiary or a joint venture with a Chinese firm. The most popular locations for Japanese firms to operate subsidiaries in China are Dalian and Beijing. The other mode of offshoring from Japan is for Western multinationals to move their programming and back office functions from Japan to a lower-cost environment in China. Dalian's software industry has grown (from a small base) at over 50 percent annually in sales volume and reached $544 million in revenues in 2003 (Xiong 2004).

Japanese firms, such as Fujitsu, NEC, Sharp, and Sanyo have subsidiaries to produce software in India. For example, through a publicly listed affiliate, Fujitsu (in 2005) employs more than 2,000 workers in its four facilities in Pune. It is difficult to establish whether these operations support the Japanese market or the English-language operations of Japanese firms. Despite great effort on the part of Indian vendors, with only a few exceptions, their sales in Japan have been small.

[11] For further information on Japan and offshoring, see Umezawa (2002; 2005a; 2005b).

Impact on Japan of Offshoring

The impact on Japan of IT and software services offshoring is uncertain for two reasons. First, the software services offshoring phenomenon is recent so that patterns are not yet well established and data is scant. Second, Chinese vendors generally do not conduct business directly with their Japanese customers so the role of the Chinese company is somewhat obscured. There is typically an intermediary such as a Japanese software firm or a US or European-based multinational, that holds the contract with the Japanese client; the Chinese company is a subcontractor. The Japanese software firms have typically retained the higher value-added activities in Japan.

Actual sales are relatively small. While sales of the Japanese information services industry are $141.7 billion, the share offshored is $480 million or only 0.3 percent of the total sales (Umezawa 2005a). This may underestimate the total amount of offshoring because many multinationals operating in Japan have begun servicing the Japanese market from China or India. For example, in 2004 the US consultant firm, BearingPoint, established a development facility in Dalian with 60 employees, and it planned to increase employment to 1,000 "as soon as possible" (Thibideau 2004). Although Dalian has just begun to grow as a software offshoring center, Western multinationals there already include IBM, General Electric, Accenture, Dell, and SAP. Among the Japanese firms in Dalian are Sony, Matsushita Telecom, Mitsubishi, Toshiba, Nokia, Omron, CSK, Alpine, Furuno Softech, FTS, and Sino-Japan Engineering (Xinhua News Agency 2003). Despite this rapid growth, these operations are still not significant enough to have much impact on the Japanese economy.

The movement of Japanese software production to China is likely to continue. However, there seems to be a division of labor emerging with Japan undertaking the higher-end software development, while the Chinese subsidiaries and subcontractors undertake the more mundane coding functions. This is borne out in the China Venture Capital Research Institute (2004) assessment of the situation, "the export to Japan was mostly done in the form of outsourcing, just like traditional manufacturing, what was subcontracted to our country was only the development of lower-layer modules."

Conclusion on Japan

The amount of work offshored to China is likely to increase due to the increasing pressure to lower prices. Users are beginning to require that their Japanese vendors offer software development prices that assume offshore development in China. Given the strong linkages Japanese firms have with their customers, it is unlikely that Chinese firms will be able to establish direct relationships with Japanese customers. However, Japanese firms will be under pressure to reduce costs and thus will almost surely have to increase the scale of their Chinese operations or form alliances with Chinese firms. This suggests that Japan will not be immune to the pressure to offshore.

