Indian Information Technology Industry : Past, Present and Future& A Tool for National Development

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Abstract

India's software and services exports have been rising rapidly. The annual growth rate ranges between 20 -22% in IT services and nearly 55 % in IT-enabled services (ITES), such as call centres, Business Process Outsourcing (BPO) and other administrative support operations. Together they are predicted to grow at 25% pa till 2010.The IT industry is highly export oriented and the exporters are predominantly Indian. The Indian BPOs (ITES) are moving up the value chain, handling high end data for airline information, insurance, banking sector and mortgage companies, enterprise resource planning, among others. Some of the companies have already moved into significantly higher value added segments such as mission- critical applications, development and support, product design, HR Management, knowledge process outsourcing for pharmaceutical companies and large complex projects.

Software exports make up 20 % of India's total export revenue in 2003-04, up from 4.9 % in 1997.This figure is expected to go up to 44% of annual exports by 2010. Though India accounts for just about 3 % of the world market for information technology services, this sector has been growing at a scorching pace, helped by a large pool of English-speaking workers, nearly 2 million engineers and the increasing tribe of tech-savvy entrepreneurs in the country.

The Information Technology industry currently accounts for almost 4.8 % of India's GDP. It will account for 7 % of India's GDP by 2010.

Software and IT enabled services have emerged as a niche sector for India. This was one of the fastest growing sectors in the last decade with a compound annual growth rate exceeding 50 per cent. Software service exports increased from US $ 0.50 million in 1990 to $5.9 billion in 2000-01 to 23.6 billion dollars in 2005-06 recording a 34% growth. A compound annual growth of over 25% per annum is expected over the next 5 years even on the expanding base. The impact on the economy of projected software and IT enabled service exports of $ 60 billion by 2010 is likely to be profound. One manifestation is that India notched up a current account surplus in 2001-02, for the first time in 24 years. India further needs an open environment under GATS to promote exports of services through outsourcing and off-shoring[2].

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[2] Cross border IT enabled services are services provided from one country to another over telecommunication or data networks; and are either externally contracted (outsourced) or provided by a remote subsidiary of the same company(off-shored /out-located). Offshore outsourcing jobs can be performed at a fraction of the cost in low wage countries such as India and China. Though issues such as wage inflation and rising competition from other low-cost contenders has narrowed their overall lead. Due to a revolution in digital technology and reduction in telecommunication costs,

The present study examines the growth performance of India's IT industries, with particular attention paid to the role of policy in this process. **The study recognizes that emergence of a strong Indian IT industry happened due to concerted efforts on the part of the Government, particularly since 1980s, and host of other factors like Government-Diaspora relationships, private initiatives, emergence of software technology parks, clustering and public private partnerships**. In this study we further look at the major parameters of the Indian IT industry and give justification for including the main factors responsible for the IT boom in India. The study has looked into the past and present trends of the Indian IT industry and has considered further needs of IT sector to act as a catalyst of growth and development. The study has examined whether the Indian IT growth does have enough lessons for other countries to model their IT policy which may help them to shape their IT industry as driver of growth and development.

IT firms were actually required to export software in the early days of the industry. This arose in the context of a shortage of foreign exchange in India in the 1970s and early 1980s.Software firms that needed imported inputs were required to earn foreign exchange themselves through export of software. This enabled them to get an idea of global markets very early. Besides **formulating the national vision to promote software industry in India in the early 1980s by the government**, there were deliberate attempt by the companies to promote software production like compilers, device drivers and operating system to cater to the domestic hardware sector. The high tariffs for the hardware sector had meant that the production of domestic hardware segment (including PCs which were introduced in the same period) had to be sustained requiring necessary softwares like operating system and drivers. Subsequently by mid 1980s, software started coming up unbundled with the hardware. This further gave fillip to the software industry and exports. The 1990s and early 2000 saw the rise of Software Technology Parks and formation of the Ministry of Information Technology, respectively. Despite liberalization of the 1991, the software industry flourished signifying the inherent strength that it developed due to benign and enabling environment provided over a period of time and also the fact that the 1990s saw the dramatic decline in telecommunication costs (government explicit intervention) and the commercialization of the internet along with the Y2K "problem".

