

Software

SUMMARY

Software services and product development has been one of India's most successful industries in the last 5 years. Accounting for 0.6 per cent of India's GDP and 0.1 per cent of employment, the sector has grown rapidly from a handful of companies in the late 1980s to over a thousand large companies and hundreds of thousands of employees today. While the US\$ 2.2 billion output (excluding "onsite" services) of this sector is equally provided by its exports and domestic markets, two-thirds of its 210,000 employees work in the domestic market and only a third in the export market. This sector is the most productive, relative to the US, of all the sectors we have studied and is an excellent case example of how companies can almost optimise their productivity potential in the absence of product market barriers and government ownership.

We believe that the sector can increase its productivity performance still further and ensure its continued growth if a few reforms are carried out. Specifically, the government should:

- ¶ **Increase the output of high quality software students:** The government should increase capacity in high quality universities and ensure that there is no bottleneck to the continued growth of the industry.
- ¶ **Attract high quality teaching talent:** The government should improve the compensation structure and put in place mechanisms to attract and retain high quality software teaching talent.
- ¶ **Upgrade urban infrastructure in software hubs:** The government should invest in upgrading the infrastructure in software hubs and make them world-class cities. This will reduce the attrition to other countries and ensure sustained growth in the industry.

If these reforms are carried out and if the economy grows at 10 per cent a year, which we expect if our recommended reform programme is undertaken, the software sector will continue on its aggressive growth path and become a US\$ 46 billion industry by 2010.

Productivity performance

The software industry has the highest productivity levels of all the sectors studied. Its overall productivity is estimated to be 44 per cent of US levels. While the productivity in software services is 50 per cent, the overall productivity is brought down by the poor performance of software product companies, which are at 12 per cent of US levels.

The productivity levels of best practice companies in services are as much as 100 per cent of the US average. In fact their onsite operations in the US and other countries can reach productivity levels of almost 150 per cent, which is comparable to the productivity levels of large services companies in the US such as Accenture or EDS.

Operational reasons for low productivity

At the operational level, we look separately at the reasons for the productivity gap between average and best practice companies in India for each segment – services and products.

For services companies, the main reasons for this gap are: (a) poor organisation of functions and tasks (OFT) within software development centres; (b) lower value-added product mix on average; and (c) lack of a good brand name. Given India's significant advantage as a source of low-cost software professionals, it is likely to continue to dominate the lower-value end of the global software services market. Therefore, even though several companies will reach productivity levels comparable to or even exceeding the US average, there will always be many more at the lower end, thus keeping India's productivity largely at current levels, increasing marginally to reflect the improved OFT and branding.

For products companies, the main reason for low productivity is the lack of scale. Software product companies enjoy increasing returns to scale and hence Indian companies have to improve their scale of operations in order to improve their productivity. This is very consistent with our findings from Russia and France where products companies suffer from the same scale disadvantages.

Industry dynamics

On analysing the dynamics of the industry, it becomes clear that the main reason for the low productivity of Indian companies as compared to the US is the absence of entry barriers to the industry. As a result, despite increasing competition in the market and the adoption of global best practices in quality and process

standardisation by best practice companies, there will be new companies with low cost labour entering the low-value end of the market. While this will keep the productivity level low, it will also sustain the aggressive growth of the export industry, which thrives on the high labour cost differential between India and the developed world.

External factors responsible for low productivity

Although the biggest external barrier to growth in productivity for the Indian software services industry is the low wage level, it is also the single most favourable factor for growth in output and will continue to allow Indian services companies to grow at an aggressive growth rate of almost 30 per cent a year for the next 10 years.

In the products segment, the lack of a sophisticated, domestic end-user industry (due to problems associated with the rest of the modern sector industries) makes it very difficult for Indian companies to achieve minimum scale and become globally competitive. The poor enforcement of Intellectual Property Rights legislation is another factor constraining the growth of the products industry. Furthermore, although the supply of software professionals has so far not been a hindrance to the industry's continued growth, it could well become its biggest barrier.

Industry outlook

The export potential of the Indian software industry (excluding onsite services) is estimated to reach around US\$ 25 billion by 2010. India is likely to gain a 50 per cent share of the legacy services market as well as make an aggressive entry into new generation services. The domestic market is expected to grow at nearly 30 per cent a year, reaching US\$ 21 billion by 2010. This phenomenal growth is expected to lead to the creation of over 2 million additional entry-level jobs and an increase in demand for experienced project managers from the current level of 50,000 to over 200,000. The current output of Indian universities and private training institutes might be able to meet the demand for entry-level programmers. However, the migration of experienced professionals to the US and other developed markets could lead to a shortage of project leaders and managers by 2010, thus severely hampering growth.

Policy recommendations

The output of software professionals from the educational system has to be increased dramatically to meet the growing needs of the Indian industry.

Increasing the admission quota in engineering colleges for disciplines like computer science and encouraging the creation of private colleges focusing on computer science would help build a workforce large enough to match demand. The government should also take initiatives to attract and retain high quality talent to teach software courses in the universities. Improving the urban infrastructure in software hubs would also help retain this workforce in India.

Software

The software case is important from the perspective of this study because it profiles the success of an industry that has so far been free of product market barriers and government ownership. Although the industry has grown at over 50 per cent every year for the last 5 years and created thousands of high paying jobs, competition from other countries has been increasing. Keeping this in mind, it is important to study the productivity levels in the industry, the competitive dynamics and the external factors affecting output and productivity growth in order to understand whether the current growth is sustainable or not.

Software productivity in India is the highest across all the sectors studied. It does, however, lag behind its potential. This is primarily due to the low cost of entry-level programmers in India. As a result, even though Indian best practice companies are continuously improving their productivity to match global levels, new companies continue to enter at low levels of productivity. While this does ensure that productivity remains low, it is also the key reason behind the explosive growth of the industry and will continue to sustain such growth over the next 5-10 years.

Although the industry is typically divided into two distinct segments – the domestic market and the export market – for the purposes of this study we have focused on the domestic market. This includes the offshore market – that part of the market outside India, which can be serviced by professionals working out of India and encompasses approximately 40 per cent of the export market in terms of revenues and 70 per cent in terms of employment. The rest of the export market is accounted for by “onsite services”, which are services rendered by software professionals from Indian companies working in other countries. Although Indian companies would probably consider this a significant proportion of revenue, we have excluded it from our calculations because it is part of the software industry of the end-user country. We must note, however, that onsite services could help significantly in financing India’s trade deficit through the transfer of corporate and personal savings.

The rest of this chapter is divided into seven sections:

- ¶ Industry overview
- ¶ Productivity performance

- ¶ Operational reasons for low productivity
- ¶ Industry dynamics
- ¶ External factors responsible for low productivity
- ¶ Industry outlook
- ¶ Policy recommendations.