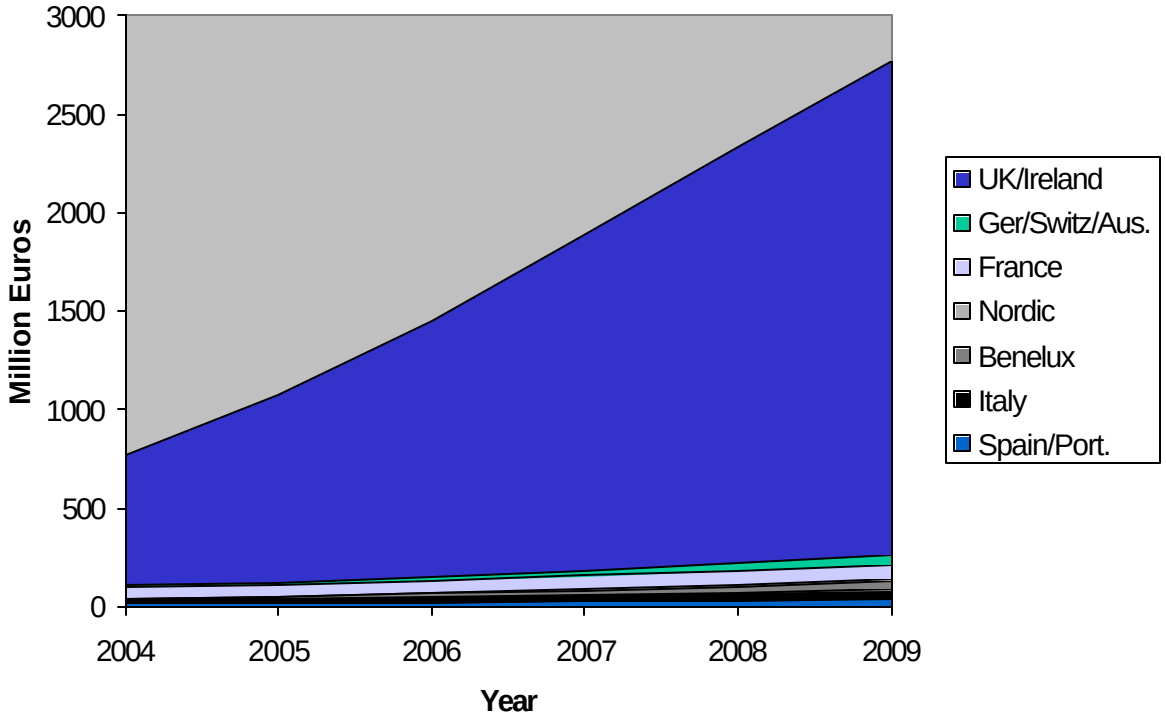
3.7 The European Union – Western and Eastern Europe

After the United States, the European Union as a whole is the second largest software market in the world. In 2004, Germany accounted for 8.1 percent (15.4 billion Euros), and the United Kingdom accounted for 7.1 percent (13.5 billion Euros) of the world software market (Heng 2005). This is much smaller than the US share of 44.5 percent (96.6 billion Euros). However, this statistic is somewhat misleading in that the Europe Union is not yet a single market but is rather a loose confederation of markets with different customs and languages. Europe has only one major software products firm (SAP). With the exception of SAP, US firms are dominant in Europe's packaged software market. Europe has no major software service firms. The European market for IT services is divided by national language differences. For example, Siemens Business Services is a leader in Germany, while Cap

Gemini is a leader in France. The giant US software service providers, such as IBM, Hewlett Packard, and Accenture, play an important role in European markets where they usually face firms that are only significant in their home nation (see Table 3-1). The greatest European strengths are in software embedded in other products. Unfortunately, there are few statistics publicly available to gauge the size of the embedded software market.

The European Union has been slower to embrace offshoring than the United States. The United Kingdom was the first European country to do a sizable amount of offshoring, and it is responsible for almost two-thirds of the IT and service jobs offshored from the European Union (see Figure 3-5). Thirty percent of the jobs offshored come from Germany and Benelux, and there is a noticeable increase in interest in offshoring in the German-speaking nations recently. French, Italian, and Spanish firms have been more reluctant to send work offshore.

