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Working Party on the Information Economy

**THE INFORMATION AND COMMUNICATION TECHNOLOGY SECTOR IN INDIA:
PERFORMANCE, GROWTH AND KEY CHALLENGES**

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FOREWORD

This report was presented to the Working Party on the Information Economy (WPIE) in December 2008, and declassified by the Committee for Information, Computer and Communications Policy in March 2009. The report was updated to take into account comments and developments through 2009 and at the beginning of 2010.

The report was written by Mita Bhattacharya, Monash University, Australia and Graham Vickery, OECD Secretariat, under the overall direction of Graham Vickery. It is part of the WPIE's analytical and policy studies of the enhanced engagement countries, Brazil, China, India, Indonesia and South Africa, and it contributes to the Organisation's economic and policy analysis of these countries.

The report is published on the responsibility of the Secretary-General of the OECD.

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THE INFORMATION AND COMMUNICATION TECHNOLOGY SECTOR IN INDIA: PERFORMANCE, GROWTH AND CHALLENGES

SUMMARY

The Indian economy has grown at 7.5-8% per annum in recent years and is forecast to grow by 8% in 2010.¹ The acceleration of economic growth has reduced poverty both at state and national levels. Impressive transformation and growth of the economy has created opportunities both in exporting software and services and in the domestic market. Growth in Indian information technology (IT) in the world market is primarily dominated by IT software and services, including system integration, IT consulting, application management, custom applications, infrastructure management, software testing and web-development. Competitive factors such as skilled workers, adequate telecommunication networks, and an improving policy and regulatory environment have enabled both domestic and foreign firms to rapidly expand in the internationally competitive IT services sector. In contrast, the IT hardware segment has lagged and has focused very largely on the domestic market, which remains heavily dependent on imports of components and finished IT goods.

The rapid emergence of the information and communication technology (ICT) sector has placed India on the global stage during the last one and a half decades.² An explosion in the free flow of information and ideas has brought knowledge and its myriad applications to the global information society creating new choices and opportunities in the development process. The sector has acted as a catalyst for growth across the Indian economy, including in areas such as real estate, automobiles, travel and tourism, railway and mortgage banking industries. It is contributing to better governance and efficiency, and helping in changing the image of India abroad. In this study, the Indian IT sector is broadly categorised into IT services and software, information technology enabled services-business process outsourcing (ITeS-BPO) and hardware segments. The sector grew by 12% in FY 2008-09 to reach USD 71.7 billion in aggregate revenue (including hardware). Of this, the software and services segment accounted for USD 59.6 billion. In FY 2008-09, the revenue of the information technology sector was equivalent to 5.8% of GDP compared with 1.2% in FY 1997-98,³ and this total compares very favourably with the 8% contribution of the broader ICT sector to business value added in OECD countries (OECD, 2010a). Despite some slowdown, Indian IT firms and the IT sector have weathered the financial market collapse and subsequent recession and have recovered particularly by reorienting into new products and emerging country markets.

In addressing the contribution of this sector to the Indian economy at the NASSCOM India Leadership Summit 2007, the Nobel Laureate Professor Amartya Sen stated that "... [it] is not that the IT industry should do something for the country at large, for that it does anyway. It makes enormous contributions: it generates significant income for many Indians; it has encouraged attention to technical excellence as a general requirement across the board; it has established exacting standards of economic success in the country; it has encouraged many bright students to go technical rather than merely

¹ See OECD (2009), *OECD Economic Outlook, Number 85*, June, OECD (2010b), *OECD Economic Outlook, Number 87*, May; OECD (2010a), *OECD Information Technology Outlook 2010*.

² The terms ICT and IT sector are used interchangeably in this report.

³ NASSCOM as reported by India Brand Equity Foundation (2009), 'Information technology, Sector structure/Market size, 9 November: http://www.ibef.org/artdisplay.aspx?cat_id=114&art_id=24623

contemplative; and it has inspired Indian industrialists to face the world economy as a potentially big participant, not a tiny little bit-player. ... , rather, is that it can do even more, indeed in some ways much more. This is because the reach of information is so wide and all-inclusive, but also because the prosperity and commanding stature of the IT leaders and activists give them voice, power and ability to help the direction of Indian economic and social development”⁴.

There is however no recent detailed OECD analysis on the Indian IT sector as a whole. In previous OECD work, the *OECD Information Technology Outlook 2000* included a chapter on the Indian software segment between 1990 and 1997 (OECD, 2000, Chapter 6), and a section in the *OECD Information Technology Outlook 2006* explored the Indian IT sector as a source of global outsourcing (OECD, 2006, Chapter 3). This report sets out to fill the analytical gap, in particular by analysing longer-term developments through the 2000’s. It provides an overview of the recent performance and growth of the Indian ICT sector and related policies, focussing both on the software and hardware segments, and discusses the short- and longer-term outlook.

This first section contains a general introduction of the IT sector. The second section describes the general economic setting in India, while the third section describes the competitiveness of the Indian IT sector. The fourth section analyses stages of development, identifying various domestic segments and trade development, and the next section describes revenue, employment and spending. The sixth section identifies some factors driving growth, while the next section highlights some important policy changes and different initiatives taken by the government and other bodies, including industry associations. The final section identifies challenges in maintaining growth in the IT sector and includes discussion of the short- and long-term effects on the Indian IT industry of the economic recession and recovery.

⁴ See Amartya Sen “I.T. and India” at http://www.nasscom.in/upload/51245/Amartya_Sen.pdf

GENERAL ECONOMIC SETTING

The Indian economy has undergone significant changes in economic management. Economic liberalisation since 1991 has impacted most aspects of economic policy and the development of industry and finance in domestic markets and in trade and foreign investment. Annual growth in GDP per capita has increased from 1.2% in the three decades after independence to 9% in 2007 and is forecast to grow at approximately 8% in 2010, after some slowdown in the previous two years.⁵ GDP per capita was USD 812 in 2006-07 (see OECD, 2007b). The average share of exports and imports in GDP increased from 6% in 1985 to 24% in 2006. Rapid growth in exports of merchandise and IT-related services has contributed to the increase in the export share of GDP. Employment in general has increased significantly; however with a net increase occurring almost exclusively in the informal sector. Employment in the organised (formal) sector has been shrinking (OECD, 2007b). This is due to the high wage and labour costs inducing larger firms to substitute more capital for labour. Levels of income have been growing faster than middle income countries amongst non-OECD countries. However constraints remain in terms of infrastructure and utilities, particularly transport and electricity (OECD, 2007b).

COMPETITIVENESS OF THE INDIAN ECONOMY

Competitiveness rankings

India and China are major global economies, and other non-OECD countries are rapidly joining them. The changing business landscape is a major challenge for multinational firms, including IT firms, to use these economies as export bases and to access their markets. One dimension of this changing business landscape is captured in international competitiveness rankings, which clearly show that despite their high growth rates these countries still have some way to go before they become competitive bases and markets for global firms. For example, before the global recession, international rankings such as the Global Competitiveness Report, 2007 (World Economic Forum), ranked India as 48th amongst 131 countries. China, Russia and Brazil were 34th, 58th, and 77th respectively.⁶ Similarly the IMD World Competitiveness Yearbook 2007 and 2008 provide rankings by: economic performance, government efficiency, business efficiency and infrastructure. This ranked India 29 out of 55 countries, while China was 17th in 2008 (Table 1).

India ranked 44th out of 122 countries in the networked readiness index of 2006-07, and China's position was 59th based on the Global Information Technology Report (WEF, 2006-07). Other driving factors for India are cost effectiveness, quality assurance, supply of technical graduates, availability of an adequate telecommunication infrastructure and a favourable time zone relative to the United States and Europe. While multinationals such as IBM, Accenture, Electronic Data Systems and Deloitte are rapidly expanding in India using its low-cost, high quality labour force, Indian firms, providing high-end consulting services, are growing in the United States and Europe. These competitiveness reports illustrate India's comparative advantage in various areas and its importance in the world market.

⁵ See OECD (2009), *OECD Economic Outlook, Number 85*, June, and OECD (2010b), *OECD Economic Outlook, Number 87*, May.

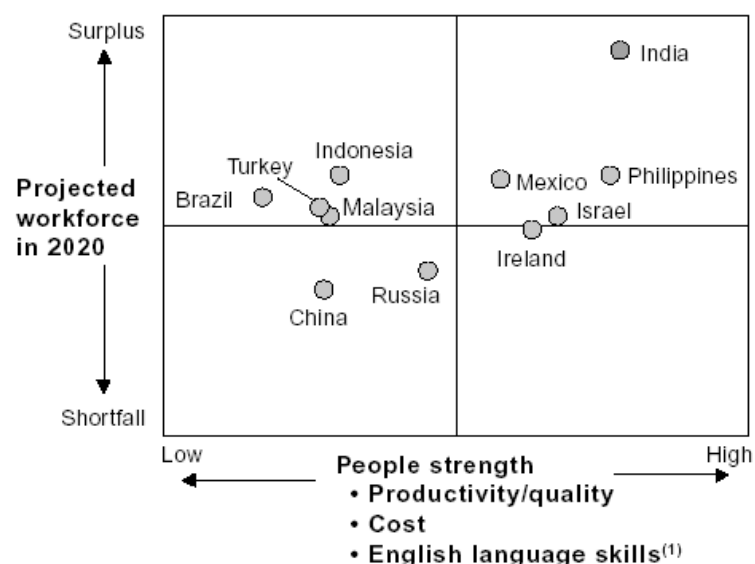
⁶ Source: www.weforum.org/en/

Table 1. IMD World Competitiveness Scoreboard, 2007-08

Score 2008	Country	Rank 2007 (Total 55 countries)	Rank 2008 (Total 55 countries)
100	United States	1	1
99	Singapore	2	2
95	Hong Kong, China	3	3
84	Luxembourg	4	5
84	Denmark	5	6
90	Switzerland	6	4
80	Netherlands	8	10
82	Sweden	9	9
74	China	15	17
61	India	27	29
66	France	28	25
46	Russia	43	47
49	Brazil	49	43

Source: IMD World Competitiveness Year Book, 2007 and 2008.

As to the future, India has a very large pool of high quality manpower compared with other countries. The competitive advantage in skilled, low cost, highly productive workers is reflected in a projection for 2020 (Figure 1). India is ahead in supplying a quality labour force compared with countries such as Mexico, the Philippines, Israel, Ireland and Brazil. In recent years, the emergence of these alternative locations and maintaining the supply of quality human capital to meet increasing demand have been seen to be the key challenges in maintaining Indian IT sector competitiveness.

Figure 1. India's competitive advantage vis-à-vis other nations

(1) Over 50% of shortages expected from English-speaking countries.

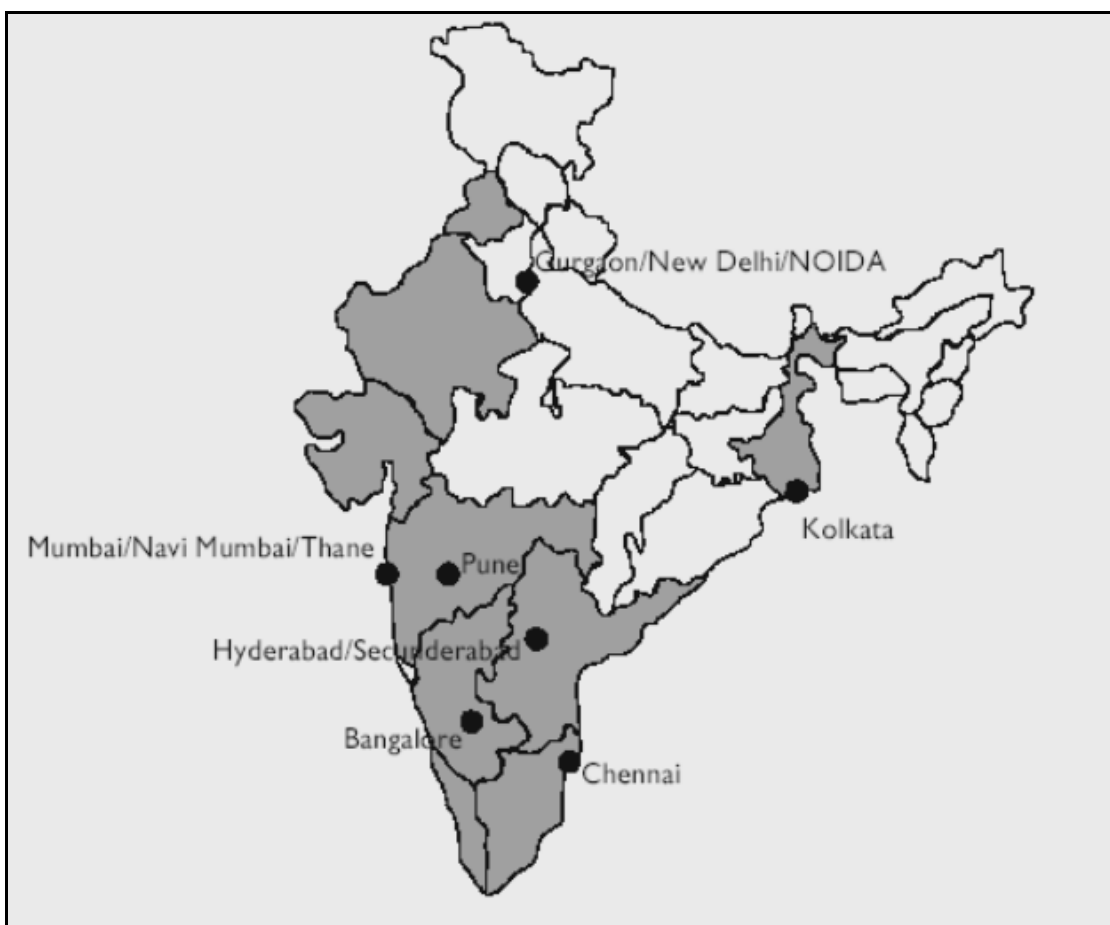
Note: Pakistan, Bangladesh and Vietnam are not shown due to lack of reliable data on productivity and cost of service employees.

Source: World Competitiveness Yearbook 2001; Britannica Yearbook; Literature search: BCG analysis.

GROWTH OF THE IT INDUSTRY

The majority of IT / ITeS activities are concentrated in seven Indian cities/clusters. Bangalore has been saturated owing to the infrastructure limits (transport and utilities, especially electricity, a common problem throughout India) and the scarcity of land. Hyderabad and Chennai are now alternative locations in the south. The geographical spread of IT / ITeS activity is gradually expanding to cover cities such as Ahmedabad, Bhubhaneswar, Chandigarh, Coimbatore, Jaipur, Kochi, Madurai, Mangalore, Mysore and Trivandrum. The major ICT clusters are depicted in Figure 2.