INDUSTRY OVERVIEW

Software contributes about 0.6 per cent to India's GDP and accounts for 0.1 per cent of India's employment. The industry grew dramatically, at over 50 per cent a year, over a 5-year period, to reach US\$ 2.2 billion by 1999. Furthermore, by 2000, it was estimated to have reached as much as US \$3.1 billion (**Exhibit 5.1**). This included a growth rate of 68 per cent in exports and about 32 per cent in the domestic market.

The software industry in India (both the domestic and offshore markets) is segmented into products and services (which account for 82 per cent of employment). The services segment dominates the market and has done so since 1996 when the demand for Y2K services first exploded. The number of services companies grew rapidly from just a handful in 1995 to over 1,000 in 1999. Today, services account for over 75 per cent of output (**Exhibit 5.2**). As a result of this uneven and rapid growth in the services segment, there has been a complete lack of focus on the products and packaged software segments. The lack of a well-developed domestic industry has also played its part in limiting the growth of products companies.

PRODUCTIVITY PERFORMANCE

The labour productivity of Indian software companies is at 44 per cent of US levels (**Exhibit 5.3**). This is driven by the services companies, which even in 1998 were at productivity levels of US\$ 58,000 per year per person, 50 per cent of US levels in the services segment. While this is the highest productivity level seen across all the sectors studied, individual services companies have the potential to reach much higher levels: 100 per cent of US levels. In fact, best practice companies in India already match the US average.

Products companies on the other hand are at much lower levels of productivity, at only 12 per cent of the US average of US\$ 305,000 per year per person. We must note, however, that the US average for products is much higher than the US average for services companies, which is only US\$ 115,000 per year per person. This is because products companies like Microsoft have increasing returns to scale and very high levels of productivity. Notwithstanding this, Indian companies are still performing far below their potential, which we have estimated to be 50 per cent of the US average.

OPERATIONAL REASONS FOR LOW PRODUCTIVITY

This section explains the main reasons for the differences in productivity at the operational level. Since the issues that surround software services and products at the operational level are entirely different, we will need to look at each of them separately.

Low productivity in software services

The productivity of the average Indian services company is only half that of best practice companies (which are at US levels). This difference in productivity is caused by a number of operational factors acting simultaneously (**Exhibit 5.4**). The most important of these are: (a) differences in the organisation of functions and tasks (e.g., the average capacity utilisation of billable employees); (b) the ratio of senior resources to entry-level programmers and the standardisation of processes; (c) the product mix of the average Indian company which is biased towards low value-added work; and (d) the lack of a global brand name for average Indian companies. We discuss each of these operational factors in detail (listed in order of ease of implementation for individual companies):

- ¶ **Organisation of functions and tasks (OFT):** While Indian companies have focused on growth, average capacity utilisation in Indian companies has been at around 65 per cent compared to 80 per cent in best practice companies. Another element of OFT that has resulted in penalising Indian companies is the higher attrition rates of employees, which are driven by the low wage levels in India combined with the intense demand for software professionals (**Exhibit 5.5**). Although the problem is widespread, it is only best practice Indian companies that have succeeded in addressing it by designing attractive employee retention programmes including stock options and performance-linked bonuses.

¶ **Product mix differences:** Indian companies pay a heavy productivity penalty for the high component of low value-added services in their product mix. The penalty arises because almost a third of their revenues are generated from the domestic services market, which is intrinsically lower value added. In addition, Indian companies are unable to move up the value ladder in the export market for a variety of reasons.

- **Lack of investment in IT:** The Indian end-user industry has traditionally not invested in IT. As a result, the domestic services market is characterised by old and commoditised technologies, leading to low charge rates. For example, one software CEO complained about the fact that most Indian banks are still web-enabling their current businesses and are very far from operational Internet banking. Other CEOs cite examples of large government-owned companies that are only now implementing ERP systems, which at present are commoditised and command very low charge rates.
- **Lower value-added segments:** Moreover, Indian companies also compete in inherently lower value-added segments of the global services market. This happens for two reasons. First, it is easier for clients to outsource parts of the value chain that are related to the maintenance of large mainframe systems and other legacy systems, where technology is stable and projects have long timeframes. The portfolios of Indian companies are, therefore, dominated by such projects. Second, Indian companies typically face a shortage of senior resources like project managers and domain experts. They are thus less equipped to do higher value added activities like developing IT strategy or creating high-level design parameters for projects. Currently, the average Indian company has one project leader per 15 entry-level programmers, compared to one per eight in best practice companies.

We should note, however, that the pressure of rising wages for good software talent puts continuous pressure on software companies to constantly climb the value ladder and improve on average charge rates. As a result, we expect that although companies will keep moving up the value ladder, there will at the same time be a constant stream of new companies coming in at the lower end, employing lower cost resources and providing lower value-added services. The net result of this will be that average productivity will continue to be low, driven by a lower value-added product mix. Paradoxically, however, this helps the current healthy output growth of the Indian

software industry and will continue to do so until wage rates in India cease to be the lowest in the world.

¶ **Branding premium:** Companies have traditionally outsourced their IT requirements to services companies in their own countries. While cross-border outsourcing is now becoming more popular, Indian companies on average still suffer from a lack of brand recognition. Two important reasons for this are:

- **Weak front-end sales teams:** Indian companies have weak front-end sales teams, which lack skills in consultative selling and have low domain knowledge. These teams are also typically not culturally sensitive and as a result come across poorly to clients in Europe and North America which are the major markets
- **Risk perception:** Many companies in the West have still not changed their perception that outsourcing to a country like India, which is halfway across the world, is risky. To overcome this perceived risk, average Indian companies have to continue to offer a discount on the rates that an average company in the same geography would offer. Only leading Indian companies have managed to deal with this by having front-end organisations in each geography.

Consequently, very few Indian companies have managed to shed the image of themselves as low-cost body shops and branded themselves in the eyes of customers as companies that can understand business problems and provide technology solutions.

Low productivity in software products

Productivity in Indian products companies is 12 per cent of the equivalent US levels. Productivity growth in products is almost entirely driven by increasing returns to scale. Therefore, most of the gap is accounted for by the small size of Indian products companies vis-à-vis large US products companies like Microsoft and Oracle (**Exhibit 5.6**). Best practice Indian companies, which focus primarily on the exports market, are at 20 per cent of US levels. The key difference between such companies and the US average is scale. We explain this in more detail.

¶ **Low scale in the domestic market:** On average, domestic products companies are extremely small and sub-scale, which accounts for their low productivity. The difference in productivity between a company focused on products for the domestic market and one focused on the exports market is as high as 10 percentage points of the US average. This

can be linked directly, as will be discussed later, to the inadequate piracy laws in India.