The Data Envelopment Analysis (DEA) model is used to work out technical efficiency of Information and Communication Technology (ICT) Industry in host of countries which are front runners as far as ICT are concerned. India lags behind the most as far as ICT (not IT) is concerned. However, information and Communication technology industry has brought revolution in India because it has reduced intermediation in business and society, provided solutions across sectors and is increasingly becoming an important tool for

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jobs related to functions such as software programming and design, call center operations, accounting and payroll operations, medical record transcription, paralegal services, and software research and testing etc., can be performed at a foreign location and transferred through the internet. Also, rise of protectionism in the West as a reaction to growing outsourcing poses a major threat to trade in services emanating from the Developing Countries like India and China. This calls for determined and innovative GATS negotiating strategies(the theme of the present work though is different)

national development. DEA is also applied to benchmark the performance of the 92 Indian Software Companies for 2005- 2006. The impact of various determinants on technical efficiency of the Indian Software companies is worked out using tobit regression. The impact of the explanatory factors on net exports of 92 software firms in 2005-06 is also worked out using simple regression exercise.

E-government is the application of Information and Communication Technologies (ICT) by government agencies. Its use promises to enhance the effectiveness and efficiency of government and alter its relationship with the public.

E-Commerce primarily refers to buying, selling, marketing and servicing of products or services over internet and other computer networks. E-Commerce in India is just taking off with the advent of Railway and Online Air bookings and Net banking. The business is likely to grow to Rs 2300 crore by 2007 .Electronic commerce allows efficient interactions among customer, suppliers and development partners cutting down on transaction time and reducing the costs of doing business. The role of government is to facilitate the development of E-Commerce.

For promoting South-South Cooperation and making it meaningful, the governments of the member countries need to pool resources and capabilities in R&D and human resource development for harnessing the fruits of Information and Communicating technologies. The study spells out in detail a number of examples where ICT has been used by rural communities for their benefit and for policy and development goals of the government in general.

Introduction

Riding high on the outsourcing wave[3], India is likely to witness software and services exports growth of 25-28% clocking revenues of $36-38 billion in fiscal year 2007. IT- ITES [4](Information Technology enabled services) exports are likely to grow by 27-

[3] Outsourcing is a business strategy that many corporations have used for decades. The most common processes that carriers are outsourcing are software development, system maintenance, core systems hosting and other systems hosting. In the last decade, the IT and BPO industries have seen substantial offshoring. India has been the leading offshore destination during this period, and now accounts for 65 per cent of the global industry in offshore IT and 46 per cent of the global Business Process Offshoring (BPO) industry. Traditionally, off shored functions have involved IT enterprise applications, infrastructure management, and IT support. However, recently we have increasingly seen off shoring extending to more mainstream functions such as HR back office, payroll, benefits administration, and inbound call centers. New entrants in this market include recruitment and staffing functions, tax planning, budgeting and reporting, risk management, and also the operations planning and scheduling functions. According to a report on global sourcing published by Gartner, the leading provider of research and analysis on the global IT industry, India remains the undisputed leader in terms of offshore centers, with China and Russia emerging as strong contenders. Countries such as India, Malaysia, and the Philippines are popular because they offer well-educated, English-speaking workers at a fraction of what they would cost in the US, and are therefore reaping rich dividends. Other countries benefiting from outsourcing are Mexico (where the first jobs from the US moved), Bangladesh and Sri Lanka. India holds the upper hand with a perfect time zone difference that enables a 24/7 service to US firms. The areas of greatest global sourcing expansion over the next three years are expected to be Eastern Europe and Southeast Asia.