Figure 2. Indian ICT clusters



Source: Indo-Italian Chamber of Commerce and Industry (2006), 'ICT Industry in India', November.

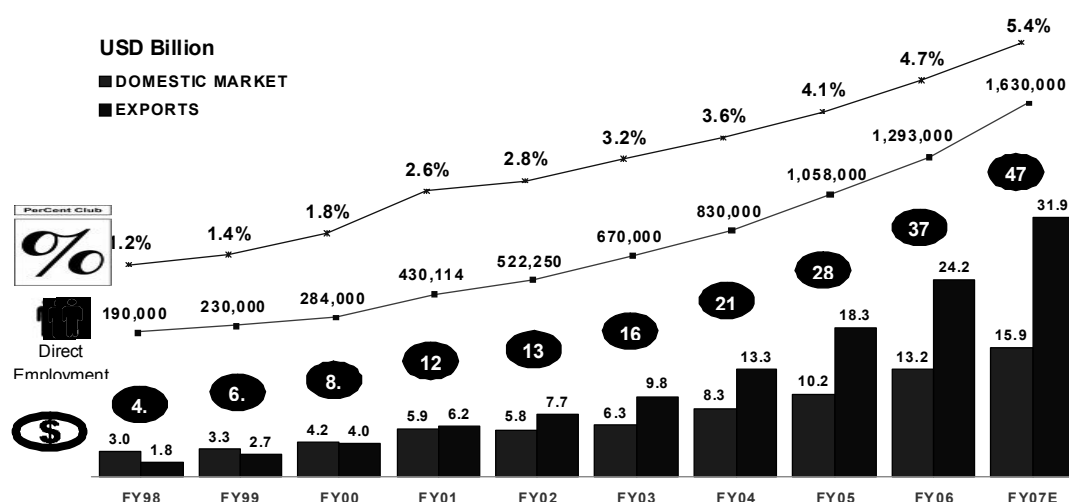
Stages of development

The government of India initiated a series of software export policies from the late 1960s⁷ (Schwere 1987, 1992; Sen 1995; Heeks 1996; *OECD Information Technology Outlook 2000*; Kumar and Joseph 2005; Mathur 2007a, b). Nevertheless, various policies during the 1970s and 1980s protected domestic hardware and restricted competitiveness and growth.⁸ In 1986, the government announced a new policy to develop a strong software sector, followed in 1988 with the World Market Policy and the establishment of the Software Technology Park from India (STPI) scheme. The National Taskforce on Information Technology and Software Development (NTITSD) was established in 1998 to formulate long-term plans and remove impediments to the growth of the IT sector. In 2000, the formation of the Ministry of Information Technology was another step in promoting these initiatives. A Task Force on Human Resource Development was established to develop long-term strategies to increase the number of well-trained IT professionals. More recent initiatives include upgrades to the Education and Research Network (ERNET) connecting various universities and regional engineering colleges (RECs), lowering customs duties on IT products, allowing 100% foreign investment and passing the Information Technology Act, 2000.

The growth path

The Indian IT sector has grown at a remarkable rate over the last decade. The growth is predominantly in IT services, but the hardware has also grown in recent years. Figure 3 presents the performance of the industry in both domestic and export markets in the period 1998-2007. In 2008-09,⁹ total revenue was USD 72 billion; the industry employed 2 million people and contributed 5.8% to GDP. The NASSCOM-Crisil report (2007) calculated that: “Every rupee spent by the IT-ITeS sector (on domestically sourced goods and services) translates into a total output of INR 2 in the economy. Also for every job that is created in this sector, four jobs are created in the rest of the economy.” In this section we first focus on the software, services and Business Process Outsourcing segment, followed by a discussion of the hardware and electronics segments for both domestic and external sectors.

Figure3. Industry performance 1998-2007



Source: NASSCOM (2007c), IT Industry Fact Sheet, August.

⁷ The first electronic computer arrived in India in 1955. Computer policy dates back to August 1963 when the Committee on Electronics was introduced (Heeks, 1996).

⁸ Import tariffs were high (135% on hardware and 100% on software) (Dossani, 2006).

⁹ The Indian financial year runs from 1 April to 31 March.

Domestic demand

The domestic market in IT has started to emerge from the shadows of the export segment. The overall size of domestic demand, comprising hardware, software and services (IT-BPO), grew by 29% in 2005-06, and was USD 15.9 billion in 2006-07. Spending on software and services (IT-BPO) was greater than total spending on hardware for the first time in 2005-06 and is expected to continue increasing its share in 2006-07.¹⁰ Banking, financial, services and insurance (BFSI), manufacturing, railways, telecom, and government are the key vertical markets driving growth in domestic IT spending across categories which include hardware systems, networking, storage, security, enterprise application products and related services.

Software and services

Domestic demand has shifted from hardware towards a solutions-oriented approach, with a growing emphasis on services. In the early years, software firms were mostly software solution providers. Manufacturing of packaged products with high value-added along with sustained improvement in quality, investing in manpower and a competitive R&D environment has helped them gradually move up the value chain both in the domestic and export sectors.

Business process outsourcing (BPO)

The demand for BPO has shown noticeable growth in the domestic sector over the past few years. BFSI, telecom and consumer durables have been early domestic adopters of BPO services and currently account for about three-quarters of this market. An increasing number of Indian brands such as Infovision, HTMT Global Solutions and Bharti Airtel are investing in quality customer care and gradually adopting global best practices in the booming domestic market. Education, retail and healthcare have started contributing to growth in this sector, and increasing competition and growing emphasis on customer satisfaction is also driving public sector organisations towards BPO. For example, Air India outsourced its domestic customer service operations to third-party providers and Indian Railways announced its plans to establish Railway Enquiry Franchisees across the country. The success of these early initiatives by the public sector is of critical importance to the domestic BPO sector.

Hardware and consumer electronics

The Indian hardware segment mostly caters for the domestic market. Hardware accounted for about 49% of total domestic IT-BPO spending in 2006, with revenue growing at approximately 17%, and personal computers, notebooks, and servers leading hardware spending. In the hardware segment, many multinationals are establishing plant in India. In this respect, India has started competing with China as a hub for original equipment manufacturers (OEMs). Various initiatives have been introduced to improve the investment climate and remove bureaucratic delays in hardware exports in the current five-year plan.

- **Computers and peripherals**

The computers and peripherals segment in India in 2005-06 (including printers, uninterrupted power supply (UPS) and networking products) was approximately USD 5 billion. The consumption of computers was 5.13 million units with a growth of 32% between 2004-05 and 2005-06. Desktops accounted for 4.6 million units growing 28%, while notebooks accounted for 0.5 million units growing 144%. In value terms, computers and notebooks were worth about USD 2.5 billion. Notebook sales have continued very rapid growth.¹¹

¹⁰ This section is largely drawn from NASSCOM, Indian IT Industry Factsheet (various issues).

¹¹ www.ibef.org/, source *Economic Times*, 1 February 2007.

Almost 85% of desktops are assembled locally. All leading global brands, including HP, Lenovo and ACER, have assembly units in India. In 2006, Dell started its assembly unit in Tamil Nadu. Multinational brands account for 65% of the PC market and Indian PC brands such as HCL, Zenith, Wipro and PCS account for 35%. Major firms include HCL Infosystems, Aceel Frontline, Acer Indian (Pvt), Apple Computer International (Pvt), CCS Infotech, D-Link India, Team Engineers, Ingram MicroIndia, VXL Instruments and WeP Peripherals.

- **Consumer electronics**

Currently India imports almost 60% of its electronics goods. Consumer electronics (CE) is the largest segment of the electronics sector. The electronic manufacturing services (EMS) industry contributes 33% to electronics production in the country. The premium consumer electronics market is dominated by Sony, Samsung and LG Electronics with a strong presence of imported products. The top five mobile handset firms Nokia, Motorola, Samsung, Sony-Ericsson and LG also manufacture in India.

Colour TV (CTV) This segment is the main driver of the CE Sector in the Indian market. It has registered reasonable growth mainly due to the explosion of cable TV channels. CTV production doubled to 10.5 million in 2006 from 5.2 million in 2002, but the total TV market including B&W has remained stagnant at around 10 million during the tenth plan period 2002-07. The penetration level in rural areas is still low providing immense scope for expansion in the domestic market, but the tax rate is very high on consumer electronic products. Major TV makers LG, Samsung, Akai, BPL, Onida, Videocon, Bigesto (clients include LG, Onida, Akai, BPL and Videocon) each produce 1 million TVs per year.

Audio This segment consists of stand-alone radio sets, combinations of radios with cassette players and CD/DVD players. Total production of stand-alone radios is estimated to be around 6 million of which organised sectors contribute about 2.5 million.¹²

Car Audios This segment consists of cassette players, FM radios, and cassette/CD/DVD players in combination with radios. Estimated demand is around 2 million items. This includes 0.5 million stand-alone FM radios for automobiles, mostly 3 wheelers. Of the remainder, domestic production accounts for about 1 million, with only 20% from the organised sector.

DVD Players This segment of the industry has had exponential growth in the last 2-3 years. The growth has been due to rapid decline in the price of hardware and the easy availability of cheap pirated software. The price of DVD players of any reputable brand dropped by a factor of eight from 2002 to 2006, and the market grew almost 100-fold in this period. LG electronics has a new DVD facility in Pune serving both domestic and export markets.¹³

- **Semiconductors**

India is increasingly important for semiconductor production. The semiconductor market was estimated to be USD 5.5 billion in 2009, up from USD 2.7 billion in 2006. In 2005, the India Semiconductor Association (ISA) was formed to strengthen the semiconductor design and supply system. Designing chips at lower costs is the main attraction for MNCs. India specialises in producing Very Large Scale Integration (VLSI) and System on Chips integration. Nokia, Alcatel, Texas Instruments, NXP Semiconductors and Videocon are among 130 firms engaged in chip design. Sony, Matsushita Electric, Sharp, Fujitsu, Toshiba and Sanyo have all set up software

¹² India has a large grey market with illegal/refurbished/counterfeit products.

¹³ Statistics for consumer electronics are sourced from the document on Eleventh Five Year Plan, 2007-12, Department of IT, Ministry of Communications and Information Technology, Government of India.

development centres in India. Bangalore, Hyderabad, Delhi/Noida and Chennai are major design centres.¹⁴ The semiconductor industry has received priority in the Eleventh Five Year Plan.

External market

Indian firms have become important competitors in world markets, and Indian businesses have started to face increasing levels of global competition. This has forced them to deliver world class products and quality services. In 2007, total aggregate revenue including both the domestic and export sectors was estimated to exceed USD 47.8 billion, a ten-fold increase over the USD 4.8 billion reported in 1998, with the segment growing at 28% in 2007. BPO (NASSCOM, 2007d). The government expected turnover to reach USD 80 billion by 2011, with an annual growth of 30%, and the global recession only reduced the positive outlook a little.

Exports of software and services

During 2008-09, electronics and IT exports were estimated by NASSCOM to be around USD 47 billion, compared with USD 41 billion in 2007-08. Tata Consulting Services (TCS), Infosys and Wipro are the top three exporters, and only six of NASSCOM's Top 20 IT software and services exporter are MNE affiliates. There are many examples of advanced software products from top firms. TCS has launched packaged software for the banking, insurance, securities, accounting and health care industries. Banking software from Infosys (Bankaway, Finance and Payaway) has been widely adopted. Wipro Technologies has introduced Teleprodigy, a billing system for ISPs, and WebSecure, an Internet security package. Many smaller, highly specialised Indian firms are developing software in banking, financial and accounting in the United States, the United Kingdom and Europe. While the United States and the United Kingdom remain the dominant markets for IT-ITeS exports, other markets are growing. Leading multinational firms also have extensive operations in India.

Exports of Business Process Outsourcing (BPO)

In the last decade, India has been the leading source for offshore service supply, and is estimated to account for 65% of the global industry in offshore IT and 46% of the global BPO industry. BPO exports were estimated to be around USD 8.3 billion in 2007. The United Kingdom is the major market within the EU, particularly for finance and accounting (F&A) services, customer interaction services, human resource administration (HRA) and a wide range of other specific services. The Indian BPO firms include 3iInfoTech, Mindtree Consulting, NIIT SmartServe, Perot Systems, Hewitt Associates, and Infinite Computer Solutions. Knowledge Processing Operations (KPO) is also becoming a significant market. MNCs are setting up third party captive units of data analysis, data modeling. India's share in global KPO revenues is estimated to be 60-70%, and was estimated to grow to USD 12 billion in 2009-10 (NASSCOM, 2007e). Call centres, insurance claims processing, legal databases, digital content development, online education, medical transcription, data digitisation, payroll/HR services and web services are other products where India has started specialising in the world market.

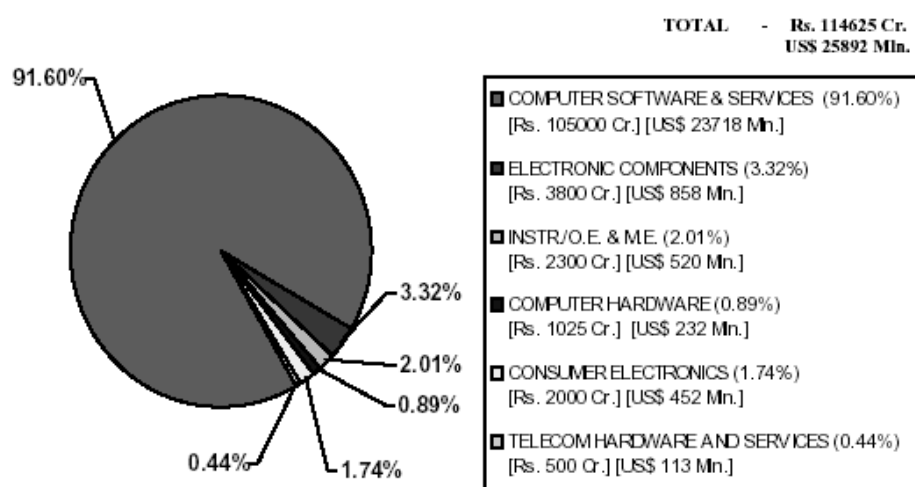
Exports of hardware and consumer electronics

India is gradually building a hardware manufacturing base but the electronic hardware industry in India is still orientated towards the domestic market. The market is fragmented, lacks a component base, and has infrastructural barriers with high cost of finance and high technological obsolescence. The electronics hardware industry is very import dependent. Given that consumption is increasing rapidly, the trade deficit is set to accelerate.