- ¶ **Low scale in export-focused companies:** Productivity of best practice Indian products companies is only 20 per cent of the US average. This is despite the fact that they are completely export focused. The key reason for this is that Indian companies are sub-scale even when compared to small companies in the US and other developed markets. As a result, they lack the market intelligence of companies in the West, leading to long product lifecycles and obsolete products. This further preys upon their market intelligence, and a vicious cycle is set in motion. There is also a direct penalty because Indian companies have smaller distribution networks. For example, an ERP products company based in India has a network of about 20 branches around the world, while a comparable small-sized company in the US has a network twice as large. This situation is expected to improve over the next few years as Indian companies grow in size and build strong marketing teams in developed markets. Early moves are already visible as Indian companies attempt to acquire companies with strong sales and marketing teams in the US and other markets.

Smaller companies in the West have productivity levels that are 50 per cent of the US average (**Exhibit 5.7**). The systems software and mass markets are dominated by a few big names such as Microsoft, Oracle and SAP, which result in raising the overall industry average. As a consequence, it is extremely difficult, even for products companies based in developed markets, to reach the US average because the big players have virtually locked them out of these attractive market segments. In fact it would take significant investment by a products company to get even a foothold in the operating systems market or the desktop packaged goods mass market. It is unlikely that Indian companies will be able to afford such an investment over the next 10 years. Therefore, they are likely to be limited in potential to about 50 per cent of the US average productivity. .

INDUSTRY DYNAMICS

Driven by the ever-higher wages being offered for the best programmers, best practice Indian companies continue to improve their productivity levels and charge higher rates. However, due to the low cost of labour at the entry level, companies continue to enter the low end of the value ladder. As a result, despite increasing competition at the high end and sufficient exposure to best practice, average

Indian productivity remains almost constant at its current low level (**Exhibit 5.8**).

- ¶ **Low but growing competitive intensity:** As discussed earlier, Indian companies set prices that are at a discount when compared to international prices to attract developed-market clients looking to outsource their IT requirements. Although these clients do not yet feel the pressure to cut costs and improve productivity because of low wages in India, this is changing gradually as emoluments for high-quality software programmers rise. Best practice companies that employ large numbers of software engineers are under pressure to keep increasing their productivity levels. This is necessary for them to maintain their current margins, especially as wages are increasing by more than 20 to 25 per cent every year (**Exhibit 5.9**). Adding to this pressure is the scarcity of good quality experienced talent to lead project teams and carry out top-level design work.
- ¶ **Adequate exposure to best practice:** Most large Indian services companies have achieved very high levels of process standardisation, often better than the US average. Over three-fourths of the companies worldwide to have achieved CMM Level 5 certification (the highest level of the most widely accepted certification issued by Carnegie Mellon University, achieved so far) are Indian. Large global players like Microsoft, Oracle and Cisco are also setting up large software development centres in India. Lack of exposure to global best practice is therefore clearly not responsible for the lower productivity levels of Indian services companies.
- ¶ **Low barriers to entry:** Given the abundance of low cost programming talent in India, we expect small Indian companies to continue to enter at the lowest end of services. Entering as a low cost competitor is the easiest option for such companies, which do not have strong capabilities in any industry or technology domain. As a result, while there will be best practice companies that reach and exceed US productivity levels, the average for India will continue to remain at the current low level.

EXTERNAL FACTORS RESPONSIBLE FOR LOW PRODUCTIVITY

In this section we discuss how external factors combine to keep productivity in India low, when compared to that of the US. Low wages is the single largest external factor contributing to India's continued low productivity and,

simultaneously and paradoxically, high output growth. Another very important external factor is the lack of a sophisticated end-user industry, which results in the small scale of Indian products companies as well as the low value-added product mix of services companies. These factors, together with the high piracy rate in India, are responsible for the low productivity of Indian companies (**Exhibit 5.10**).

¶ **Macro-economic conditions – low wages:** India has a large supply of English-speaking software professionals, available at very low wage rates compared to the worldwide average. As a result, India is well positioned to provide outsourced software services to the world market. Given its low-cost position, it is also favourably positioned vis-à-vis countries like Ireland and Mexico that are also competing for the outsourced services market. Therefore, the Indian product mix will continue to consist mainly of maintenance work on mainframe systems and other legacy systems, which is typically outsourced. Given that these are low value-added areas, average productivity levels will continue to be low.

¶ **Related industry barriers – lack of a sophisticated end-user industry:** The Indian end-user industry is not very sophisticated in its use of IT. In fact, overall IT expenditure contributes not more than 0.5 per cent of GDP compared to over 4 per cent in the US (**Exhibit 5.11**). Since most of the modern sector is government owned, the adoption of IT in business and manufacturing processes has been slow, and many companies in India are still catching up with their counterparts in the developed world in terms of IT-enabling their business processes. As a result, the software services requirements of most of these companies is still largely in basic data processing and ERP implementation, which command lower charge rates as they have become commoditised services. This, in turn, leads to a lower value-added product mix for those Indian companies that serve the domestic market.

A well-developed end-user industry is also critical to the development of the products industry. It has been observed worldwide that countries that have very advanced end-user industries have also developed the best software products in that area. For example, the UK is reputed to have the best financial software products while France is noteworthy for its airline software. The fact that India does not have a sophisticated end-user industry in any area is therefore a natural disadvantage for products companies, since they remain sub-scale as a consequence.

¶ **Product market barriers – lack of enforcement of IPR:** Piracy rates in India are 60 per cent, which is substantially higher than the US rates of

25 per cent. This is primarily due to the weak enforcement of Intellectual Property Rights (IPR) laws. Piracy translates into lost revenues for products companies. If piracy rates were brought down to US levels, products companies could be 87.5 per cent more productive (**Exhibit 5.12**). While the direct impact of this would be a virtual doubling of current productivity in products, the indirect impact would be even greater – higher returns on investments in research and development, increase in scale and dramatically improved productivity.

While the factors listed earlier affect current productivity levels, we expect the shortage of experienced software professionals to be the biggest external barrier to the continued strong growth of the industry.

At current growth rates, India will require around 2 million entry-level programmers and 200,000 high quality senior resources by 2010. We expect the Indian industry to grow at nearly 30 per cent a year to reach US\$ 46 billion by 2010. This will be accompanied by a marginal increase in productivity of around 7 per cent, for the reasons discussed earlier. Consequently, employment will grow at 23 per cent a year leading to a requirement of over 2 million entry-level programmers by 2010 (**Exhibit 5.13**).