Figure 3-5: European Offshore Services Spending by Region



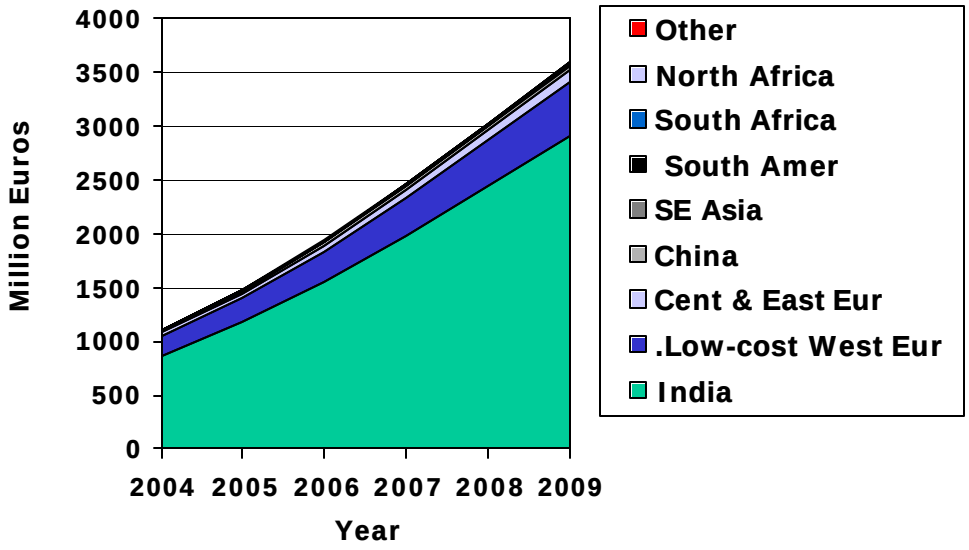
Source: Parker 2004

Cost pressures are driving Continental European software and software services firms to consider offshoring. According to a study by the consulting firm Roland Berger Strategy Consultants (2004) in which executives at 93 major European firms were interviewed, almost 40 percent of the firms have already relocated some services offshore, and 50 percent of all of the firms intended to offshore more activities. The firms already offshoring gave the strongest indication of willingness to offshore new functions in the future. There is anecdotal evidence that offshoring is increasing across Continental Europe. For example, in 2005, the Renault-Nissan alliance awarded IT services outsourcing contracts worth approximately $600 million to two US firms, Hewlett Packard and Computer Sciences Corporation, and the French firm Atos (Ovum 2005). With this outsourcing contract, much of the work will be transferred to lower-cost environments since all three of these firms have global operations.

Where the work is sent divides primarily along language lines. The United Kingdom sends most of its work to India, while the Western European nations speaking languages other than English are more likely to look to Eastern Europe. Due to the European Union's expansion into Eastern Europe, this is a natural near-shore location for the movement of services. A significant percentage of Eastern Europeans speak a Western European language such as German and, in the case of Estonia, Finnish. Hungary, Poland, and Romania are seen as prime sites for this nearshoring work.

Although many studies predict that Eastern Europe and Russia will receive much of the future offshoring work from Continental Europe, Figure 6 shows that, for Europe overall, the most attractive location by a considerable margin will continue to be India. India wins on price. For example, even though Romania is one of the lower-wage Eastern Europe destinations, it still has wages that are higher than those in India. India also wins on language and culture factors for the United Kingdom.

Figure 3-6: European Offshore Service Spending by Recipient Location



Source: Parker 2004

Germany provides an interesting case study. A sample of 93 major German industrial firms conducted by Horst Wildemann (2005) of the Technical University of Munich found that, of the firms that have offshored, 29 percent sent their work to Eastern Europe, while 46 percent went to India and China. R&D and administrative functions were areas that received considerable attention. This study also showed that the number of firms planning to offshore service functions is increasing and predicts that Germany could lose 152,000 jobs per year, for a total of 758,000 jobs potentially lost in the next five years. A recent study by A. T. Kearney (2004) predicts that by 2007 Germany will lose 130,000 jobs to offshoring. Although German labor unions have resisted offshoring, the state government of Bavaria is actively advising small and medium-sized enterprises on how to offshore their IT functions.

Cost reduction is the prime driver of this offshoring for German firms. According to the Roland Berger report (2004), the cost savings achieved through service offshoring were typically in the range of 20 percent to 40 percent with an average of almost 30 percent, which is similar to the results reported by Dossani and Kenney (2003) for US firms offshoring to India. The wage differential between Germany and Eastern Europe is

significant. For example, in Germany, a systems engineer with a university degree and three years experience earns between 57,000 and 63,000 Euros per year, while a counterpart in Poland receives 15,000 to 18,000 Euros per year. Eastern Europe also has the advantage in that there are no time zone differences to complicate communication. Nevertheless, India and China are 50% less expensive than Eastern Europe which may be a determining factor is some offshoring destination decisions.

SAP and Globalization of the European Packaged Software Industry

SAP is the only major package software firm in Europe. Established by a group of former IBM Germany managers and headquartered in Walldorf, Germany, SAP had global sales of $9 billion in 2004. In keeping with its global reach, the company has internationalized its sales, support, and development operations, and staffing is growing in India in particular. The company employed approximately 32,000 people globally in 2004, including 13,500 workers in Germany, 5,000 in the United States, and 1,500 in India. SAP's operations in Bangalore are not only at the low end. For example, the Bangalore facility is developing software dealing with international taxation which will be sold globally. However, with the exception of SAP, it does not appear as though the European software industry will significantly increase its strength in packaged software and thus, in packaged software, it is unlikely that the employment offshored by the other software firms will be large.

Case Study: Siemens Business Services and Globalization of European Software Services

Siemens Business Services (SBS) is a Siemens subsidiary that does software and other outsourced production work on a global scale. It employs approximately 36,000 workers and has developed a strong business in helping companies to implement SAP software. Its 2004, revenues of 4.8 billion Euros came from Germany (48 percent), the rest of Europe (39 percent), the United States (8 percent), and the rest of the world (5 percent) (Siemens Business Services 2004). Like many other large service firms, SBS has been globalizing its service delivery operations and, in the process, downsizing its domestic workforce. Of the company's 36,100 global employees, only 15,100 are now located in Germany, and 4,000 are located in its rapidly growing Indian subsidiary.