¹⁴ Information is sourced from Evalueserve, 'Semiconductors: Market and Opportunities'.

Exports of electronics hardware has increased rapidly but not as fast as imports (see OECD 2010a). Celetronix, Hewlett Packard India, Samsung, VXL Instrument, Bacro Electronic, L.G. Electronics, Zenith Computers, and WEP Peripherals are amongst the top exporters. With a very high growth of 118% (121% in USD), uninterrupted power supply (UPS) has emerged to be the top export item. Colour television, which was in fifth position in 2004-05 registered high growth of 101% (104% in USD terms) moving to fourth position during 2005-06. The other major export items during 2005-06 were CD-recordables, memory cards, picture tubes, DVDs, medical instruments, connectors and clocks/watches.¹⁵ Figure 4 shows exports from electronic hardware and computer software and services for 2005-06. Computer software and services contributed 91.6 % of total exports; the other 8.4% is from the electronics and hardware segment.

Figure 4. Sector contribution in exports of electronic hardware, computer software and services: 2005-06



Source: *Statistical Year Book 2005-06*, Electronics and Computer Software Export Promotion Council, Government of India.

Table 2 presents production and export figures for electronics and software products between 2000-01 and 2005-06. Export in relation to total production has increased from 47.5% to 63.5% between 2000-01 and 2006-07.¹⁶

¹⁵ Government of India, Department of Commerce, Electronics and Computer Software Export Promotion Council, *Statistical Year Book 2005-06*.

¹⁶ Government of India, Department of Commerce, Electronics and Computer Software Export Promotion Council, *Statistical Year Book 2006-07*.

Table 2. Electronics and computer software production and exports: 2000-01 to 2005-06 (USD million)

SECTOR	2000-01	2001-02	2002-03.	2003-04	2004-05	2005-06
CONSUMER ELECTRONICS						
PRODUCTION	2597.83	2662.47	2851.24	3304.35	3741.65	4178.90
EXPORT	134.78	146.75	154.96	179.35	256.12	451.77
COMM. & BROADCASTING EQUIP.						
PRODUCTION	978.26	943.40	991.74	1163.04	1024.50	1219.79
EXPORT	126.09	31.45	103.31	35.87	77.95	112.94
INSTRUMENTATION & STRATEGIC EC.						
PRODUCTION	1250.00	1320.75	1663.22	1923.91	2394.21	2823.58
EXPORT	121.74	199.16	289.26	329.35	334.08	519.54
ELECTRONIC COMPONENTS						
PRODUCTION	1195.65	1194.97	1363.64	1652.17	1959.91	2055.57
EXPORT	397.39	461.22	495.87	816.30	846.33	858.37
COMPUTER HARDWARE						
PRODUCTION	739.13	744.23	878.10	1478.26	1959.91	2371.81
EXPORT	260.87	377.36	113.64	313.04	267.26	231.53
TOTAL (A)						
PRODUCTION	6760.87	6865.83	7747.93	9521.74	43800.00	11080.18
EXPORT	1040.87	1215.93	1157.02	1673.91	7700.00	1781.74
EXPORT Vs PRODUCTION	15.40	17.71	14.93	16.08	17.19	
B. COMPUTER SOFTWARE						
PRODUCTION	8021.74	9931.66	12376.03	16141.30	74250.00	21587.97
EXPORT	5978.26	7651.99	9607.44	12608.70	58000.00	17216.04
EXPORT Vs PRODUCTION	74.53	77.05	77.63	79.75	79.87	
TOTAL (A+B)						
PRODUCTION	14782.61	16797.48	20123.97	25663.04	32668.15	42344.70
EXPORT	7019.13	8867.92	10764.46	14282.61	18997.77	25892.25
EXPORT Vs PRODUCTION	47.48	52.79	53.49	58.15	61.15	
Average Exchange Rate 1USD =	46.00	47.70	48.40	44.90	44.27	

NOTE: Production figures of Electronic Hardware Panels Source: Published figures of MIT in their annual report.

Source: Statistical Year Book 2005-06, Electronics and Computer Software Export Promotion Council, Government of India.

Import of electrical machinery

Table 3 depicts the top five sources of Indian imports of electrical machinery over the period 2002-07. During this period China's share increased from 10.1% to 27.8% of total import demand for electrical machinery products, and demand for these imports increased 44% per annum. Telecom, computer and electronic components are the most important imported items followed by audio and video components.

Table 3. Top 5 importers and world supply of imports for electrical machinery to India: 2002-07 (USD million)

Countries	2002	Countries	2004	Countries	2007
USA	87.33	USA	118.26	China	544.62
Japan	66.02	China	101.5	Germany	212.38
Germany	61.32	Germany	95.43	USA	177.34
China	59.95	Korea	84.61	Japan	110.59
Korea	56.83	Japan	81.04	Korea	100.38
World	596.15	World	872.82	World	1954.35

Source: Centre for Monitoring Indian Economy (CMIE Database)

Destination of exports

Indian IT exports are predominantly based on services. In recent years electronics goods exports have increased. Table 4 provides a breakdown of electronic hardware and computer software & services exports to the major destination countries for 2005-06. The United States and European countries together registered nearly 52% of electronic hardware and around 85% of computer software exports. Exports to North America during this period are estimated to be USD 15 334 million, up from USD 11 546 million in 2004-05 registering a growth of 33% in USD. Exports to EU countries grew by 42% in USD terms during the same period. In value terms, exports of Electronics and Computer Software / Services to EU Countries increased from an estimated USD 4 671 million in 2004-05 to USD 6 627 million in 2005-06. Singapore, Hong Kong, China and other South Asian countries attracted around 23% of total electronics exports for the same period. In recent times, besides traditional exporting countries, Indian firms are extending into the Middle-East, North Africa and Latin American countries.

Table 4. Major destinations for electronic hardware and computer software and services exports, 2005-06

Destination	Electronic Hardware		Computer Software		Total	
	Value	% of Sector Total	Value	% of Sector Total	Value*	% of Sector Total
NORTH AMERICA	2682.61 (605.97)	27.87	65200.00 (14727.81)	62.10	67882.61 (15333.77)	59.22
EUROPE (EU)	2339.44 (528.45)	24.31	27000.00 (6098.94)	25.71	29339.44 (6627.39)	25.60
SINGAPORE, HONGKONG, CHINA & OTHER SOUTH ASIA	2199.87 (496.92)	22.86	2800.00 (632.48)	2.67	4999.87 (1129.40)	4.36
JAPAN, KOREA & OTHER FAR EAST	550.31 (124.31)	5.72	3200.00 (722.84)	3.05	3750.31 (847.14)	3.27
MIDDLE EAST	1083.43 (244.73)	11.26	2500.00 (564.72)	2.38	3583.43 (809.45)	3.13
EUROPE (NON EU)	52.98 (11.97)	0.55	2200.00 (496.95)	2.10	2252.98 (508.92)	1.97
AUSTRALIA & OTHER OCEANIA	87.05 (19.66)	0.90	1300.00 (293.65)	1.24	1387.05 (313.32)	1.21
AFRICA	370.20 (83.62)	3.85	425.00 (96.00)	0.40	795.20 (179.63)	0.69
LATIN AMERICA	144.12 (32.55)	1.50	350.00 (79.06)	0.33	494.12 (111.62)	0.43
RUSSIA & C.I.S.	115.00 (25.98)	1.19	25.00 (5.65)	0.02	140.00 (31.62)	0.12
TOTAL	9625.01 (2174.16)	100.00	105000.00 (23718.09)	100.00	114625.01 (25892.25)	100.00
Average Exchange Rate 1USD = Rupees 48.40 (44.27)						
*Excluding Telecom & Related Services Export of INR 3700 (USD 804 m.)						
*Excluding Video Film Software Export of INR 1200 (USD 261 m.)						

Source: *Statistical Year Book 2005-06*, Electronics and Computer Software Export Promotion Council, Government of India.

For electronics goods, as shown in Table 5, the USA remains the major export destination for India. Other top destinations are Singapore, Germany, Netherlands and the UAE for 2007. Export revenue from the world for Indian electronics goods has increased 132% over the last five year period (i.e., 2002-07).

Table 5. Top 5 export destinations of electronics goods from India: 2002-07 (USD million)

Countries	2002	Countries	2004	Countries	2007
USA	240.78	USA	390.44	USA	730.79
Malaysia	178.41	Singapore	132.27	Singapore	262.14
Singapore	128.1	Netherlands	125.63	Germany	205.26
Netherlands	84.22	UAE	109.5	Netherlands	172.95
Hong Kong	56.98	Germany	108.42	UAE	151.3
World	1174.81	World	1729.5	World	2730.33

Source: Centre for Monitoring Indian Economy (CMIE).

Table 6 presents major exporting items. Computer Software/Services, ITeS/BPO, UPS and colour TV are popular for export market particularly in the United States and European countries. Middle East and other South-Asian countries are also popular destinations for these products.

Table 6. Top export items (software/services and hardware related) and destinations: 2004-05 to 2005-06

Rank	Items	Export 2005-06 - m USD.	Export 2004-05 - m USD	Growth (in %) in 2005-06 compared to 2004-05	Major destinations during 2005-06 with approximate share (%) of total export value
1	Computer Software / Services	16941.50	12026.73	40.87	US (60.05), UK (18.83), Netherlands (2.33), Japan (2.24), Singapore (1.45), UAE (1.73), Germany (1.45), Canada (2.04), Others (9.88)
2	ITES/BPO	6776.60	5189.31	30.59	US (70.00), UK (5.00), Germany (5.00), Japan (5.00), Singapore (5.00), Australia (5.00), Canada (5.00)
3	Un-Interrupted Power (UPS)	284.51	128.49	121.43	US (98.31), Netherlands (1.47), UAE (0.04), Sri Lanka (0.02), Nepal (0.02), Kenya (0.01), Uganda (0.01), Lebanon (0.01), Others (0.07)
4	Color TVs	190.00	93.25	103.76	Italy (45.65), UAE (27.54), Turkmenistan (6.10), Kazakhstan (3.74), Sri Lanka (3.55), Belgium (2.76), Bangladesh (1.98), Russia (1.47), Nepal (0.92), Others (6.30)
5	C.D Recordable	188.53	155.92	20.91	Germany (29.63), Us (27.17), Netherlands (21.38), Luxembourg (7.01), UAE (3.60), Argentina (1.93), Lithuania (1.67), Uruguay (1.08), Russia (0.74), Brazil (0.62), South Africa (0.61), Saudi Arabia (0.50), Ecuador (0.49), Australia (0.40), Japan (0.32), Chile (0.27)
6	Memory Card	153.13	83.01	84.46	US (85.00), UK (5.76), Singapore (3.55), UAE (2.05), Hong Kong (1.12), Sri Lanka (1.09), Belgium (0.52), Switzerland (0.22), France (0.20), South Africa (0.16), Australia (0.13), Germany (0.07), Canada (0.04), China (0.04), Brazil (0.03), Chinese Taipei (0.02)
7	Picture Tubes	135.66	108.78	24.71	USA (13.99), Singapore (13.11), China (12.38), Japan (12.36), France (12.34), Turkey (8.43), Russia (7.68), Bangladesh (7.26), Spain (7.20), Egypt (1.55), UK (1.11), Germany (0.93), Netherlands (0.45), Italy (0.34), Romania (0.22), Croatia (0.15), Thailand (0.15), Belarus

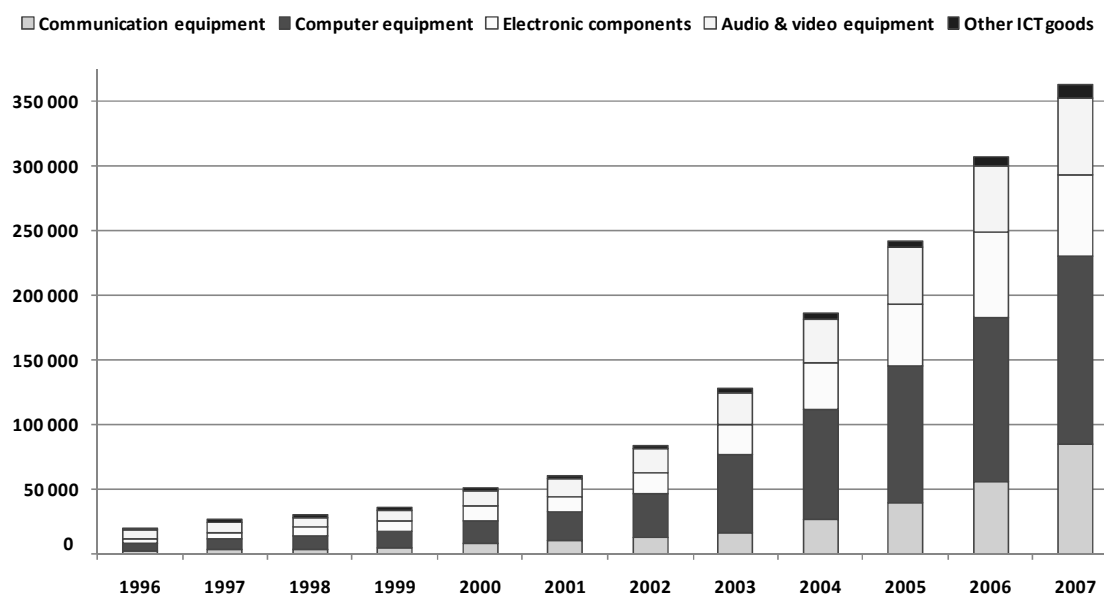
Source: Statistical Year Book 2005-06, Electronics and Computer Software Export Promotion Council, Government of India.

Trade developments: Comparison with other countries

Figure 5 presents the exports of ICT goods from the emerging BRICs countries. The total ICT exports from BRICS countries have increased twenty fold between 1996 and 2007.

Figure 5. ICT goods exports from the BRICS economies, 1996-2007

(USD millions in current prices)



Notes: Data are incomplete, with no data for Brazil, the Russian Federation and South Africa in 1996.

Source: OECD, 2008, based on data from the joint OECD-UNSD ITCS database.

Table 7 presents a further breakdown of trade in ICT goods for BRICs countries over the period 1996 to 2007. ICT goods comprise communication equipment, computer equipment, electronic components, audio and video equipment and other ICT goods. Brazil, Russia and India were net importers of these goods. China has very large trade surpluses with a surplus of USD 100 billion in 2007. The Indian trade deficit for ICT goods has increased more than tenfold between 1996 and 2007 and was over USD 16 billion in 2007, and the rate of increase is much faster in the import sector compared to exports.