However, at the current levels of output of computer science and engineering graduates, we estimate a shortfall of almost 35 per cent in meeting the demand for senior resources. Of the 95,000 new, high quality professionals that graduate annually from Indian colleges, only 35,000 are likely to be available to software companies each year (**Exhibit 5.14**). The addition of these 35,000 new graduates each year to the current stock of around 100,000 programmers will be insufficient to meet the demand for 200,000 project leaders in 2010 as a large percentage are likely to emigrate to other countries. Even the government's current plans for education will yield only modest increases and are unlikely to meet the expected demand. The situation is further aggravated by the fact that companies from developed markets (particularly the US) have started luring away large sections of this pool for their home markets (**Exhibit 5.15**). The rapid rise in wages of senior resources is an indication of their increasing scarcity. For instance, while average software wages grew by 25 per cent in 2000, the wages of senior resources increased by more than 60 per cent.

INDUSTRY OUTLOOK

The Indian software industry has enormous potential to grow from its current size of US\$ 2.2 billion (excluding onsite services) to nearly US\$ 46 billion by 2010.

India's competitive advantage over other countries positions it very well vis a vis the export services market which is expected to grow to over US\$ 25 billion by 2010. The low levels of IT proliferation in the domestic end-user industry also promise an attractive growth rate of nearly 30 per cent for the next 10 years. As a result, the domestic software industry could reach US\$ 21 billion by 2010.

Growth in the export market (excluding onsite work)

The worldwide IT services market is growing at the rate of 8 per cent in real terms and is expected to reach about US\$ 721 billion by 2003 and US\$ 910 billion by 2010. Of this, about 54 per cent will consist of hardware maintenance, IT management and other services that cannot be outsourced. The remaining 46 per cent will form the market relevant for Indian companies and comprise legacy services (7 per cent) and new generation services (39 per cent) (**Exhibit 5.16**).

- ¶ **Legacy services:** These services include the maintenance of mainframe and client server systems and migration from legacy systems to new generation systems. Only 50 per cent of this US\$ 70 billion market can be outsourced and therefore the market available to Indian companies is around US\$ 35 billion. Of this, only US\$ 25 billion will be available for offshore outsourcing. This space is largely commoditised and demands large teams of programmers who can code in older programming languages like COBOL. This has led to very low charge rates for these services. India therefore has a comparative advantage vis-à-vis other countries in these services because of its large supply of low cost software professionals.

India's share in this market will depend primarily on the availability of software professionals, and could be as high as 50 per cent. Going by purely economic considerations, India could capture as much as 90 per cent. However, Fortune 500 companies, which account for most of the global IT outsourcing market, are unlikely to outsource all their IT requirements to India because of what they perceive as the risk attached to outsourcing to India. As a result, we do not expect India to gain more than a 50 per cent share of this market.

- ¶ **New generation services:** These include Internet application integration services, ERP/EAS services, maintenance of packaged applications and implementation of components/packages. Of this US\$ 355 billion market, we expect only about 50 per cent to be outsourced. Hence the available market for Indian companies will be around US\$ 180 billion. Indian companies have only recently started competing in this market

and have already captured about a 1 per cent share. McKinsey estimates that India is well positioned to capture a 15 per cent share of this market by 2010. Indian companies would have to grow their new generation businesses at 30 per cent, on average, to do this. The target is ambitious, but Indian companies have achieved similar targets in the past when they first entered the legacy services business arena.

Therefore, assuming that the availability of software professionals does not become a constraint, Indian companies can expect a total export potential of US\$ 25 billion from both legacy and new generation services by 2010.

Growth in the domestic market

The domestic market in India has been growing at over 30 per cent per year in real terms over the last 5 years. While increasing usage of IT in the Indian end-user industry has driven this, the IT-spend of the Indian corporate and government sectors is still far below the world average. For instance, although financial services are the largest user of IT services worldwide, Indian banks spend as little as 1.1 per cent of their revenue on IT while the US banks spend 6 times as much. Similarly, the government, often a driver of software services growth in many other markets, has not invested enough in computerising its departments and making them more efficient. Assuming that complete reform will take place in all sectors of the economy and that GDP will grow at 10 per cent per year¹, we expect IT spending in all sectors to increase to 2 per cent of GDP. This will bring it on par with more developed countries. The domestic software industry can thus be expected to grow to over US\$ 20 billion by 2010.

Growth in future scenarios

Given the large quantum of demand from the international and domestic markets, the real constraint to output growth going forward, as was evident in the section on external barriers, will be the shortage of high quality software professionals. We describe two likely scenarios and draw the implications of not investing in increasing the output of software professionals for India:

- ¶ **Status quo:** For this scenario, we have assumed that there will be no change in the current rate of supply of software professionals. Productivity is expected to continue to grow at 7 per cent per year (as it has in the last 5 years) so that charge rates approximately double over 10

¹ Please refer to Volume I, Chapter 5: India's Growth Potential, for a discussion on complete reforms.

years. Under the output assumptions, India would need over 2 million entry-level software programmers by 2010 and around 200,000 experienced programmers/ project leaders. However, as discussed earlier, under the status quo scenario, the number of experienced professionals available by 2010 would only be 125,000. This implies that growth would be curtailed and the Indian software output would be limited to US\$ 28.5 billion by 2010.

- ¶ **Reforms in all sectors:** In this scenario, the educational system would be reformed to ensure that the growth of the software sector was not hampered by the lack of quality professionals. Productivity would grow as in the previous scenario at 7 per cent per year and output would reach US\$ 46 billion. The industry would be able to employ over 2 million entry-level programmers and over 200,000 experienced managers.

POLICY RECOMMENDATIONS

The growth of the software industry in the past has been aided by good policy. However, the biggest bottleneck to its future growth is the availability of good software talent. To deal with this, the government and industry should focus on increasing the capacity for software programmers in colleges, attract the best talent to train them and improve the infrastructure in software hubs to retain this trained pool of programmers. We make three key recommendations:

- ¶ **Increase capacity:** Ensure that there are a sufficient number of students graduating out of colleges to provide a base of at least 200,000 high quality software professionals by 2010. These professionals should be able to lead and manage teams of entry-level programmers and carry out high-level design and strategy work. At current levels, the educational system yields only 35,000 such professionals every year. This needs to be increased to at least 50,000 to 60,000 a year by undertaking several targeted measures. The output of premier engineering colleges (the IITs, the Regional Engineering Colleges and the State Engineering Colleges) and good quality private colleges needs to be increased significantly. Private colleges should be encouraged to introduce courses targeted at building software skills and banks should be encouraged to provide educational loans for such courses. Private training institutes like NIIT and Aptech have already begun to do this. They would however need to increase the quality and scale of their operations if they are to serve as substitutes to full-time graduate courses.