[4] Information technology essentially refers to the digital processing, storage and communication of information of all kinds. IT can be defined as computing and telecommunication technologies that provide automatic means of handling information. IT includes software and hardware. The role of IT in services i.e., IT-led services includes the following : Product support Process outsourcing Hardware & software maintenance Training & education IT outsourcing System integration & application development .Therefore, IT can potentially be used in every sector of the economy(Nirvikar Singh,2003). The true impact of IT on growth and productivity continues to be a matter of debate, even in the United States, which has been the leader and largest adopter of IT. However, there is no doubt that the IT sector has been a dynamic one in many developed countries, and India has stood out as a developing country

30% in FY 06-07, posting revenues between $29-31 billion, according to National Association of Software and Service Companies (Nasscom), which stated that exports for FY 05-06 had risen 33% to register revenues worth $23.6 billion as compared with export revenues of $ 17.7 billion in FY04-05.FY 05-06 also saw the overall Indian IT-ITES industry(including domestic market) grow by 31%, revenues of $29.6 billion up from $22.5 billion in 04-05. Over a period of time, India has established itself as a preferred global sourcing base in these segments and they are expected to continue to fuel growth in the future. These segments have been evolving over the years into a sophisticated model of operations. Indian IT and ITES companies have created global delivery models (onsite-near shore-offshore), entered into long term engagements with customers, expanded their portfolio of services offerings, built scale, extended service propositions beyond cost savings to quality and innovation, evolved their pricing models and have tried to find sustainable solutions to various issues such as risk management, human capital attraction and retention and cost management. A key demand driver for the Indian IT services and ITES industry has been the changing global business landscape which has exerted performance pressures on multinational enterprises. The IT industry and IT-enabled services, which are rapidly growing offer opportunities for FDI as well. India has emerged as an important venue for the services sector including financial accounting, call centers, and business process outsourcing. There is considerable potential for growth in these areas. Biotechnology and Bio informatics, which are on Government's priority list for development, offer scope for FDI.

The industry has crossed $27 billion dollar mark in 2005. Software exports accounted for 20% of Indian export revenues in 2003-04.By 2008 it would account for 7% of India's GDP and would contribute 30% of total Indian export revenues. The IT sector is likely to give employment to 9 million people in India by 2008 and also generate $87 billion in annual revenues & $225 billion in market value by 2008 (see McKinsey Report, quoted in the Department of Information Technology webpage http://www.mit.gov.in/dbid/eproduction.asp- appendix Table I). In addition to the nearly 1.3 million-strong workforce employed directly in the industry, Indian IT-ITES is estimated to have helped create an additional 3 million job opportunities through indirect and induced employment. Indirect employment includes expenditure on vendors including telecom, power, construction, facility management, IT, transportation, catering and other services. Induced employment is driven by consumption expenditure of employees on food, clothing, utilities, recreation, health and other services. Against the level of $9.5 billion achieved in 2002-03, software and IT services exports are expected to grow to $87 billion by 2008. While the software export target is set at $50 billion, the target for export of hardware has been kept at $10 billion by 2008.India's share in the overall global software market is expected to increase from the present 2 per cent to 7 per cent by the terminal year of the Tenth Plan.

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where IT, in the guise of software exports, has grown dramatically, despite the country's relatively low level of income and development. An example of IT's broader impact comes from the case of so-called IT-enabled services, a broad category covering many different kinds of data processing and voice interactions that use some IT infrastructure as inputs, but do not necessarily involve the production of IT outputs. IT enabled services include call centres, medical transcription, back office operations, revenue accounting, insurance claim processing ,legal database, payroll records, logistic management, content development/animation, entertainment software, graphics and design, computer animation, among others