Table 7. Emerging economies' trade in ICT goods, 1997-2007

(USD millions, current prices)

	1997	1999	2001	2003	2005	2007
BRAZIL						
Exports						
Communication equipment	214	402	1 337	1 349	2 844	2 332
Computer equipment	257	330	290	227	373	229
Electronic components	174	218	416	352	358	245
Audio & video equipment	400	334	375	240	176	178
Other ICT goods	131	194	222	164	287	397
Total ICT exports	1 176	1 479	2 640	2 332	4 038	3 380
Imports						
Communication equipment	2027	1588	2193	599	1150	3187
Computer equipment	1516	1424	1639	1188	1854	2457
Electronic components	2748	2876	3273	3077	5446	5404
Audio & video equipment	987	376	348	333	803	1146
Other ICT goods	1217	993	1247	976	1380	2122
Total ICT imports	8495	7257	8701	6173	10634	14315
RUSSIAN FEDERATION						
Exports						
Communication equipment	98	131	105	166	271	476
Computer equipment	53	74	31	50	66	115
Electronic components	153	260	191	189	266	385
Audio & video equipment	267	30	39	28	28	38
Other ICT goods	346	260	643	463	526	666
Total ICT exports	917	755	1009	896	1157	1680
Imports						
Communication equipment	1492	690	1090	1376	3804	7035
Computer equipment	373	230	478	716	1609	3971
Electronic components	238	124	250	552	934	1359
Audio & video equipment	321	73	317	421	1352	4051
Other ICT goods	907	664	827	958	1166	2887
Total ICT imports	3332	1782	2963	4024	8865	19303
INDIA						
Exports						
Communication equipment	63	49	84	101	161	355
Computer equipment	249	118	346	390	409	347
Electronic components	112	133	202	327	424	692
Audio & video equipment	77	59	122	262	161	140
Other ICT goods	44	85	127	182	268	344
Total ICT exports	545	444	880	1262	1424	1877
Imports						
Communication equipment	280	352	753	2674	5402	8320
Computer equipment	637	1012	1237	1899	3469	4075
Electronic components	598	671	867	1286	1641	2291
Audio & video equipment	103	140	176	313	694	1436
Other ICT goods	378	441	530	695	1309	1968
Total ICT imports	1997	2617	3564	6868	12516	18091

Table 7. (cont'd) Emerging economies' trade in ICT goods, 1997-2007

(USD millions, current prices)

CHINA						
Exports						
Communication equipment	2685	3738	8759	14558	36303	82035
Computer equipment	7513	11697	21076	59245	104651	144514
Electronic components	4922	7766	11371	22879	46890	60841
Audio & video equipment	7168	8453	12616	24289	43265	59570
Other ICT goods	906	1009	1483	2332	4057	8608
Total ICT exports	23194	32663	55305	123303	235167	355568
Imports						
Communication equipment	2453	4904	7416	7812	6544	19618
Computer equipment	3864	6968	11607	22890	33705	38066
Electronic components	9664	18386	31333	67442	124455	173473
Audio & video equipment	1989	2345	2796	5438	8557	12148
Other ICT goods	1618	2169	4117	6949	9766	11891
Total ICT imports	19588	34771	57269	110530	183025	255195
SOUTH AFRICA						
Exports						
Communication equipment	119	182	219	186	193	274
Computer equipment	133	182	125	106	137	193
Electronic components	33	33	64	96	167	191
Audio & video equipment	32	42	55	79	99	212
Other ICT goods	77	86	81	148	201	271
Total ICT exports	394	525	545	615	798	1142
Imports						
Communication equipment	1211	1322	1165	1216	2342	2785
Computer equipment	1075	1104	991	1424	2303	2221
Electronic components	440	392	387	374	555	790
Audio & video equipment	358	336	328	441	798	939
Other ICT goods	433	370	383	483	742	972
Total ICT imports	3516	3524	3255	3939	6741	7707

Note: South Africa includes the South African Customs Union for 1996 through 1999.

Source: OECD, 2008, based on data from the joint OECD-UNSD ITCS database.

The market size of the global electronics industry was estimated to reach USD 2 100 billion by 2010.¹⁷ In 2004-05 the Indian electronics industry still had a minuscule share (only 0.7%) of global electronics hardware production compared to neighbouring countries China (14.6%), Chinese Taipei (3.5%), and Korea (7.2%). However production has been much higher in India compared to many OECD countries. Only growth in Brazil, the Slovak Republic and Vietnam is comparable with India during this period (see Table 8).

¹⁷ Government of India, Electronics and Computer Software Export Promotion Council, Department of Commerce, 2003.

Table 8. Growth in the value of electronics production, 2005-08 (% per annum)

Country	EDP	Office Equip	Control & Instr	Medical & Industrial	Radio Comms & Radar*	Telecommunications	Consumer	Components	TOTAL
Australia	1.09	2.62	3.67	4.05	5.54	-0.76	-1.83	3.71	2.42
Austria	-4.83	0.00	10.39	3.53	3.13	7.47	-2.27	1.80	2.86
Belgium	-1.41	..	2.95	5.74	-0.65	-7.12	-3.78	2.07	-0.51
Brazil	27.26	14.41	14.98	8.88	16.81	15.75	14.80	14.28	21.24
Bulgaria	14.05	2.70	13.04	12.00	15.37	7.72	1.06	9.39	10.67
Canada	1.73	6.07	8.91	9.10	8.64	-1.33	-6.52	2.01	4.78
China	15.80	10.74	25.39	15.38	17.81	15.55	14.40	15.17	15.86
Croatia	10.33	0.00	6.27	6.27	9.14	5.27	..	14.05	8.17
Czech Republic	11.29	-1.94	9.99	7.07	11.64	8.02	28.69	-2.84	12.76
Denmark	6.64	..	8.63	10.79	2.60	11.03	1.36	2.26	6.93
Egypt	7.07	3.61	6.15	10.82	10.46	12.90	2.63	3.37	6.28
Estonia	14.67	0.00	-0.33	7.22	4.31	3.67	..	5.49	4.75
Finland	-3.15	..	7.34	8.49	-4.28	-2.85	5.27	0.25	-2.22
France	-13.80	6.74	7.71	9.47	-0.76	0.22	-3.81	1.82	-0.36
Germany	0.39	-4.15	8.62	6.19	-1.19	0.99	-4.19	9.08	4.76
Greece	11.84	3.45	6.38	18.98	7.72	10.85	0.00	21.14	10.54
Hong Kong, China	-18.53	-15.75	-4.75	-2.15	-8.33	-13.01	-10.46	-7.12	-10.23
Hungary	7.99	0.00	10.63	7.52	7.33	2.01	21.52	3.80	10.38
India	21.70	7.72	13.48	10.75	65.17	11.34	9.05	5.28	19.93
Indonesia	-0.66	-0.61	3.78	5.76	4.42	-11.13	-3.21	2.99	0.19
Ireland	7.67	1.72	11.64	2.47	14.14	-3.82	7.99	3.25	6.03
Israel	1.33	-11.17	5.96	10.70	2.81	0.82	-2.23	2.41	3.20
Italy	-2.43	-23.31	5.26	10.63	-2.48	3.09	7.34	3.11	2.14

Country	EDP	Office Equip	Control & Instr	Medical & Industrial	Radio Comms & Radar*	Telecommunications	Consumer	Components	TOTAL
Japan	-3.05	-7.02	-3.98	2.22	-5.16	-7.22	1.50	0.49	-1.31
Lithuania	7.24	10.06	7.56	32.64	43.42	37.00	-0.93	-19.66	0.68
Malaysia	13.67	34.03	16.39	23.52	20.89	11.31	-6.43	5.63	8.58
Mexico	3.06	10.72	5.90	1.50	7.67	-5.65	20.78	3.39	10.34
Netherlands	-2.82	-9.29	3.19	16.34	-8.16	2.33	-7.17	-1.15	1.76
New Zealand	5.70	-12.21	3.27	7.92	8.54	2.10	-8.53	10.90	5.99
Norway	0.99	..	5.53	7.72	4.70	5.17	..	20.10	6.58
Philippines	4.07	9.20	3.72	10.98	-5.94	-0.67	-4.16	3.93	3.34
Poland	5.98	2.17	2.96	4.91	7.31	4.01	31.06	-8.45	15.84
Portugal	-6.88	0.00	22.00	22.00	8.76	2.67	7.51	10.82	5.59
Puerto Rico	-11.26	-3.13	1.22	-15.93	4.32	0.50	-3.29	-6.62	-11.93
Romania	13.83	0.00	9.65	11.17	8.01	2.21	-2.27	5.90	6.43
Russia	14.92	2.91	6.99	6.14	11.24	5.27	11.04	7.76	9.55
Saudi Arabia	3.31	-1.34	4.87	2.62	7.41	2.89	-3.85	3.82	3.93
Singapore	-9.12	-4.22	4.23	17.92	5.76	0.15	-12.17	8.34	1.52
Slovak Republic	7.60	3.57	9.35	4.59	7.96	1.91	61.82	12.82	40.17
Slovenia	10.97	0.00	8.13	6.40	2.44	1.90	3.23	1.54	3.99
South Africa	0.48	-0.32	2.40	0.00	2.60	0.93	4.27	-1.09	1.32
Korea	-5.00	-9.33	9.08	16.71	-2.42	-2.81	-3.88	0.84	-1.13
Spain	-1.52	-10.93	1.61	6.99	4.70	-3.45	-4.44	7.97	0.61
Sweden	-3.15	..	3.65	10.96	-2.69	0.56	9.49	1.22	0.06
Switzerland	-2.19	-10.74	6.76	6.85	0.53	-0.41	2.05	2.57	3.85
Chinese Taipei	-14.05	-9.62	18.17	33.19	3.23	-16.50	-2.16	10.02	7.38
Thailand	16.49	-2.90	18.59	17.74	6.62	1.26	12.05	13.97	14.07
Turkey	15.48	-5.80	0.66	3.98	1.64	0.48	0.82	6.73	2.01

Country	EDP	Office Equip	Control & Instr	Medical & Industrial	Radio Comms & Radar*	Telecommunications	Consumer	Components	TOTAL
United Kingdom	-21.47	-15.48	6.50	7.34	5.58	2.64	-7.60	-2.76	-1.34
Ukraine	11.32	3.23	5.07	9.31	7.00	3.70	3.45	5.36	6.52
United States	-1.21	-1.27	3.78	4.30	2.94	-0.78	-4.22	2.18	1.76
Venezuela	3.31	0.33	10.81	7.93	3.31	1.99	-2.57	9.35	4.90
Vietnam	35.29	6.35	10.85	7.60	11.76	-1.08	15.56	14.17	18.44
Total	6.64	0.45	6.09	7.55	4.75	2.88	9.34	4.94	5.86

Source: OECD, 2008, calculated from REED Electronics Research. Production figures include exports.

IT-RELATED REVENUES, EMPLOYMENT, INVESTMENT AND SPENDING

Revenue from the IT sector

The Indian IT sector grew very rapidly through the mid-2000's. Table 9 shows the growth in revenue, including the breakdown between domestic and exports segments for services/ITeS. Within this, service and software exports were the major contributor, generating USD 31.3 billion in 2007. Increases in offshore product development and engineering services are also supplementing India's efforts in IP creation. The engineering services and software product segment reported USD 4.9 billion in exports in 2007 as shown in Table 9.

Table 9. Revenue from different segments in the Indian IT sector: 2004-07

USD billion	2004	2005	2006	2007
<i>IT Services</i>	10.4	13.5	17.8	23.6
Exports	7.3	10.0	13.3	18.
Domestic	3.1	3.5	4.5	5.6
<i>ITeS-BPO</i>	3.4	5.2	7.2	9.5
Exports	3.1	4.6	6.3	8.4
Domestic	0.3	0.6	0.9	1.1
<i>Engineering services and R&D, software products</i>	2.9	3.9	5.3	6.5
Exports	2.5	3.1	4.0	4.9
Domestic	0.4	0.8	1.3	1.6
<i>Total software and services revenues</i>	16.7	22.6	30.3	39.6
Of which, exports:	12.9	17.7	23.6	31.4
<i>Hardware</i>	5.0	5.9	7.0	8.2
Total IT Industry (including Hardware)	21.6	28.4	37.4	47.8

Note: Totals may not match due to rounding off, E is estimate; Hardware does not include export component.

*NASSCOM estimates have been reclassified to provide greater granularity. Historical values for a few segments have changed due to availability of updated information

Source: NASSCOM (2006a and b), Indian IT Industry Fact Sheet.

Employment trends

Total employment in IT software and services was around 1.6 million in 2006-07, and is currently estimated around 2 million. IT-services and ITeS-BPO related activities contribute about two-thirds of total employment. Employment for the domestic market is much less than for the export market. The rapid growth of the software segment has helped to reduce the brain drain and non-resident Indians are returning to a greater extent. Moreover, non-resident Indians working in US multinationals are investing in Indian subsidiaries that develop software for their US operations (see Kumar and Joseph, 2005). Table 10 presents the sector's employment through the mid-2000's. This excludes the hardware segment that was estimated to provide direct employment for a further 1.2 million people in 2008.

Table 10. Employment-Software and Services Sector

Sector	2004	2005	2006	2007
Export sector				
IT Services	215 000	297 000	398 000	562 000
ITeS-BPO	216 000	316 000	415 000	545 000
Engineering services and R&D and software products	81 000	93 000	115 000	144 000
Domestic market (including user organisations)	318 000	352 000	365 000	378 000
TOTAL*	830 000	1 058 000	1 293 000	1 630 000

*Figures do not include employees in the hardware sector.

Source: NASSCOM (2007a), Indian IT Industry Fact sheet, February.

Variations in state-level capabilities

E-readiness, S&T capabilities and household IT and electronics

There are very wide differences across Indian states in terms of their IT and S&T capabilities and household equipment. These both drive the pattern of IT sector development and reflect this development. Three measures of these differences are summarised below.

The National Council of Applied Economic Research (NCAER) has established a state e-readiness index covering three broad indicators, IT environment, readiness of individuals and usage, and using multiple stage Principal Component Analysis (PCA). The e-readiness of all states and territories is presented in Figure 6.

Figure 6. E-readiness of different States

Source: National Council of Applied Economic Research (NCAER) (2005), India: *E-Readiness Assessment Report*.