- ¶ **Attract talent:** Colleges should also ensure that their faculty consists of top calibre software talent. To be able to attract the right talent, the compensation policy for teachers must be revised to make it attractive enough for quality software professionals to switch from line jobs to teaching jobs.
- ¶ **Upgrade software hubs:** Finally, infrastructure (power, telecom, roads and airports) needs to be upgraded to world standards in the top software hubs and metropolitan centres. The government will need to ensure that India has a critical mass of software hubs, which offer world-class living standards in order to ensure that the attraction of the developed world is somewhat dulled. Some best practice companies have already built world-class campuses in cities like Bangalore and have succeeded in retaining high quality talent.

Appendix 5A: Measuring productivity

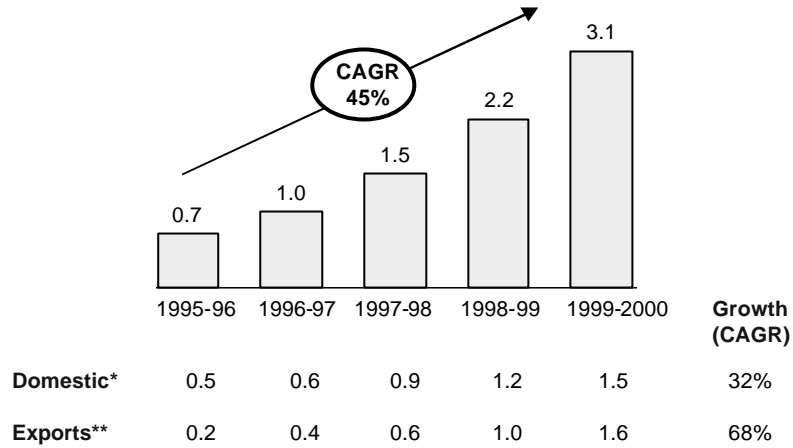
When measuring and comparing software productivity across countries, it is simplest and most effective to compare the productivity in terms of the value added. Physical measures (such as kilo lines of code per day) have limitations because of the prevalence of multiple programming languages and technologies. We therefore measured productivity in US\$ per person per hour and adjusted for differences in PPP. This adjustment was required because of the huge differences in wages between the US and India for the same quality of work. For example, a C++ programmer in the US earns around US\$ 75 per hour while an equally qualified programmer in India makes only US\$ 5.5 per hour for the same job. While this vast gap is closing as wages in India increase, it will be several years before they reach US levels. We, therefore, derived a specific PPP for the software sector based on wage rates in the US and in India (**Exhibit 5.17**).

We also had to separately account for the fact that Indian companies have grown at a significantly higher rate than the US average. For instance, US companies have grown at around 8 per cent, while Indian companies have grown at over 45 per cent in employment terms. This leads to a natural productivity penalty because Indian companies have a greater percentage of new employees (who cannot be billed for the first 3-6 months) on their rolls.

Exhibit 5.1

REVENUES OF THE INDIAN SOFTWARE INDUSTRY

US\$ billion



* Includes only the value-added component of products and packages that are imported and distributed

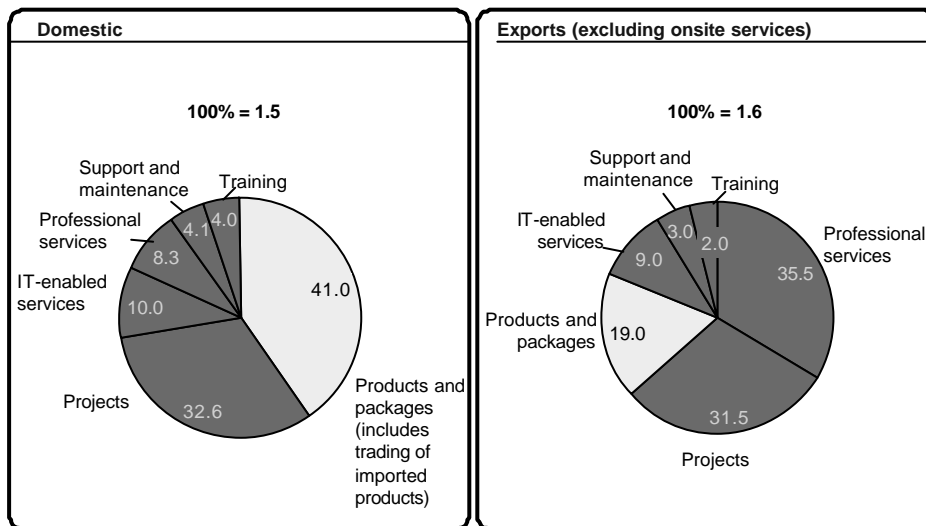
** Excludes the contribution from "onsite" services and focuses on offshore revenues

Source: NASSCOM

Exhibit 5.2

SEGMENTATION OF INDIA'S SOFTWARE MARKET, 2000

US\$ billion, per cent

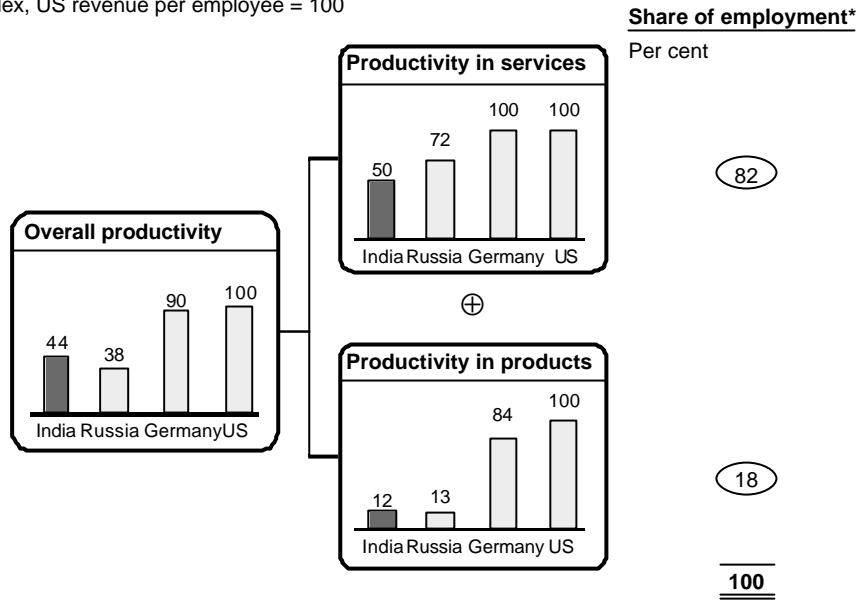


Source: The IT Software and Services Industry in India - Strategic Review 2001, NASSCOM; McKinsey Analysis