India's strength has emerged through large client wins, cross border mergers and acquisitions, and the movement of the industry towards a stable pricing model. With low costs no longer being the deciding factor for foreign companies looking for developing software in India, research, chip design and financial analytical modeling are some of high-end services increasingly coming to India. In an industry which has been one of the flywheels of robust economic growth in India gaining a reputation for being able to handle complex contracts, the country top firms are now looking at large-sized, multi-year orders to boost revenue stability. Asia's third-largest economy has become a hub for global firms like Motorola Inc. and International Business Machines Corp. for services such as handset software and supply chain management. India's large English-speaking engineering workforce and cheaper wages of nearly one-fifth of western salaries have helped to attract outsourcing. The top three Indian software exporters, flagship Tata Consultancy Services Ltd, Infosys Technologies Ltd. and Wipro Ltd., each boast more than a billion dollars in annual revenue. The United States is the biggest market for Indian software firms, accounting for as much as 70 percent of revenue. The domestic software sector is dominated by ready-to-use products and packages, which account for 40 per cent of the market followed by projects, around 30 per cent. Domestic companies account for less than 20 per cent of the total market, indicating a high demand for imported products.

It is a surprise that India has been able to achieve as much as it has in IT development(Srinivasan,2005). Many scholars have termed this as leapfrog development. Even data on information and communication indicators tend to support the hypothesis. The number of personal computers per 1000 people in India in 2002 at 7.2 is just about the average of 6.9 for low income countries and a fourth of China's 27.6.Internet users per 1000 people at 17 is just about the average of 16 for low income countries, but still a quarter of China's 64.India spent 3.7% of GDP on IT compared to China's 5.3%(World Bank World Development Indicators on CDROM,2005).This points out to the concerted policies and vision by the government and industry to promote software exports and transfer of technology and telecommunication links in 1980s and particularly in 1990s.

Since 1984 under the rule of Prime Minister Rajiv Gandhi, India has been pursuing liberalization policies that have helped the IT industry develop. More specifically the computer policy of 1984 and 1986 policy on computer software export and software development and training[5] gave a much needed fillip to the software industry. On the other hand, the People's Republic of China provided little state support for this endeavor until the late 1990s. Now lagging behind, China is trying to catch up by replicating India's model.

The government recognizes the significant economic opportunity that the information technology (IT) explosion represents to India and is committed to the policies,

[5] The policies reflected in various government documents emphasized that : Effective software export promotion on a sustained basis can be effective in the long run only if it is planned as a part of an overall software promotion scheme covering both export and internal requirements including import substitution. Also planning for software development is integrally connected with the plan for hardware development and system engineering (Government of India,1985).The policies ,for example, called for the setting up of a separate Software Development Promotion Agency under the erstwhile Department of Electronics. The import of inputs needed for software development was also made more liberal.

infrastructure development and education investment to maintain the growth. The Government of India is providing for more liberal policy framework for the IT sector. As stated above one of the major factors of excellent and consistent growth of Indian software industry can be attributed to continuous liberalization of policies of the Government of India. NASSCOM and the government have worked together in close co-operation over a long time for forming and implementing these policies. During 1991, NASSCOM lobbied with the Government and for the first time, secured income tax exemption from profits of software exports. Later, Government, systematically and gradually, reduced import duty on computer software from a high 114 percent to nil. Copyright laws were also amended.

The Ministry of Information Technology is meant to act as a nodal institution for the promotion of the sector, facilitating and coordinating the various initiatives of the central and state governments and the private sector. Priority is given to e-governance, development of software in Indian languages, IT for the masses, distance education, e-commerce, cyber security and HRD. Postgraduate education and research in IT is pursued for promoting R&D in the emerging areas of Bluetooth technology[6], e-commerce, and nano-technology and bioinformatics solutions.

Foreign investment in the sector is encouraged by simplifying policies and strengthening and upgrading telecommunication and IT infrastructure. Establishing an interface of computers with diverse Indian languages. The endeavor will be to develop suitable software and technologies to enable the people to use computers in local languages. Attempts to take IT to the masses will be accelerated by promoting Internet accessibility[7], content creation in local languages, IT applications for various disabilities, empowerment of the masses with special thrust on women and children, rural healthcare systems, digital libraries in order to preserve the country's cultural heritage and social identity. Enrolment in Indian technology schools is expecting to reach 600,000 by 2008. The government has set a target of 20 million broadband users by 2010. The Indian federal and state governments are committed to developing and broadening e-governance. Fourteen state governments have IT-specific priority policies and many have implementing IT-related projects. Thus, we see that India's proactive government played an instrumental role in encouraging the IT industry.