In a similar exercise, 21 states have been grouped according to their level of science and technology development. Delhi, Goa, Tamil Nadu, Kerala and Andhra Pradesh have the ‘most advanced’ status, and are ranked highest with an S&T score above 0.70 (Table 11). The ‘more advanced’ states are a step below with scores ranging between 0.42 and 0.70. These include Maharashtra, Karnataka, Gujarat, Uttaranchal and Punjab. The third ‘less advanced’ states are those with S&T Index scores of between 0.16 and 0.42 including West Bengal, Assam, Haryana, Himachal Pradesh, Orissa and Uttar Pradesh. Finally, at the bottom of the S&T ladder are the ‘least advanced’ states with scores less than 0.16, Chattisgarh, Bihar, Jharkhand, Madhya Pradesh and Rajasthan.

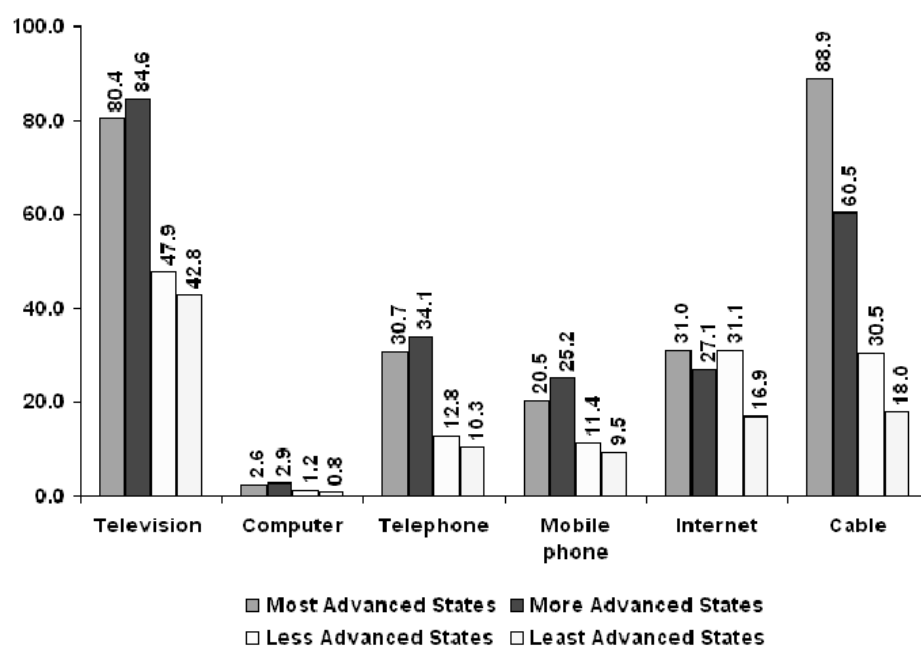
Table 11. Level of S&T advancement of different States, 2004-05

Most advanced states (S&T index >0.70)	More advanced states (S&T index 0.42-0.70)	Less advanced states (S&T index 0.16-0.42)	Least advanced states (S&T index < 0.16)
Delhi	Maharashtra	West Bengal	Chattisgarh
Goa	Karnataka	Assam	Bihar
Tamil Nadu	Gujarat	Haryana	Madhya Pradesh
Kerala	Uttaranchal	Himachal Pradesh	Jharkhand
Andhra Pradesh	Punjab	Orissa	Rajasthan
		Uttar Pradesh	

Source: NCAER (2006), Working Paper, May.

The welfare status of the population in different states is indicated by access to ‘assets’ such as TVs, computers, telephones, Internet and cable services and mobile phones. While the top two groups of states have a higher penetration of televisions, telephones, mobile phones, Internet and cable services, the corresponding penetration for the bottom two groups is much lower, as shown in Figure 7.

Figure 7. Household ownership of selected goods and services (% of households), 2004-05



Source: NCAER (2006), Working Paper, May.

The investment environment and foreign investment

India still faces many deficiencies in its investment climate compared with its competitors. A poor investment climate and a policy structure non-conducive to hardware manufacturing still hinder significant foreign investment. The Indian government has also hindered investment in telecom by delaying the introduction of new services. Firms cannot access additional spectrum to expand their wireless services as the Ministry of Defense has been reluctant to surrender the spectrum. 3G spectrum auctions have also been delayed, most recently in January 2009, preventing firms from offering new services and products.

Foreign investment

FDI as a proportion of total investment more than doubled between 2003-04 and 2006-07, according to a review by the Department of Industrial Policy and Promotion (DIPP). The share of FDI in GDP increased from 0.77% to 2.31% in the financial year 2006-07. De-licensing of various sectors and increased ease of doing business by foreign firms has boosted foreign investment significantly. Electrical equipment (including computer software – usually classified with services - and electronics) has attracted the highest inflows of FDI, followed by financial and non-financial services and telecommunications. A number of EMS (Electronic Manufacturing Services) firms, including Flextronics, Honhai/Foxconn, Solectron Centum, Celestica and Jabil Circuits have mobile phone market operations in India, and peripherals manufacturers such as TVS electronics, WeP Peripherals and Emerson have set up manufacturing facilities in Himachal Pradesh. In the audio sector, low investments in organised segments and a high tax rate have resulted in poor quality products with high prices to consumers. Cross-border mergers and acquisitions (M&A) involving Indian IT and IT-enabled firms increased nearly 12% in 2008 (total of USD 3.22 billion and 98 deals).¹⁸

¹⁸

Source: www.ibef.org accessed 9 April 2009.

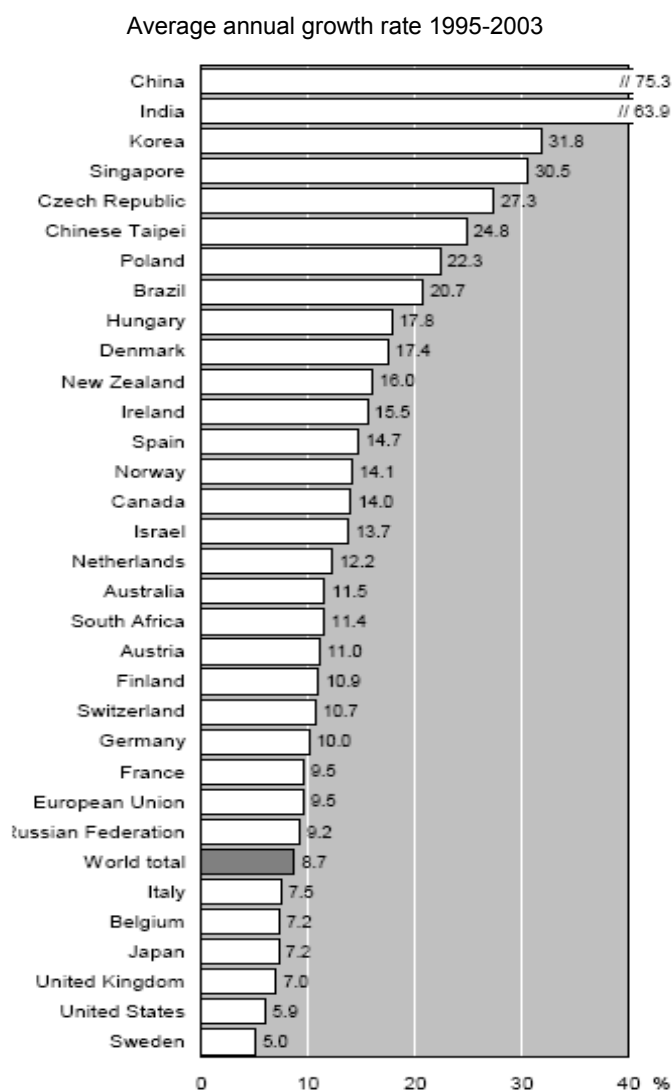
ICT R&D and patents

India's total R&D investment is 0.8% of GDP which is very low compared to countries such as China (1.31%), Brazil (1.05%) and Denmark (2.63%). The emergence of India as a world centre for outsourcing and IT software services is helping to change the perception of India, and 150 of the Fortune 500 firms have R&D centres in India.¹⁹ Nevertheless, investment in R&D by the private sector is still relatively low and based largely on the outsourcing market, where Indian firms such as HCL, MindTree, TCS, Wipro and others are well placed.²⁰ MNCs in the revenue range of USD 100-200 million have the most problems hiring the right quality people. In general, R&D institutions lack resources and industry support. The education system is not standardised across various states to meet the demand for researchers, and industry partners play an insignificant role in the accreditation process. To help overcome these weaknesses, government bodies such as the Technology Information Forecasting and Assessment Council (TIFAC) of the Department of Science and Technology have been actively associated as an interface in bringing academic institutions and industry partners together.

On the other hand India's patenting record has improved rapidly. Figure 8 shows trends in ICT-related patent applications to the European Patent Office (EPO). In terms of average annual growth rates, India ranks second after China in patent applications through the EPO between 1995 and 2003. Its annual growth rate is seven times the world total for patent applications for this period. Despite the rapid growth of patent applications the number from India nevertheless remains low. India's share of ICT-related patents filed under the Patent Co-operation Treaty (PCT) in 2004 was 0.3% compared with China 2.5%. India also has a very high level of foreign co-inventors, suggesting both its relative openness in research activities and its dependence on foreign partners.

¹⁹ A 150% tax deduction is allowed under Section 35(2AB) of the Income Tax Act on expenditure in scientific research in the area of electronics/IT sector.

²⁰ For the outsourcing industry, Intellectual Property Rights (IPRs) belong to the customer, so there is no multiplier effect.

Figure 8. Trends in ICT-related patent applications¹ to the EPO²

Note: Patent counts are based on the priority date, the inventor's country of residence and fractional counts. The graph only covers countries/economies with more than 100 patent applications to the European Patent Office (EPO) in 2003 and more than 250 patents filed under PCT for the period of 2002-04.

1. The definition of ICT-related patents includes Telecommunications, Consumer Electronics, Computers, Office Machinery and Other ICT.

2. Patent applications filed under the Patent Co-operation Treaty (PCT), at international phase, designating the EPO.

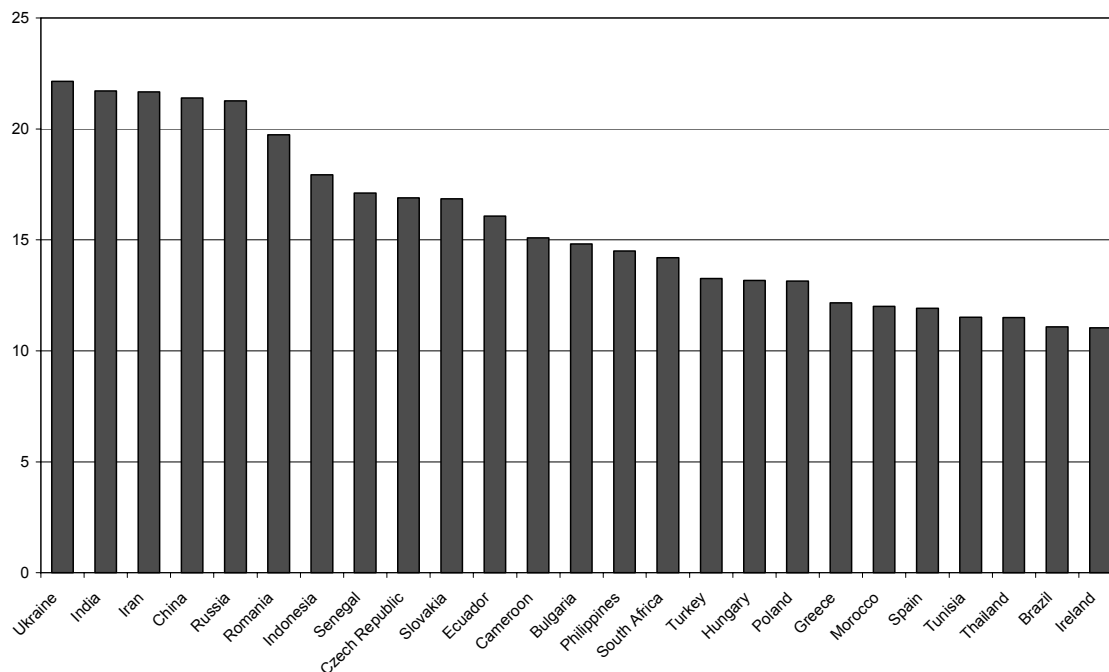
Source: OECD (2007a).

ICT spending

In general foreign investment flows into large, high growth economies, and these flows are further reinforced if the host country has good infrastructure and a hospitable investment climate for both export- and domestic-oriented activities. Figure 9 shows the growth of IT spending of 25 countries including the BRICS (Brazil, Russia, India, China and South Africa) (see *OECD Information Technology Outlook 2008*) with ICT spending increasing very rapidly in some emerging non-member economies. China's ICT spending is estimated to have exceeded USD 170 billion in 2007, having grown by more than 21% per annum since 2000. ICT spending in India and Russia increased just as rapidly over the period, with spending increasing by 21.7% per annum to USD 66 billion in India and by 21.3% per annum to USD 35 billion in Russia. In terms of growth in ICT spending 2000-07, India was second. China was

fourth, Russia fifth, the Czech Republic eighth, the Slovak Republic ninth, South Africa fourteenth and Brazil twenty-fourth. Investment flows have thus reinforced and been reinforced by inward investment.

Figure 9. Fastest ICT spending growth, 2000-07
Annual average growth, %



Note: Includes the 25 fastest growing markets.

Source: OECD, 2008, from data published by WITSA, based on research by Global Insight, Inc.

Table 12 shows ICT spending for selected emerging economies - China; Hong Kong, China; Chinese Taipei; India; Russia; Brazil and South Africa - for different segments for the period 2000-07. While China is the leader in spending on software and IT services, India is ahead of China in spending on hardware and communications segments. Overall growth is higher in the case of India (296%) compared to China (289%), and India is the leader amongst these emerging economies for this seven year period.