Exhibit 5.3

PRODUCTIVITY OF INDIAN SOFTWARE COMPANIES

Index, US revenue per employee = 100



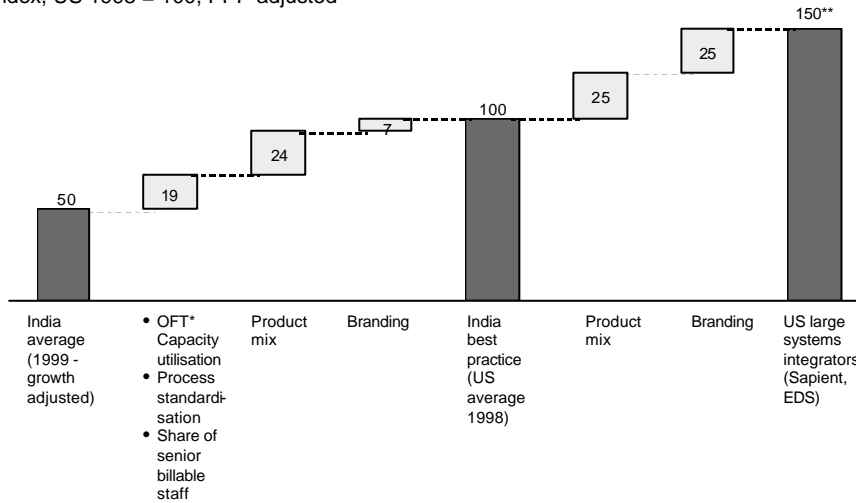
* Excludes employees of Indian companies outside India in onsite services

Source: NASSCOM directory; IDC black book; McKinsey analysis

Exhibit 5.4

OPERATIONAL FACTORS EXPLAINING PRODUCTIVITY DIFFERENCES IN SOFTWARE SERVICES

Index, US 1998 = 100, PPP adjusted



* Organisation of functions and tasks

** Onsite productivity of Indian companies in the US and other countries matches that of large companies like Sapient and EDS driven by very high capacity utilisation

Source: Interviews; NASSCOM; Analyst reports; McKinsey analysis

Exhibit 5.5

PENALTY DUE TO HIGH ATTRITION

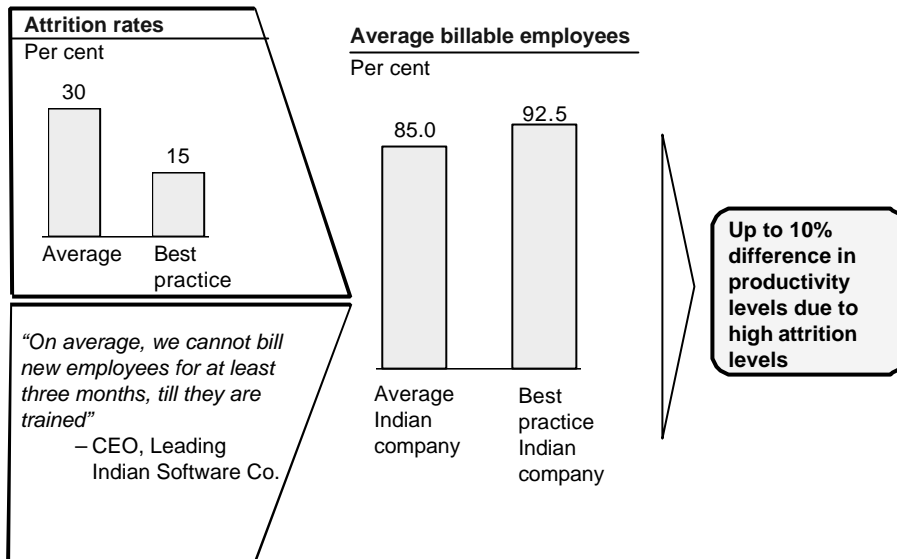
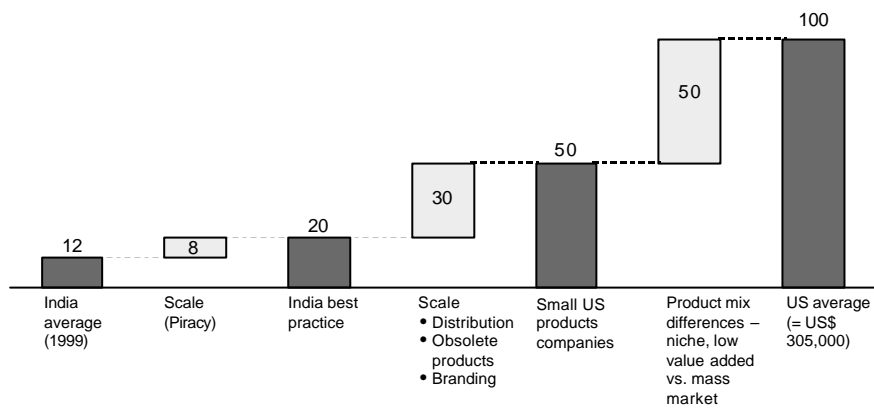


Exhibit 5.6

OPERATIONAL FACTORS EXPLAINING PRODUCTIVITY DIFFERENCES IN SOFTWARE PRODUCTS

Index, US 1998 = 100, PPP adjusted



Source: Interviews; McKinsey analysis

Exhibit 5.7

PRODUCTIVITY OF SMALL US PRODUCTS COMPANIES

Small products company in the US

Product mix

- ERP applications for medium-sized enterprises

Key activities

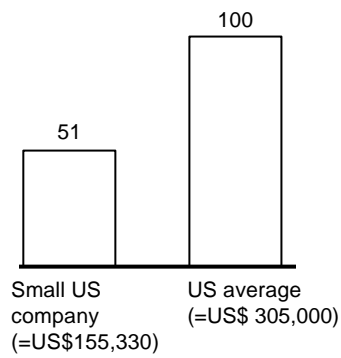
- Design, development and marketing of client server/ERP software

Revenues

- Annual revenues of US\$ 115 million

Productivity (Revenue per employee per year)

Index, US average = 100



Source: Web pages, McKinsey analysis

Exhibit 5.8

INDUSTRY DYNAMICS

- High importance
- Medium importance
- × Low importance

Industry dynamics	Importance of factor	Rationale
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Competition for export market </div>	○	<ul style="list-style-type: none"> High profit margins (25% net margin) and large size of export market have kept players focused on revenue growth in the past. However, rising wage costs are forcing large players to focus on profitability
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Exposure to best practice </div>	×	<ul style="list-style-type: none"> Many MNCs have set up operations in India 7 out of the 12 companies in the world with SEI CMM level 5 certification are Indian