The present study examines the growth performance of India's IT industries, with particular attention paid to the role of policy since 1960s in this process. **The study recognizes that emergence of a strong Indian IT industry[8] happened due to**

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[6] Bluetooth connectivity — one that helps you talk handsfree with a wireless headset, or send data from one phone to the other wirelessly. Bluetooth is not a technology owned by one company, but by a conglomerate called the Bluetooth Special Interest Group (SIG), led by promoter companies comprising Microsoft, Intel, Nokia, IBM, Motorola, Toshiba, Ericsson, and Agere. Bluetooth-enabled products include printers, accessories, presentation systems, MP3 players, and mobile phones.

[7] India has an estimated 40 million Internet users, making it the country with the fifth-largest number of Internet users. Yet, that number only represents 3.6 per cent of the total population. The USA, with over 100 million Internet users, has a penetration rate of 68.7 per cent and Australia, with approximately 14 million users, has a penetration rate of 68.2 per cent.

[8] Indicators of the strength of India's software export capabilities include the depth of its base, and the breadth of its global reach. There are over 2,500 Indian software exporters, and while only the top five (TCS, Infosys, Wipro, Satyam and HCL) are – or are approaching the status of – global brands, they together account for only about 35% of software exports. The United States remains by far the largest market for India's software exports, its share of India's software exports being 63%, with Europe coming in at 26%, and Japan and the rest of the world accounting for the remaining. Going forward, the more traditional IT outsourcing service lines such as

concerted efforts on the part of the Government, particularly since 1980s, and host of other factors like Government-Diaspora relationship, private initiatives, emergence of software technology parks, patterns of spatial agglomeration in the IT sector and public private partnerships. In this study we further look at the major parameters of the Indian IT industry in particular and give justification for including the main factors responsible for the IT boom in India. The study will look into the past and present trends of the Indian IT industry and consider further needs of IT sector to act as a catalyst of growth and development. The study will also examine whether the Indian IT growth does have enough lessons for other countries to model their IT policy which may help them to shape their IT industry as driver of growth and development A number of studies have looked into different aspects of India's IT software export boom(Schware,1987,1992;Sen,1995;Heeks,1986;Kumar,2000a,b,2001;Arora et.al,2001;Joseph and Harilal,2001;Kumar and Joseph,2005;Parthsarthi and Joseph,2002;Joseph,2002).Arora and Athreye(2002) argue that the software sector has contributed to Indian economic performance well beyond the macroeconomic indicators of GDP share, employment and foreign exchange earnings. In particular, they argue that software companies have come to represent models of good corporate governance that other enterprises can and increasingly emulate. This creates productivity spillovers to other sectors. Among the practices the authors cite are: (i) increased investment in staff training;(ii) incentive pay linked to corporate performance;(iii) flat hierarchies and team organization, designed to encourage knowledge sharing(iv)IT sector in promoting entrepreneurship. The international competitiveness of the Indian software industry has been developed in two stages. First, via long-term investment by the state in technical education and science and technology, with neither necessarily directed at the production of software. Subsequently, an incipient software industry with recognizably high export potential has been targeted via fiscal incentives and the provision of export-enabling infrastructure (Pulapre Balakrishnan , 2006)

INDIAN IT INDUSTRY: Study of the Past till Present

1960s and 1970s: Indigenization and Self Sufficiency

India was motivated to try to develop self-sufficiency in computers and electronics largely by national security concerns related to border conflicts with China and Pakistan. The government created an Electronics Committee which devised a strategy for achieving self-sufficiency in electronics within ten years by "leapfrogging" ahead to absorb the most advanced products and technologies available. The goal was eventually to achieve indigenization of technology, whereby India would move away from dependence on foreign technology and produce its own. This approach not only