SBS has developed a customer service strategy that uses a matrix of vertical industry knowledge and sets of general competencies. One aspect of the matrix is the industry expertise (vertical knowledge) concentrated in competency centers that are scattered across different nations. For example, the paper and pulp vertical center is located in Finland (Hallez 2004). The other part of the matrix involves general activities, which are located in offshore sites in Canada, Ireland, and Turkey to handle stabilized processes. India has two roles: it functions as a back office operation for finance and accounting, and it does general software programming and service and applications development for SAP programs. SBS uses Russia for very labor intensive and repetitive back office and software application development (Hallez 2004).

Conclusions on Europe

The European software industry and employment pattern is different from that of the United States with much software production done in-house and embedded in physical products. This does not prevent offshoring, and certainly many leading European industrial firms are establishing offshore facilities to produce embedded software. Much of this

employment is subsumed under research and development and other activities such as application-specific integrated circuit design that are not directly relevant to this report.

Continental European firms continue to lag the Anglophone nations in sending software work across their borders. The Germanic and Nordic nations have only recently begun to build offshore software and software service delivery capabilities, but firms with global practices such as SAP, SBS, and others are moving rapidly to build their offshore capabilities in Eastern Europe, China, and India. The geography of European offshoring will be somewhat different from that of the United States in that Nordic and German firms will use Eastern Europe and Russia in addition to India. Those parts of Europe speaking a Romance language as the predominant language have been slower to begin offshoring. But now their major firms are sending work to Romania, Francophone Africa (particularly Morocco), and Latin America, in addition to India. There is no reason to believe that the pressures to offshore software-related work in these Romance-language countries will be substantially different from in the Anglophone nations. Given that US-based multinationals with strong global delivery capabilities, such as IBM, EDS, Hewlett Packard, and Accenture, are present and competitive in all European markets, there are cost and delivery pressures on companies throughout Europe to offshore, similar to the pressure on US firms. The only possible mediating factors that will make the European and US situations different are union and government opposition to offshoring in Europe. The most likely impact of this opposition is a delay in offshoring, not a change in the final outcome.

3.8 Russia

In Russia, the largest state formed out of the former USSR, software was traditionally a relatively neglected field outside the military. In the late 1980s, software comprised only 1.5 to 2 percent of the total outlays on computer systems, while the corresponding figure was 50 percent in the United States. At the time, there were reportedly few highly skilled professionals among the country's 500,000 programmers (Katkalo and Mowery 1996). In the 1990s, Russia began a transition to a market economy, and many skilled software engineers left the low-paid state enterprises, research institutions, and universities. They either emigrated or moved to multinationals or Russian startups. The greatest international product success of any of these companies was the computer game Tetris.

Large US and EU firms are active in Russia. Russia's advantage is that, as a legacy of the Soviet era, it has "more people working in R&D than any other country, and ranks third in the world for per capita number of scientists and engineers" (American Chamber of Commerce in Russia 2001). Russia's investments in education mean that it has a large stock of technically trained individuals. On the other hand, a recent Forrester report indicates "while [the number of programmers in Russia] has increased during the past two to three years, there is still less total development capacity than any of the large global system integrators can provide in the United States or Europe alone (Hoppermann and Parker 2004)". Even though Russia has trained technical personnel, the local software market is small and undeveloped compared to those in Western Europe and the United States. Russian firms have yet to play an important role in producing products or participating in global software services.

Offshore software development in Russia represents a small fraction of the worldwide offshoring headcount, although the number appears to be growing rapidly. Hawk and McHenry (2005) estimated that the Russian offshoring software industry generated revenues of between $200 and $450 million in 2003 and employed about 15,000 of the

70,000 programmers in Russia.[12] The stock of potential programmers, that is, those with some training in programming, may be as high as 200,000 and, in 2003 alone, there were approximately 68,000 new graduates in electrical or telecommunications engineering, computer science, mathematics, and physics (Hawk and McHenry 2005). Using the most liberal definition of programmers, that is, college graduates from all disciplines who might be capable of programming, it has been estimated that Russia could have graduated as many as 225,000 in 2003 (Hawk and McHenry 2005).