Source: MSDW; Goldman Sachs; Interviews; McKinsey Analysis

Exhibit 5.9

WAGE COSTS IN SOFTWARE SERVICES COMPANIES

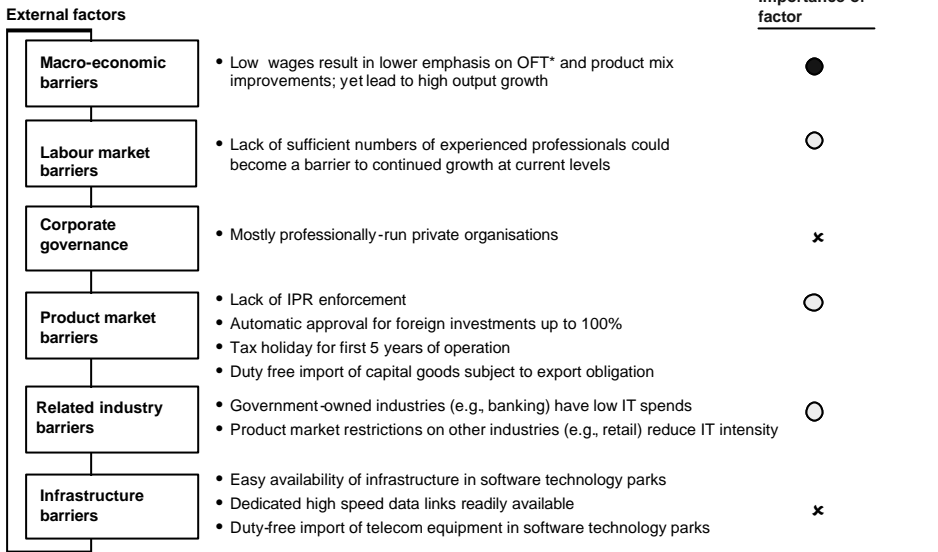
Company	Wage cost, 1996 US\$/year/per person	Growth Per year	Comments
Sonata Software	4,700	63	<i>"Employee costs in IT companies are rising at 20-25% per annum"</i> – HR compensation expert
Rolta Software	2,500	57	
Silverline	1875	24	<i>"Out of 29 firms surveyed, 15 reported a higher rate of growth in salaries than in revenues"</i> – Salary survey of Indian software firms
BFL Software	6000*	13	

* 1998 figures

Source: Annual reports; Interviews with HR consultants; McKinsey analysis

Exhibit 5.10

EXTERNAL FACTORS EXPLAINING LABOUR PRODUCTIVITY DIFFERENCES

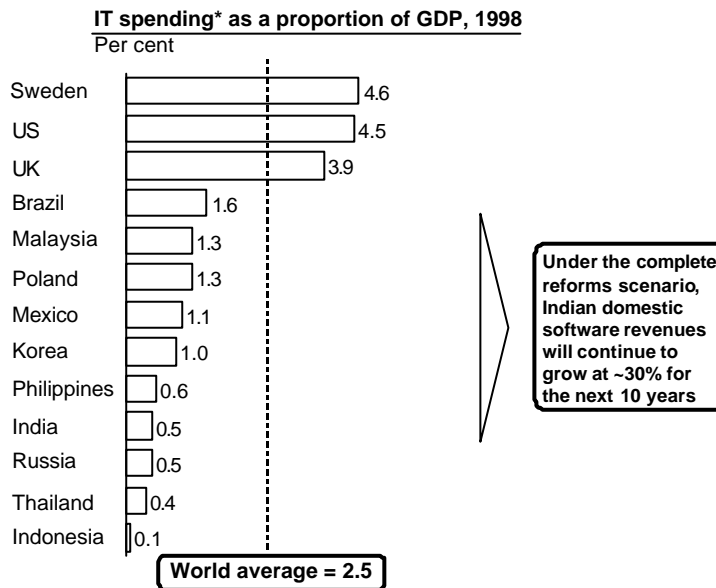


* Organisation of functions and tasks

Source: MSDW; Goldman Sachs; NASSCOM; Interviews; McKinsey analysis

Exhibit 5.11

CROSS-COUNTRY COMPARISON OF IT SPENDING

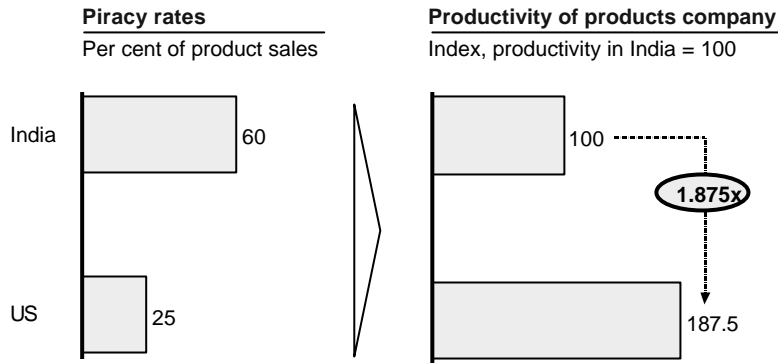


* Software and IT services

Source: IDC; July 2000 World Almanac and Consensus Forecasts; McKinsey Analysis

Exhibit 5.12

IMPACT OF PIRACY ON PRODUCTIVITY OF INDIAN PRODUCTS COMPANIES

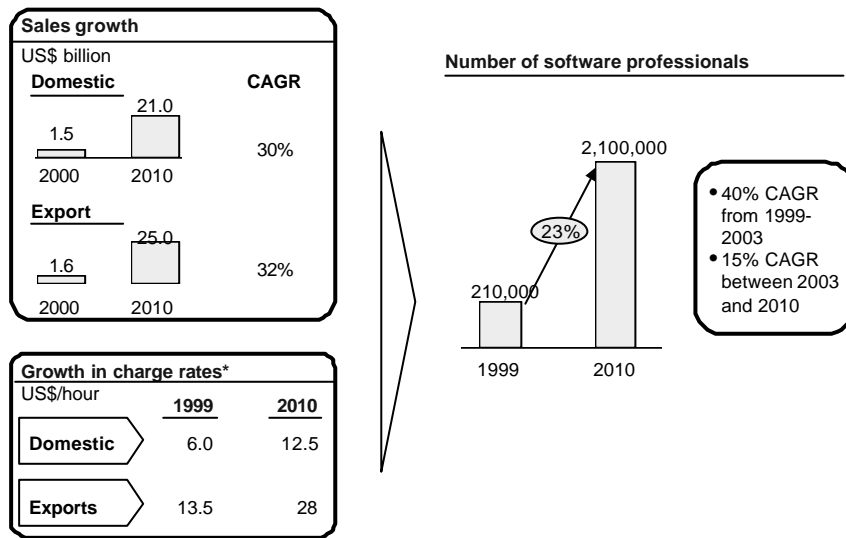


If Indian piracy rates went down to US levels, Indian products companies would gain in productivity by 87.5%