Table 12. Emerging economy ICT spending by segment, 2000-07
 Million US Dollars in current prices

	2000	2003	2004	2005	2006	2007	Growth (percentage point)
IT HARDWARE							
China	12 507	27 027	39 057	47 927	57 813	68 303	4.46
Hong Kong, China	1961	1 921	1 980	2 026	2 015	2 001	0.02
Chinese Taipei	2767	3 605	4 148	4 391	4 550	4 871	0.76
India	2257	5 013	7 204	10 264	13 630	17 910	6.94
Russia	1816	2 881	3 900	4 852	5 574	6 078	2.35
Brazil	6263	9 905	12 407	15 946	17 316	17 454	1.79
South Africa	1661	2 503	3 457	4 024	4 412	4 646	1.8
SOFTWARE							
China	1085	3 344	5 295	7 940	11 376	16 328	14.05
Hong Kong, China	278	373	432	492	558	649	1.33
Chinese Taipei	519	860	1 046	1 228	1 408	1 690	2.26
India	358	948	1 350	1 908	2 519	3 336	8.32
Russia	343	570	742	923	1 056	1 182	2.45
Brazil	1602	2 469	2 877	3 566	3 828	3 803	1.37
South Africa	627	1 328	1 965	2 369	2 781	3 159	4.04
IT SERVICES							
China	851	3 591	6 203	10 006	15 539	24 081	27.3
Hong Kong, China	540	747	903	1 071	1 266	1 532	1.84
Chinese Taipei	788	1 226	1 478	1 731	1 973	2 358	1.99
India	1120	2 859	3 876	5 243	6 607	8 356	6.46
Russia	891	1 537	2 099	2 747	3 299	3 881	3.36
Brazil	4937	7 353	9 040	11 911	13 530	14 238	1.88
South Africa	1293	2 440	3 632	4 408	5 206	5 951	3.6
COMMUNICATIONS							
China	29917	41 437	47 102	51 759	57 586	63 668	1.13
Hong Kong, China	9098	9 595	11 662	12 240	12 807	13 851	0.52
Chinese Taipei	14200	12 570	13 247	14 367	14 949	16 305	0.15
India	12841	16 873	23 734	29 023	32 549	35 978	1.8
Russia	6064	11 566	14 798	18 806	21 695	24 017	2.96
Brazil	20 609	21 491	24 006	30 642	33 996	34 240	0.66
South Africa	6896	8 947	11 709	12 825	13 073	12 792	0.85
TOTAL ICT							
China	44359	75 400	97 658	117 632	142 313	172 380	2.89
Hong Kong, China	11878	12 637	14 977	15 829	16 646	18 033	0.52
Chinese Taipei	18274	18 262	19 920	21 718	22 879	25 223	0.38
India	16575	25 692	36 164	46 438	55 304	65 580	2.96
Russia	9114	16 554	21 539	27 327	31 624	35 158	2.86
Brazil	33410	41 217	48 330	62 065	68 670	69 734	1.09
South Africa	10477	15 217	20 763	23 625	25 471	26 549	1.53

Source: OECD, 2008, from data published by WITSA, based on research by Global Insight, Inc.

DRIVING FACTORS

The major cost advantage of sourcing from Indian IT/ITeS firms has been lower wages and the lower cost of living. As shown in Figure 1, the Indian economy has comparative advantages in skilled workers compared to competing nations. However, increasing demand for human resources has gradually added pressure to labour costs, forcing firms to revamp human resource management practices and to choose alternative locations. The increasing availability in major cities of high-quality international and national dedicated telecommunication infrastructure has also become increasingly important as Indian firms have thrived and foreign firms have located to India. The Indian government has also made considerable efforts to provide dedicated, international quality, cost effective real estate in software parks, Special Economic Zones (SEZs) and knowledge sector industrial estates. In 2008 a scheme for Information Technology Investment Regions (ITIRs) was approved and these have begun to be implemented by mid-2010, with announcements from Andhra Pradesh (Hyderabad) and Karnataka to set up ITIRs. Under the ITIR scheme each State in India can set up an integrated township for facilitating growth of IT/BPO, with provision of world-class infrastructure, supported by investor-friendly policies.²¹ These regions would aim to become magnets for investment, employment opportunities and economic growth. Simultaneously, this will reduce the pressure on existing urban centres by enabling growth of new townships.

Human capital

India has a very large pool of labour, with nearly 60% of its population between the ages of 15-59, and more than 50% below the age of 25. Despite the lack of universal literacy, the Indian education system creates a large number of IT professionals. Indian curricula are heavily based on science, mathematics and engineering, creating a suitable environment for producing IT professionals. Table 13 depicts the labour supply of this sector. Even at current levels of employability, India has the largest pool of suitable offshore talent, accounting for 28% of the total suitable pool available across all offshore destinations. NASSCOM estimated demand for 850 000 IT and 1.4 million ITeS professionals in the 2009-10 financial year, outstripping new supply. However, Indian education tends to underestimate the importance of creative activities, and there is always a mismatch between the knowledge and real practice amongst the professional labour force.

Table 13. Indian IT labour supply: IT software and services

	2003-04	2004-05	2005-06	2006-07	2007-08
Degree (four years)	139 000	170 000	222 000	270 000	290 000
Diploma & MCA (three years)	177 000	195 000	219 000	231 000	246 000
No. of engineering graduates	316 000	365 000	441 000	501 000	536 000
Of which:					
Engineering IT graduates (degree)	84 000	102 000	133 000	162 000	180 000
Engineering IT graduates (diploma)	95 000	99 000	113 000	118 000	123 000
**No of IT professionals	179 000	201 000	246 000	280 000	303 000

Note: ** IT professionals include Computer Science, Electronic and Telecom professionals. Figures do not include employees in the hardware sector.

Source: NASSCOM (2006c), Knowledge Professionals Fact Sheet.

²¹ Ministry of Communications and Information Technology (2010), <http://www.mit.gov.in/content/e-infrastructure-0>

Business policy and regulatory environment

By encouraging foreign participation in most sectors of the economy, policy makers in India have placed special emphasis on its importance as both a source of finance and a facilitator of knowledge and technology transfer. The Indian ITeS-BPO sector has benefited from this approach, with participating firms enjoying minimal regulatory and policy restrictions along with a broad range of fiscal and regulatory incentives (NASSCOM, 2007d). However, the telecommunications industry is subject to the oversight of two different regulatory/administrative bodies (the Department of Telecommunications and Telecom Regulatory Authority of India) that often publicly disagree on fundamental directions of market liberalisation, and this has affected the structure and rate of telecommunications growth (see below and Conclusions, telecommunications infrastructure). Indian labour laws are flexible and mostly non-union workers are found in the IT sector due to the better working conditions, salaries and other job-related opportunities compared to employees in other sectors. Copyright protection and cyber laws were included in the comprehensive Information Technology (IT) Act introduced in 2000.

Telecommunications network

Telecommunications play a major role in the growth of the IT sector. India is the second-largest (after China) and one of the fastest growing mobile markets in the world with over 600 million subscribers in April 2010, adding 10-15 million subscribers per month in 2009 and 2010.²² By April 2010 tele-density was over 54% with mobile tele-density 51%, but fixed tele-density had slowly declined to 3.1%. The number of wireless subscribers was only 13.3 million in 2003. Revenue from telecommunications operations was expected to be around USD 43 billion in 2009-10. FDI inflow into telecommunications is very significant and India is also emerging as a telecommunications equipment manufacturing hub. Within a decade, the Indian telecom sector has shifted from a public sector monopoly to an increasingly liberal policy environment. Prior to deregulation the Department of Telecommunications (DOT) was the sole provider within the sector. The establishment of the Telecommunications Regulatory Authority of India (TRAI) in 1997 was an important step in reforming this sector. Since 1992, mobile services, followed by fixed line services in 1994 and long distance services in 1999 were opened to private competitors.

Until recently, mobile penetration was very much lower than in other major non-OECD economies. In 2005 competing countries all had around 60% penetration -- Brazil (60% in 2005), China (57%) and Mexico (63%) – while India was languishing below 15% (see Table 14), before its acceleration to over 50% in mid-2010. Competition from FDI has been one force driving mobile growth. FDI in the telecom sector increased from USD 116 million in 2003-04 to USD 521 million in 2006-07, and even in the global slump FDI in the ICT sector tended to continue to flow into India and other non-OECD countries (OECD, 2010a, Chapter 2, mergers and acquisitions). The flow still tends to be from OECD countries into non-OECD ones, but non-OECD countries, including India, are becoming a considerable source of international FDI. Prior to extensive market liberalisation, global services had been provided through co-operation agreements with an Indian licensed telecommunications operator, responsible for providing the Indian regulated service elements. In 2006, AT&T was the first foreign telephone company to obtain international and national long distance licences under the new FDI guidelines to allow 74% foreign ownership, and since that time has grown rapidly serving the multinational enterprise customer market.

The telecom equipment sector includes many manufacturing plants established by firms such as SemIndia, Siemens, Flextronics, Nokia, LG, Samsung, Ericsson, Motorola and Vodafone. For example, 40% of software used in Motorola phones worldwide is designed in India.

²² <http://www.traai.gov.in/WriteReadData/traai/upload/Reports/45/Report13jan09.pdf>; and TRAI (2010) as reported in Business News, 28 May: <http://blog.taragana.com/business/2010/05/28/india-adds-169-million-telecom-users-in-april-traai-66008/>

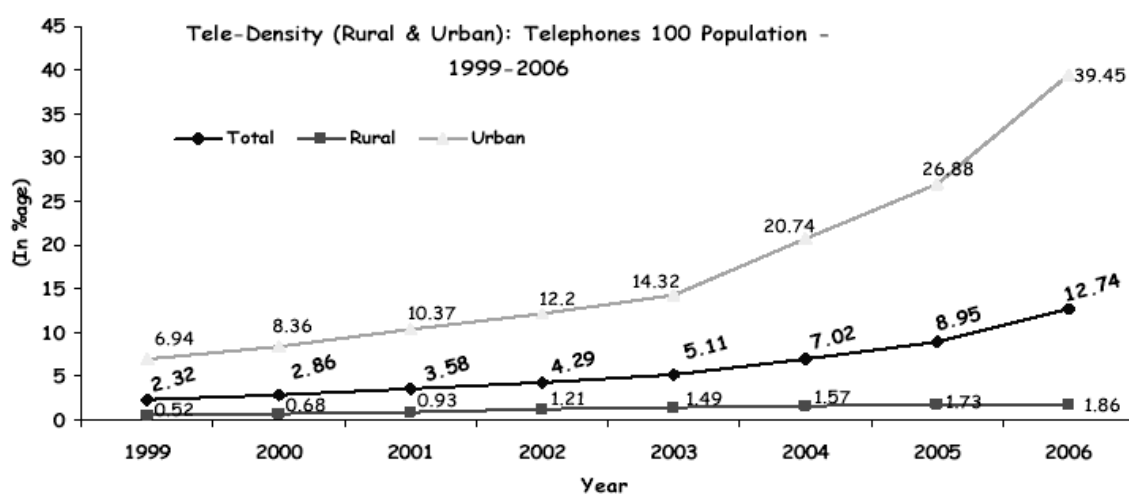
Table 14. Status of telecom indicators in selected countries, 2005

Country	Population (Million)	GDP (per capita) USD 2004	Telephones (thousands)	Tele density (%)	Internet Users (thousands)
US	298.21	36273	360347	122.71	185000
UK	59.67	26369	94791	158.51	37600
Australia	20.16	25436	29880	148.25	14190
Brazil	186.41	3338	107987	59.78	22000
Mexico	107.03	6328	66974	62.58	18622
Sri Lanka	20.74	1031	4606	22.20	280
Korea (Rep)	48.29	14136	62087	128.56	33010
Japan	128.08	31324	153525	119.86	64160
Indonesia	222.87	1156	59682	26.79	16000
China	1315.84	1268	743861	56.53	111000
Pakistan	153.96	614	18049	11.72	10500
India *	1115.59	634	142092	12.74	60000
World	6728.08	5944	3309379	49.45	964272

Source: International Telecommunication Union.

As discussed above, tele-density in the country has increased rapidly.²³ However, there is an enduring large gap between urban tele-density and rural tele-density as shown in Figure 10. Rural telephony has not kept pace with the impressive growth in urban mobile connectivity. In 2007, the percentage of the population covered by the mobile network was still much lower in India (60.9 %) compared to South Africa (99.79%), the Philippines (99%), China (97%) and Pakistan (90%).

Figure 10. Tele-density (rural and urban) telephones per 100 population 1999-2006



Source: Report of the Working Group on the Telecom Sector for the 11th Five Year Plan (2007-12).

Basic services comprise fixed use line and wireless in local loop (WLL-fixed) services. Bharat Sanchar Nigam Limited (BSNL) and Mahanagar Telephone Nigam Limited (MTNL) are major operators. Private players are Bharti and Reliance. In the handset market in 2008 Nokia dominated with a 72.5% share followed by Motorola with 11.1%, LG with 11%, Sony Ericsson (6.5%) and Samsung (5.6%).

²³ TRAI (2010) as reported in Business News, 28 May: <http://blog.taragana.com/business/2010/05/28/india-adds-169-million-telecom-users-in-april-trai-66008/>

Internet and broadband penetration has tended to remain very low.²⁴ 2007 was declared the "Year of Broadband" and in 2007-08 the number of Internet subscribers nearly doubled and broadband subscribers increased from 2.7 million to 4.9 million. By April 2010 broadband subscribers had almost doubled again to 9 million. However, low and declining fixed line penetration means that conventional fixed broadband will increase only slowly. On the other hand the advent of cheap and accessible wireless broadband will no doubt radically increase broadband access and use. Further, the National Internet Exchange of India (NIXI) has been set up by the Department of Information Technology (DIT) to ensure that Internet traffic, originating from and destined for India is routed within India. This will reduce the cost of internal usage to a greater extent. Also, plans to introduce 3G services and WiMax will reduce the cost of mobile broadband accessibility and increase use.

²⁴ <http://www.trai.gov.in/WriteReadData/trai/upload/Reports/45/Report13jan09.pdf>.

RECENT POLICY CHANGES

The IT sector plays a major role in the Indian economy. Some major policy changes in improving human capital, exports, and e-governance are highlighted below, including recent initiatives by NASSCOM.

Human capital

Investment in human capital is the most important initiative. Many initiatives have taken place at different levels. The National Council for Education Research and Training (NCERT) introduced the National Curriculum Framework School Education in 2000. Major objectives of this framework include the use of computers in the curriculum, enhancing learning opportunities by using ICT across the curriculum, designing curriculum with inter-disciplinary and cross-disciplinary areas.²⁵

Export promotion

In order to promote exports, the Indian Government has initiated several schemes to attract and encourage manufacture and export. Free Trade Zones provide competitive infrastructure facilities, duty free imports of capital goods, raw materials, components and other inputs, tax holidays for exports and access to domestic markets. These include Export Oriented Units (EOUs) within Export Processing Zones (EPZ), Electronic Hardware Technology Parks (EHTP), and Software Technology Parks (STP).