Wages in Russia are low. In 2001, programmers with less than two years experience were paid between $300 and $500 per month, while more experienced programmers earned between $600 and $1,500 per month. Wage rates are increasing rapidly. Hawk and McHenry (2005, 12) cited a 2003 survey that found that wages for development staff ranged between $380 and $1,200 per month, with experienced managers receiving from $700 to $1,900. Wages in Moscow were higher than these scales.

Contrary to the report cited, concerning the small number of high-skill programmers in the Soviet era, Hawk and McHenry (2005) report that the skill levels of today's Russian programmers is quite high quality and they are considered to be good problem solvers. On the other hand, project management skills are viewed as not so strong. Russia also presents a difficult business environment. Experienced managers are in short supply, and few Russian firms have secured certification from standards-setting bodies. Hawk and McHenry (2005) state that only recently have Russian firms applied for certification, and only Luxoft had reached CMMI Level 5 (Luxoft 2005). This may change over time as Russian firms become more experienced and hire IT managers returning from abroad (American Chamber of Commerce in Russia 2003). In addition, programmers with adequate English-language capabilities are in short supply, bandwidth costs are higher than in most of the other contracting nations, and the general legal environment in Russia is also quite uncertain.

The Structure of the Russian Software Industry

The independent Russian software industry consists of small firms. As of March 2005, the largest firm, Luxoft, had over 1,000 employees (Luxoft 2005). There are a few other firms in the 500 to 1,000 employee range. Despite this size limitation, Russian firms have won business from important multinational customers, including Boeing, IBM, Dell, and Citibank (Luxoft 2005; Hawk and McHenry 2005). A number of multinational corporations, including Intel, Sun Microsystems, Motorola, Boeing, and Nortel, have opened R&D centers in Russia to take advantage of the skills of Russian scientists and engineers. Intel is one of the firms with the most ambitious plans for its Russian operations. In 2004, it purchased two Russian technology companies, Elbrus and UniPro, increasing its total employment in Russia from 900 to 1,550 engineers and staff (Intel 2005). Sun Microsystems employs over 300 Russian technologists in Moscow, St. Petersburg, and Novosibirsk (Nicholson 2004).

Conclusion on Russia

In terms of cost, quality, and volume, Russia is an attractive destination for offshored work. There are a considerable number of capable, low-cost personnel available in Russia; however, the stability of the business environment and the capabilities of management preclude the type of massive growth seen in India or even China. The independent Russian software firms are currently too small to tackle the largest and most sophisticated projects. Russia's strengths appear to be a number of technically sophisticated engineers capable of doing cutting-edge research. Predicting Russia's offshoring future is difficult because of

[12] In 2001, the American Chamber of Commerce in Russia (ACCR 2001) estimated that there were 5,000 to 8,000 professional programmers in Russia doing $60 to $80 million per year.

uncertainty regarding the continuing development of the system of higher education and more general political and economic uncertainty.

3.9 Conclusions

Despite the changing geography of software and software services production, the most important global relationship in software continues to be US firms providing software and software services to the world. What is new is the perception by managers that capable technical talent is available in developing countries, particularly India. For managers under intense pressure to reduce costs, offshoring is now considered a normal response, and there is a growing infrastructure of lawyers, executive search organizations, and accountants in place to facilitateit.

This chapter has reviewed the countries exporting work (e.g., United States, Western Europe, and Japan) and their relationship with the countries that perform the work (e.g., India, China, Eastern Europe/Russia). A few conclusions can be drawn from this survey.

In the absence of major political or economic changes, the movement of software jobs from developed nations to lower-wage environments will continue, perhaps at an increasing pace, due to global markets, lower costs, and increased access to skilled labor.

Much of offshored IT work today is in lower skill areas, but this is changing. The change in the nature of the work will require changes in the skills of the offshoring managers as well as the employees who perform the offshored work. For the developed nations, it will be critical to find ways to utilize this new resource of lower-cost IT workers to develop high value products and services. This will require improvement in and the evolution of the educational systems in both the developed and developing nations.

India has become the primary recipient of software and software services offshoring, and this situation will continue for the foreseeable future. However, India is only the largest beneficiary of the globalization of IT work. Any developing nation with properly trained personnel, good telecommunications linkages, and the right cost structure can participate.

As a useful simplification, it can be said that India is the global center serving all geographies, but that there are also regional divisions of labor emerging with Eastern Europe and Russia tending to serve Western Europe, and China tending to serve the Asia Pacific area, particularly Japan.

An emerging form of offshoring is the formation by multinational companies of in-house laboratories located in lower-cost countries. This is one of the ways that the developing countries can participate in more advanced research and development since traditional offshoring does not lend itself as easily to advanced work.

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