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hardware and software maintenance, network administration and help desk services will account for 45 per cent of the total addressable market for offshoring and are likely to drive the next wave of growth. While the addressable market for the global offshore IT and BPO industries is quite large, industry evolution will largely be shaped by the interplay of three major forces: (1) supply (the capacity and quality of offshore locations); (2) demand ramp-up (realistic adoption of offshoring by companies); and (3) industry conduct (the actions taken by industry players.

responded to the perceived security risks, but also fit the ideology of self-sufficiency which drove much of India's post-independence political and economic agenda.

The main vehicle chosen to gain access to advanced computer technologies was negotiation with multinationals, primarily IBM, which dominated the computer market in India (from 1960-1972, IBM accounted for over 70% of all computers installed in India). From 1966 to 1968, the Indian government tried to get IBM to share equity with local capital in its Indian operations. IBM said it would leave India before agreeing to equity sharing, and the government let the matter drop.

In an attempt to satisfy the government's interest in developing domestic production, both IBM and British-owned ICL began to refurbish used computers in Indian plants and sell or lease them to Indian customers. IBM felt that India should evolve technologically from one level of sophistication to the next. However, a 1966 report by the government's Electronics Committee stated that such step-by-step technological evolution should be avoided and that India should leap ahead to the latest technologies. But at this point, the government was unable to impose its will on IBM. The government's early attempts to regulate the IT sector actually worsened the degree of technological backwardness as Indian users installed the domestically refurbished machines rather than importing newer models.
The government's inability to effectively regulate the MNCs was due partly to institutional weaknesses in the agencies assigned the task. In 1966, responsibility for implementing the Electronics Committee Report strategies had been given to the Department of Defense Supplies, with monitoring by a new agency, the Electronics Committee of India. However, the committee lacked support staff and had no authority to compel action by other agencies. This lack of authority and technical competence left the government unable to negotiate with the MNCs or to regulate the IT sector effectively. By 1971, the Department of Defense Supplies had a backlog of over 150 license requests for IT projects. After much criticism of the Department by other agencies and the private sector, the government announced the formation of a Department of Electronics and a new Electronics Commission. The Commission was responsible for policy formulation and oversight and the Department was responsible for day-to-day implementation of policies.

The Electronics Commission was given authority to direct other government units and to regulate private and public electronics enterprises, and it developed a professional staff capable of providing the necessary technical support to effectively regulate the sector. In 1975, the Department of Electronics was given power over the licensing of computer imports. The new Committee and DOE had the authority and capability to establish control over the development of IT in India and they did exactly that.

One of the first steps taken was the establishment of the Santa Cruz Electronics Export Processing Zone (SEEPZ) near Bombay. Foreign and Indian investors were offered incentives to establish an export base in India, including tax breaks, cheap land, duty-free import of inputs, and a streamlined permit process. In return, the government required

that all or most of the production be exported and that Indian components be used as much as possible.

A second step was the creation of the state-owned ECIL (Electronics Corporation of India Ltd.) as a national champion in minicomputer production. ECIL got almost all of the government's computer development funding and the DOE made it very difficult for private competitors to get operating licenses. The government's plan was to allow imports of mainframes and large minis, give the small mini market to ECIL, and allow private firms to compete in the micro sector. Thanks to this support, ECIL's market share ranged from 40% to 53% of the computer installations in India between 1973 and 1977. However, by the end of the decade, ECIL had failed to make a computer that was technologically sophisticated, price competitive or which could be delivered on time.

The third action taken by the Electronics Department and Commission was to once again challenge the position of the multinationals. Using FERA regulations, the government began to pressure IBM and ICL to dilute their equity to 40% in their Indian operations. ICL agreed to combine its two Indian operations and reduce its equity to 40%, but IBM refused.