Special Economic Zones (SEZs)

The objective of the SEZs is to provide an export environment, with lower regulations on taxes, duties, labour laws and business infrastructure. Under the Act, SEZs can be developed either jointly or separately by the central government, state government, or any individual party (including private parties). Units may be set up in a SEZ for the manufacture of goods and rendering of services. All the import/export operations of the SEZ units are on a self-certification basis. The units involved are a net foreign exchange earner, not subject to any pre-determined value addition or minimum export performance requirements.

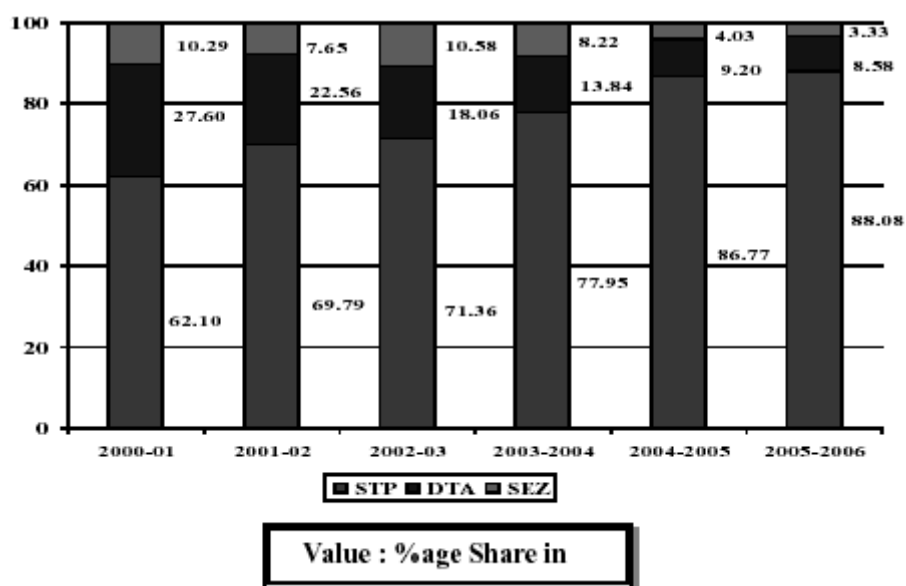
Software Technology Parks (STPs)

The STP is a non-profit society under the Ministry of Information Technology to promote and facilitate exports of software. Each STP offers all statutory services and high speed data connectivity to its member firms as 100% export-orientated units. There are now 47 centres spread across the country assisting about 6 500 software exporting firms. In 2000, a new STP was developed in Silicon Valley, with a view to facilitate software exports by small and medium-sized firms to the United States. The STPs, contributed 88% of India's electronics and computer software / services exports in 2005-06, and have been the largest contributor since 2000-01 as shown in Figure 11. Similar services are being provided to electronic hardware exporting firms under the Electronic Hardware Technology Parks (EHTP) scheme.

²⁵

See National Council of Educational Research and Training, <http://ncert.nic.in/>.

Figure 11. Distribution of exports from DTA, SEZ and STP of electronics and computer software/services: 2000-01 to 2005-06



Source: Statistical Year Book 2005-06, Electronics and Computer Software Export.

Other government initiatives

Mode Projects (MMP) at state level include the use of IT services around road transport, land records, commercial taxes, employment exchanges, agriculture, civil supplies, treasuries, land registration and in education. At the central government level they include areas such as insurance, national ID, pensions, banking, passport and visa services and income tax. The government has recently approved 100 000 broadband Internet common service centres (CSCs) in rural areas. Introduction of non-English software has started and needs to be extended to cover a large section of the non-English speaking population.

The special role of NASSCOM

To extend India's global IT-ITeS reach, the NASSCOM and industry have taken several initiatives to enhance the availability of and access to suitable talent for IT-ITeS in India. These initiatives include:

Special Economic Zones for education

NASSCOM has suggested experimenting with adapting the Special Economic Zone concept (deregulation and removal of restrictions) for education, and creating Special Education Zones. However, long-term steps are required, including much higher government investment in education, major education reform, and better compensation and research grants for teachers/researchers (NASSCOM, 2006a).

Memorandum of Understanding with University Grants Commission and All India Council for Technical Education

NASSCOM, in combination with the University Grants Commission (UGC) and the All India Council for Technical Education (AICTE), has signed a Memorandum of Understanding (MoU), to strengthen professional education in meeting increasing demand in the sector through changes in curricula, faculty and infrastructure.

Industry-University Partnerships

NASSCOM in its IT Workforce Development (ITWD) initiative is also working with academia across the country to encourage and facilitate greater industry interaction, share relevant feedback, stay updated on industry developments and giving encouragement to changes in curriculum and teaching.

Certification Program for Frontline Management

Under the NASSCOM's Executive Development Programme (NEDP), NASSCOM and QAI the leading quality consultancy in India introduced the Certification Program for Frontline Management in the ITeS-BPO sector. The program was launched nationally in five major cities - Delhi, Mumbai, Bangalore, Chennai, and Hyderabad - in 2005 and is being extended to other cities.

National Assessment of Competence (NAC)

NASSCOM has launched the NAC program for potential employees in the BPO segment. NAC is an industry standard assessment and certification program, which ensures the transformation of a "trainable" workforce into an "employable" workforce.

National Skills Registry (NSR)

In dealing with issues such as governance, physical security, business continuity, logical security, safeguarding IP, software change management and personnel security both for employees and clients more effectively, NASSCOM in collaboration with the National Securities Depository Limited (NSDL) introduced the NSR scheme in 2006. This is a national database of employees working in IT/BPO industry in India. This database contains third party verified personal, qualification and career information on IT professionals.²⁶

Data Security Council of India (DSCI)

NASSCOM is involved in making the Indian Information Security environment comparable to the world standard. As a part of its trusted sourcing initiative, NASSCOM is in the process of introducing the Data Security Council of India (DSCI), a Self Regulatory Organisation (SRO) to establish, popularise, monitor and enforce privacy and data protection standards for the ITeS-BPO segment (NASSCOM, 2007b). The Indian Computer Emergency Response team (CERT-In) provides incident prevention and response services under the Department of Information Technology.

²⁶ For details see NASSCOM, www.nationalskillsregistry.in

CONCLUSIONS

Key challenges

The Indian IT sector plays a significant role in the global market. In recent years, competition has intensified with China, Latin America, Eastern Europe and other countries such as Egypt establishing themselves as outsourcing centres, and major global firms (*e.g.*, Accenture, HP Services and IBM Global Services) establishing delivery centres in India. Manpower supply constraints, a small number of large firms dominating the industry, high tariff and import duties, lack of commercialisation of domestic R&D and lack of adoption in key vertical sectors such as agriculture, education and healthcare are seen as major limitations for this sector.

For India to fully capitalise on the opportunity and sustain growth in the global IT-ITeS market and in the IT sector in general, timely and coherent execution of initiatives to address supply-side concerns are needed in a wide range of areas. Priority areas are described below.

- **Improving the supply of quality human capital**

Human resource development (HDR) is the key area in supplying quality skilled workers for global and local markets, and various initiatives have been introduced to restructure educational institutions. In most firms, around 80% of recruitment is made at the entry level and 80% of the total training budget is spent on these employees (NASSCOM-Deloitte, 2008). Many states have established Indian Institutes of Information Technology (IITs) as centres of excellence, to overcome shortages of employable labour in the IT sector. Changing school and university curricula; providing incentives to academics; promoting industry-academia partnerships; introducing ‘bridge courses’ for managers; expanding capacity of world class institutions (*e.g.*, IITs, IIMs and IISc)²⁷ are amongst such initiatives.

- **Creating world-class infrastructure and bridging the digital divide**

Major cities (Tier I/II cities such as Bangalore, Mumbai, Delhi, Pune etc.) are already witnessing signs of strain. Tier III/IV cities (such as Mysore, Manglore, Nagpur, Indore, Bhubneshwar and Kolkata) need development of adequate infrastructure with modern facilities (transport, particularly roads, and utilities). Public-private partnerships have been initiated and investment in an increasing number of engineering colleges, housing, transport facilities is underway, but many of these initiatives need further support.

- **Telecommunications infrastructure and regulatory challenges**

While some states of India clearly benefit from advanced telecommunications infrastructures, others are lagging. Further reforms to bridge the gap between urban and rural connectivity, efficient spectrum management and a market-based regulatory framework are key regulatory measures. To maintain a sustainable level of investment in this sector, policy measures need to

²⁷

IIM: Indian Institute of Management; IISc: Indian Institute of Science.

improve the regulatory environment; for example delivery of data services is extremely poor due to low spectrum coverage, and Internet access and broadband density is poor compared to countries such as China and Brazil.

The TRAI Act (1997) was somewhat ambiguous with regard to the mandate of the National Regulatory Authority. This was amended in 2000 to clarify the role and functions of the regulatory body vis-à-vis the policy maker. Nevertheless, various licensing and regulatory functions are still performed by multiple agencies including the Department of Telecommunications (DOT, licensor), DOT Wireless Planning and Coordination (Spectrum management), TRAI (Tariff, Quality of Services and Interconnection Regulation), and the Telecom Disputes Settlement and Appellate Tribunal (TDSAT) (Dispute Resolution). Generally there is a difference of opinion among these various agencies leading to disputes and prolonged litigation. While policy making powers in respect of licensing for telecommunication services rest with the DOT, the sector regulator (TRAI) has the powers to initiate recommendations. In many cases the DOT does not accept the TRAI's recommendations on market and sector liberalisation, or delays implementation. Due to the multiple regulatory agencies, regulatory oversight, reporting requirements, and compliance requirements are heavy burdens on all type of operators irrespective of their size, market segment or market power.²⁸

- **Promoting the hardware/electronics sector for domestic demand and export**

Granting of SEZ status, high consumer demand for electronic goods and favourable FDI flows have helped building a competitive hardware sector. Consumer electronics is the driver for this segment, and increasing production of finished and intermediate components will help to reduce the hardware trade deficit. However, in more advanced segments, Indian producers rely on foreign partners such as Unisys for TUL, ICL for ICIM, Sun and other technical collaborators for WIPRO Infotech, Hewlett-Packard for HCL-HP, etc.

- **Fostering innovation**

Indian industry has been heavily dependent on imported technology and on technical collaboration agreements. India needs to transform gradually from the 'back-office of the world' to the 'front-office of the world' through innovation. NASSCOM, with the help of various state governments, is actively encouraging linkages between technology industries, academia and research institutions in promoting research and innovation. Lack of knowledge about patent regimes, inability to take risks and lack of detailed domain knowledge have hindered software firms in promoting innovation. Strengthening patent rules, simplifying procedures and reducing the cost of patenting would help the innovation environment.

Impacts of the global recession

The major factor affecting Indian firms and the IT sector has been the global financial crisis and economic recession and the subsequent recovery. How did the Indian IT sector perform? The recession led to downward revisions of growth projections for major Indian and multinational firms, and a slow-down and negative growth for the top 10 Indian firms at the start of 2009, rather than a deep slump (see Box 1). This relatively good performance compared with the global IT hardware sector is due to growing domestic demand, a weaker currency and relatively good government macroeconomic management.

²⁸

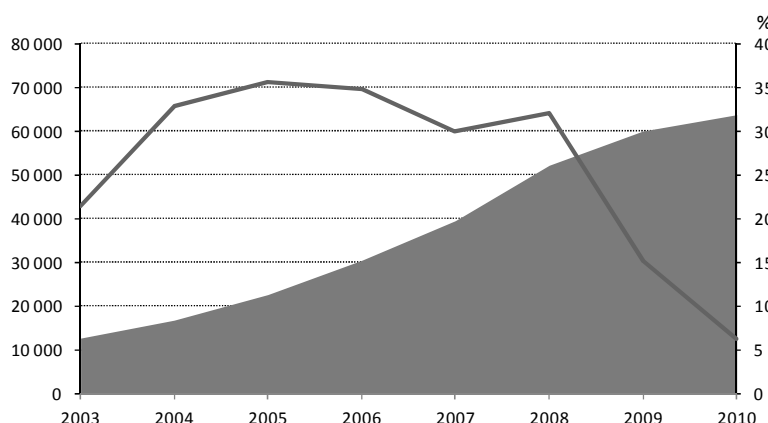
Based in part on comments from the United Kingdom Ofcom.

Box 1. Performance of IT services firms in India 2000-10

Demand for IT and business process outsourcing (BPO) continued during the crisis, with firms taking further advantage of (offshore) outsourcing to reduce their costs. Indian IT services firms have benefited from this trend. However, decreasing total contract value (in 2009 it was the lowest since 2001) and increasing competition from other offshore locations such as Brazil, China and the Philippines have put the revenue growth of Indian IT services providers under pressure.

The Indian IT services industry (including IT services, BPO, and software and engineering) has grown at two-digit rates year on year since the late 1990s, but in 2010 revenue growth slowed to one digit (6%). Between 2000 and 2010, annual revenue in the industry grew at 27% a year to reach almost USD 64 billion in March 2010 (Figure 12).

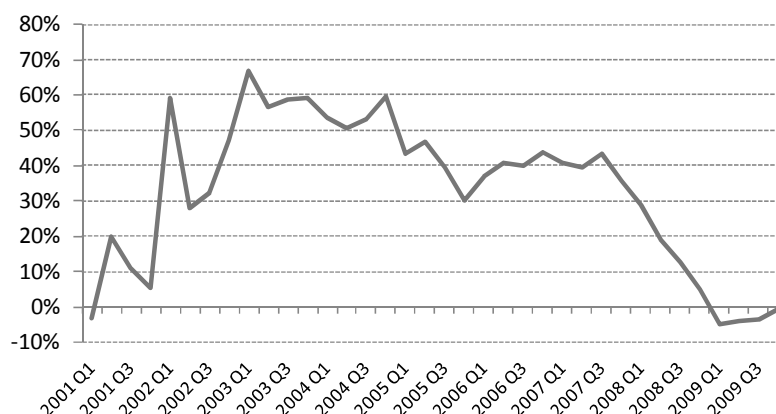
Figure 12. Revenues and growth of the IT sector in India, 2000-10
USD millions (left scale), year-on-year percentage change (right scale)



Note: The IT sector comprises IT services, business process outsourcing and software and engineering. Annual data to end of March. *Source:* National Association of Software and Service Companies (NASSCOM).

The top 10 Indian IT services firms generated almost USD 23 billion in annual revenue in 2009. This is almost 36% of the overall revenue of the Indian IT services industry. Tata Consulting Services (TCS), Wipro and Infosys Technologies are the biggest firms, accounting respectively for 27%, 24% and 21% of the top 10 revenues in 2009. Quarterly revenues of the top 10 Indian IT services firms have been increasing year on year (33% on average), since the 3% year-on-year decline in the first quarter of 2001. In the first quarter of 2009, however, quarterly revenue growth turned negative (around -5%) and remained slightly below zero in the following quarters of 2009 but growth has now resumed (Figure 13).