Source: NASSCOM; Press reports; McKinsey analysis

Exhibit 5.13

EXPECTED DEMAND FOR SOFTWARE PROFESSIONALS IN INDIA



- 40% CAGR from 1999-2003
- 15% CAGR between 2003 and 2010

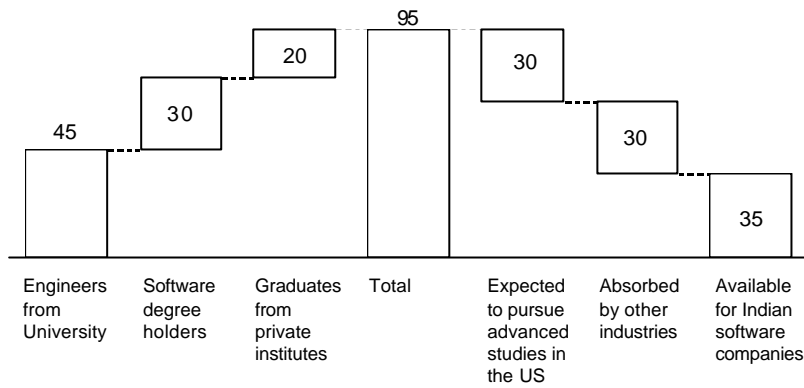
* Surrogate for the growth in productivity

Source: McKinsey analysis

Exhibit 5.14

ANNUAL SUPPLY OF HIGH QUALITY SOFTWARE PROFESSIONALS

Thousands, 2000 base



* Qualified to lead projects and programmes in cutting-edge technologies

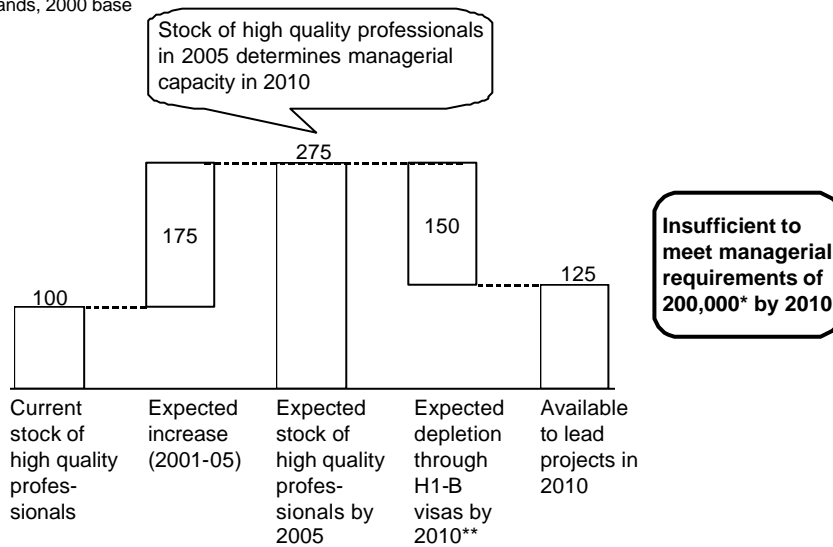
Source: Indiainfoline; Press clippings; Manpower profile of India; Interviews; McKinsey analysis

Exhibit 5.15

MANAGERIAL CONSTRAINT TO GROWTH OF SOFTWARE INDUSTRY PROFESSIONALS

ESTIMATES

Thousands, 2000 base



* Assuming every manager/project leader can manage 10 entry level programmers (current levels)

** May be partly offset countered by the flow of professionals back to India

Source: Indiainfoline; Press clippings; Interviews; McKinsey analysis

PROJECTIONS FOR GLOBAL IT SERVICES OUTPUT

US\$ billion, per cent

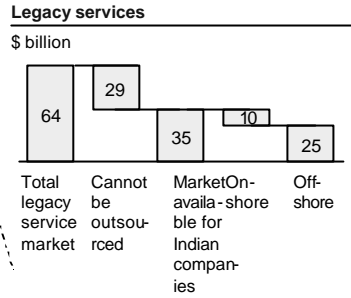
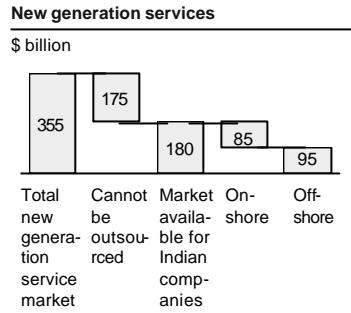
■ Relevant to India

Market composition

Per cent

100%= 327 910

	1997	2010
Others	7	7
IT management services	18	27
Hardware maintenance	27	20
New generation services	26	39
Legacy services	22	7

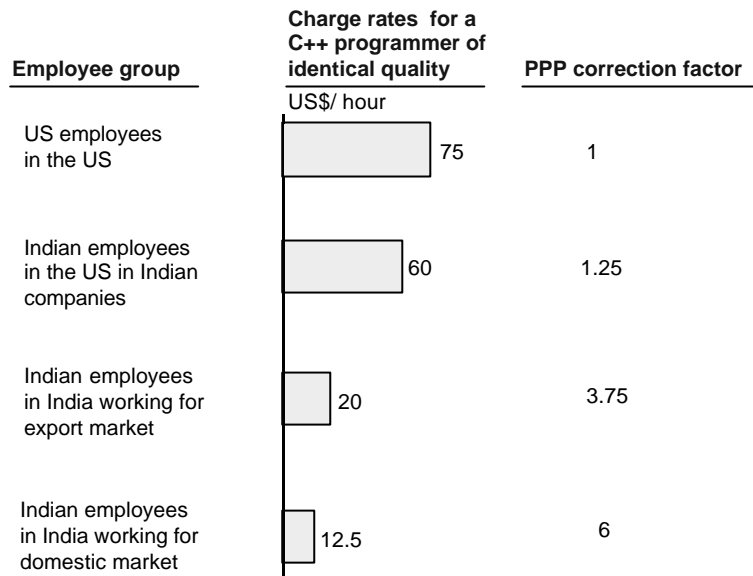


Total market available for offshore Indian companies = US\$ 120 bn

Source: Dataquest; NASSCOM; McKinsey analysis

Exhibit 5.17

PPP ADJUSTMENT FOR SOFTWARE SERVICES IN INDIA



Source: Press reports; Analyst reports; Interviews; McKinsey Analysis