Figure 13. Quarterly revenue growth of the top 10 IT services firms in India
Percentage, year on year



Note: Revenue growth before Q2 2007 is slightly exaggerated as quarterly revenues for Tech Mahindra are not available before Q2 2006.

Source: OECD, compiled from quarterly reports, SEC filings and market financials.

The global financial market crisis, economic recession and current recovery have direct and indirect effects on the Indian IT sector. Any sector based on outsourcing is not recession proof and the Indian IT sector is no exception. Outsourcing has been a source of scale economies to support growth, consolidation and globalisation of Indian firms, but an increasing number of countries have become important offshoring destinations, and the increasing cost of labour in India is driving firms to a wide range of alternative destinations. For example, the top 20 UK IT services suppliers opened 21 offshore centres in the 2007-09 period, but only 2 were in India. Nevertheless, in a recent survey by Gartner, India and China continue to be the leaders of outsourcing services, out of 72 countries as offshore destinations.

The recent slowdown of the sector is shown in Box 1, with leading Indian IT firms slowing somewhat more than the sector as a whole as they are more exposed to the difficulties of their international clients. Early in 2009 NASSCOM was projecting that the Indian IT industry was set to witness single-digit growth because of global recession and lower technology spending in the United States and Europe (The Indian News, 2009), but that longer-term prospects remain good. Subsequently growth has returned as the OECD economy has turned up faster than expected and Asian economies have boomed (OECD, 2010a, 2010b). There is some evidence that the global crisis has increased the long run trend towards outsourcing as Western firms cut costs, reconsider their core activities and outsource where they do not have competitive advantage, and sectors such as tourism, healthcare, infrastructure and energy in addition to finance and manufacturing are increasingly turning to outsourcing. Mergers and acquisitions and rationalisation in the financial sector need technical expertise to integrate disparate systems; and stricter regulatory compliance increases long-term outsourcing opportunities.

The long-term impacts of the economic crisis are still hard to predict. The collapse of some of their largest financial services clients reduced the prospects of the leading outsourced service providers in the short run, affecting the revenue of large global Indian firms which service them, as shown in Box 1. In the domestic market, the global downturn forced firms to reduce hiring, postpone new investment and freeze salaries. On the positive side, wage bills on average halved to around 10% a year, the employee turnover rate declined, and productivity increased. Some states, such as Andhra Pradesh, Maharashtra and Karnataka, have also implemented e-governance projects which have underpinned growth.²⁹

Outlook

India is one of the fastest growing large economies, and the ICT sector is a significant contributor to this growth. The contribution of the Indian IT and ITeS segment to national GDP increased from 1.2% in 1997-98 to 5.8% in 2008-09, the Indian IT sector is the major exporting sector and it employs more than 2 million people. Indian ICT firms are held in high repute world-wide, service suppliers offer high quality products and services with state-of-the-art technology and the sector is a beacon for the country. Almost all major Indian software firms have obtained the International Standards Organisation 9000 (ISO 9000) certification (NASSCOM, 2004), and 80 out of the world's 117 Software Engineering Institute, Capability Maturity Model, Level 5 firms are from India.³⁰ Global ICT leaders such as Dell, Microsoft, IBM, Oracle, Ericsson, Unisys, Motorola, HP, Texas, Fujitsu, Siemens, and Bosch have invested in India. In the recent past, a rising Rupee, spiralling salaries and a shortage of high-skilled IT professionals has affected Indian operations. To counter rising costs leading Indian IT firms are acquiring businesses or setting up

²⁹ India Brand Equity Foundation.

³⁰ The Carnegie Mellon Software Engineering Institute (SEI) is a federally funded research and development center established in 1984, with major funding from the U.S. Department of Defense. They have developed the Capability Maturity Model Integration (formerly CMM) to improve software management practices. It includes five maturity levels, each representing a different component in the development of software process. Success in software engineering management practices helps organizations predict and control quality, schedule, cost, cycle time, and productivity.

development centres/back-offices in countries such as Mexico, the Philippines, Thailand, Egypt and eastern European countries including Hungary, the Czech Republic and the Slovak Republic. English-speaking skilled manpower is available in some of these countries at half the Indian wage rate.

The very sharp recession in OECD countries has slowed revenue and wage growth in the short run, but even with the return to growth, the long run situation needs to be changed. India has become the global front office, handling customer service calls, and back office, helping to process payments and run accounting and other computer systems. However, the current ‘lift and shift’ model will not continue in the long run. India needs to become one of the head offices – innovating new products and techniques or shaping major corporate strategies – and a provider of higher value added services in this changing environment, including in growth areas such as cloud computing, security and privacy.

The global recession originated from failure of regulatory systems and lack of transparency in OECD financial institutions. Better governance and management are needed throughout advanced economies and this potentially spills over into more substantial long-term budgets for IT-related transformation and greater transparency provided that strict reforms are adopted. Indian firms are already changing their behaviour and diversifying markets outside the United States and Europe, investing in training/human resources, and research and consulting which can add higher value services. Recruitment policy has been tightened, improving productivity and utilisation levels, all of which help to meet the challenges to remain competitive. In the midst of the crisis in 2009 the following trends and changes in the Indian IT sector were noted (NASSCOM, 2009b):

- Initially the global financial crisis sparked capital flight from India, with more than USD 10 billion in Indian equities repatriated to investing countries. Fraud by some Indian firms also lost investor confidence. For example, Wipro Technology was banned for four years in June 2007 by the World Bank for “providing improper benefits to bank staff”; major financial irregularities and collapse of Satyam in January 2009 further undermined investor confidence.
- On the other hand the crisis improved firm efficiency and employee productivity. Attrition rates fell and salary inflation slowed. It is expected that India will continue to supply global human resources, and it is estimated that India will create the equivalent of the combined working population of France, Germany, Italy and the United Kingdom by 2020. Increased outsourcing opportunities will also come with domestic growth and rapid growth in emerging markets.

Overall, the recession and recovery may increase long term outsourcing opportunities as firms seek better utilisation of resources, and the industry is well poised for further growth.

Policy suggestions

The Indian IT services sector plays a major role in the global market. The strength of the sector lies in the availability of skilled labour, early initiatives taken by the central and several state governments in promoting IT services in export markets and mass demand generated from the domestic sector itself. The hardware and electronics segment was in an embryonic stage for many years, although it has started picking up in recent times. The policy suggestions that follow identify priority actions that would assist India in maintaining growth in the IT sector (they are also laid out in Annex A1, following the format of national ICT policy peer reviews):

- *Policy prioritisation:* Many initiatives have been taken at various national, state and local levels. Prioritisation of the policy agenda is needed to define the roles of government and other public sector actors along with the private sector. Monitoring performance and keeping timelines is

important in this respect. Promoting electronics production for domestic and export markets should be a priority.

- *Rural awareness:* To increase IT awareness in rural areas, the Indian government needs to increase the funding of major projects including introducing cyber cafés, software and Internet websites in Indian languages at a wider level. Connectivity in rural areas needs improvement. Initiatives such as Media Lab Asia (a collaboration of the Department of Information and Technology (DIT) with the Massachusetts Institute of Technology) are helping villages in the areas of education, training, healthcare, agriculture, etc. using broadband. This kind of programme should be introduced more widely.
- *R&D spending:* Further efforts are needed to foster business sector R&D, and commercialisation of technology, is necessary. Contributions of both public and private sector R&D should be increased. Further sources of venture capital are needed both in IT services and hardware. Particularly in the hardware segment, fast obsolescence, a weak R&D base and poor basic infrastructure (transport and utilities) have resulted in low investment.
- *ICT skills:* To create more manpower and retain people in the IT sector, government and other bodies need to constantly update the curriculum in schools, colleges and universities, whilst offering higher salaries to research professionals. Academia-industry partnerships should be promoted more extensively.
- *Content creation:* Development of websites is desirable both for public and private businesses (maps, archives, products, prices, staff and contact persons). Currently, data availability in the public domain is very poor, and use of IT in government functions remains low.
- *Importance of small and medium-sized enterprises (SMEs):* Providing SMEs fiscal incentives so that they can compete with multinationals in export markets. Development of web-sites with company details, improved access to data in the public domain and introduction of digital signatures are needed to run businesses more effectively.
- *Standard, trust and security:* Introduction of policies to deal with cyber crimes. Laws need to be introduced for electronic payments and Internet-based businesses.
- *Evaluation:* Information at various levels is not transparent or easily accessible, and evaluation of government policies remains sparse. Better and more widespread evaluation will lead to more efficient policies, the identification of good practice in policy design and delivery.

ANNEX
A.1. POLICY RECOMMENDATIONS

Policy domain	Current priority	This priority should be	Suggested recommendations
Co-ordination of initiatives	High	Continued	Current and recent past strategies are well-articulated, but the implementation process is somewhat slow, regional initiatives should be promoted to bridge the digital divide.
Infrastructure	Low to Medium	Increased	Telecom infrastructure is relatively adequate. Connectivity in rural areas needs further improvement. Initiative like Media Lab Asia (a collaboration of the Department of Information and Technology (DIT) with the Massachusetts Institute of Technology) are helping villages in the areas of education, training, healthcare, agriculture etc using broadband. This kind of programme should be introduced in every state.
R&D and Innovation	Low	Increased	R&D expenditure is well below that of many countries. Increases in industry-academia partnerships and public-private partnerships are needed.
ICT skills	High	Continued	Changes in curriculum are occurring and should be continued. Retaining skilled workers with high salaries is necessary.
Content creation	Low to medium	Increased	Enhance availability of public sector content, wider access of Indian language based software and operating system INDIX. ³¹
Small and medium sized firms (SMEs)	Low to Medium	Increased	There is scope for improvements for SMEs
Standards, trust and security	Low to Medium	Increased	Different initiatives have been taken by government and NASSCOM, continued implementation is necessary.
Evaluation	High	Continued	Firms have a good reputation in domestic and world markets. Access to economic and programme data in the public domain is necessary in evaluating performance. Clear and well articulated governance policies, trustworthiness and a greater degree of openness are needed to perform competitively in this global environment

³¹

The INDIX operating system enables Indian languages to be available freely by using information technology for various social purposes.

ANNEX

A.2. MAJOR FIRMS

The following section gives a brief review of selected domestic firms and multinationals in India before the crisis and recovery.

Tata Consulting Services Ltd: Established in 1968 as a Division of Tata Sons, TCS was a pioneer IT company and continues to maintain its pre-eminence in India. In 2006-07, total income increased by 34% compared to the previous year and net profit was 25% of total income. The company had 148 offices globally. Additionally, there are many delivery centres outside India with major sites in Hungary, Brazil, Chile, Uruguay and China. The United States was the largest market; contributing 52% of the consolidated revenue, while the United Kingdom and Europe together contributed 29%. The company has expanded into emerging markets including Latin America, the BRICs and the Asia Pacific region. It has made acquisitions/alliances in Switzerland, Australia and China, and is widely recognised including:

- Ranked among the Top 10 US application management services vendors
- Company of the year-2006 in the *Economic Times*
- Top position in ‘Top 10 Best Performing IT Services providers’ category in the 2007 Global Services Listing.³²

Infosys Technologies Ltd: Established in 1981 it was the first Indian firm listed on the NASDAQ, in 1999. It was the first to benchmark its organisational practices to global standards. In 2005-06, growth in revenues was 34% and growth in earnings was 31%, with 66% of revenues are earned from North America, 24 % from Europe, and 8% the rest of the world. Revenues from software exports increased by 32% in 2006-07, and gross profits were 46% of revenue.³³ The company has, amongst others, subsidiaries in Australia (Melbourne), China (Shanghai), the United States (Texas) and Progeon Limited in India. It also has operations in Europe, Japan and Africa. Infosys pioneered the Global Delivery Model (GDM), which is used in distribution and management across multi global locations. By 2005-06, the company ranked No. 10 in the annual *Business Week InfoTech100*, and had reached a high level of maturity, systematically benchmarked against world-class operating models.

Wipro Ltd: Wipro commenced operations in 1946 as a Vanaspati oil manufacturer and entered the IT sector in 1980. In 2007, revenues grew by 41% to INR 149,982 million and profit after tax grew by 42% to INR 29,421 million. The company had 50 subsidiaries in 29 countries and is listed on the New York Stock Exchange (NYSE). R&D efforts were equivalent to nearly 8.5% of total revenues in 2005-06. In India, the Middle East and the Asia Pacific Wipro Infotech manufactures personal computers (PCs), with growth of desktops of 21% to 4 million units in 2006, and growth of laptops of 167% to 0.6 million in 2006.³⁴ This segment is a leading strategic partner for the firms providing IT solutions. Wipro Technologies (NYSE: WIT) operates globally, providing IT consulting and software services.

³² TCS, Annual Report, 2006-07.

³³ Infosys, Annual Report, 2005-06.

³⁴ Wipro, Annual Report, 2005-06.

In the 2009 NASSCOM annual survey (January, 2009), TCS revenues went up 22% in 2007-08, with Infosys and Wipro up by 35% and 23% respectively.

Other major software/services exporting Indian firms are HCL Technologies, Patni Computer Systems, I-flex Solutions, Tech Mahindra, Perot Systems TSI (I) Ltd, L&T Infotech, Polaris Software Lab, Hexaware Technologies, Mastek, Mphasis BFL, Siemens Information Systems, Genpact.

Multinational firms in India

The first US ICT multinational company to enter India was Texas Instruments, in 1988. Until the early 1990s, MNCs relied on interim IT service contractors in India, known as 'body shopping'. Currently more than 500 major international firms have IT operations in Bangalore alone, and other centres such as Hyderabad have rapidly increased in importance. Major IT MNCs, IBM and Oracle have Indian development centres as part of all global application development projects - for example IBM has six such centres, and Electronic Data Systems and Computer Sciences Corporation have substantially increased their presence. Other major MNCs with Indian subsidiaries that export IT services include Microsoft, Hughes, Hewlett-Packard, Siemens, Lenovo, Genpact, Nortel, Motorola, Intel, i2 and Cisco.

An increasing number of Indian firms are expanding their horizons in overseas markets. China and other non-OECD countries have recently received the top priority, for example, for Infosys and TCS. Wipro's Japanese and Chinese centres focus on language-specific jobs, Eastern European centres handle BPO operations whilst French and Brazilian centres provide embedded software design. Other centres such as Egypt are also being increasingly used as regional centres for leading Indian IT firms.

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