Negotiations with IBM went on through 1976 and 1977, but before they took place, two important developments occurred. In 1975, U.S. computer maker Burroughs entered into a joint venture with Tata Consultancy Services to export software and printers from SEEPZ. This meant the government had two MNCs (ICL and Burroughs) in the country on its own terms, which probably encouraged the government to take a hard line toward IBM.
Also in 1975, the Indian cabinet approved a proposal to set up the state-owned Computer Maintenance Corporation (CMC) with a legal monopoly on the maintenance of all foreign computer systems in the country. This reduced the advantage IBM had with users as a result of its superior service capabilities. Now users would have to depend on CMC no matter whose system they purchased.
With its bargaining position substantially enhanced, the government continued to demand that IBM dilute its equity to 40% for all Indian operations. IBM responded with a proposal to share equity in its non-computer operations, meet export goals, and fund an Indian science center and an electronics testing facility. The government refused. After two years of negotiations, IBM decided it could not back down on the equity issue and in 1978 it quit India altogether.

IBM's exit was a seminal event, and illustrated the extent of the government's ability to exert its power over multinational corporations and direct the development of the IT industry in India. The question which naturally arises is why the government chose a showdown strategy with IBM. It seems that the Indian government did not originally set out to drive IBM away, but felt that it could not allow IBM to be exempt from the FERA without jeopardizing its ability to negotiate with other multinationals and implement its nationalistic policy objectives(Dedrick and Kraemer,1993).

One effect of IBM's departure was to open up the market to a number of competitors, including ECIL, ICL, and the Tata-Burroughs joint venture. ECIL dominated the market for a time, thanks to strong government support, but by the end of the 1970s, local private firms such as HCL, DCM and ORG had emerged to control most of the market

The decline of ECIL was partly due to its own inability to produce competitive products, but it was exacerbated by changes in policy. The DOE had come under criticism in the late 1970s for blocking the efforts of private sector firms to produce hardware and for protecting ECIL at the expense of users and domestic competitors. The government responded by giving permission to several private companies such as HCL, DCM and ORG to produce data processing systems and import parts and components. Soon these companies had supplanted ECIL as the major computer suppliers to the Indian market.

The 1970s and 1980s – Software Exports

During the 1950s and 1960s, there was no Indian software industry. Software came bundled with hardware provided by multinational hardware companies like IBM(from the US) and ICL(from UK). IBM's unbundling of software from hardware in the late 1960s is seen as a generic global catalyst for the existence of independent software firms (*Financial Times* 1989).

In the 1970s too, there was no separate software industry. Multinationals such as IBM and ICL were the largest providers of hardware to the industry, which used to be bundled with the operating systems and a few basic packages that were generally written in FORTRAN and COBOL languages.

Larger enterprises (including the Indian defense and public organizations) that needed customized applications employed in-house teams that did everything from installing systems to writing software. In fact, when specific software applications became popular, stand-alone boxes were made for them. In 1970s, the concept of stand-alone word processing software did not exist. Later, when local companies grew (after IBM’s exit in early 1980s), these companies also had their own proprietary operating systems that generally executed only their computer programs.

India exported its first software services and products in the mid-1970s.Although India was among the first developing nations to recognize the importance of software, the key driver behind exporting software was foreign exchange. To export software, Indian companies had to design it for hardware systems that were the standard worldwide, which in the 1970s were the IBM mainframe computers. However, Indian import duties on this hardware were extremely high (almost 300 percent) and hence during the late 1960s and early 1970s, IBM used to sell old, refurbished and antiquated machines (because that is all that Indian companies could afford). Fortunately, within a few years, the Indian Government lowered import duties on all IT equipment but with a pre-condition that the exporters would recover twice the value of the foreign exchange spent on importing computers within five years – a clause that was modified in the 1980s. Hence, overall, the regulatory scenario was not very favorable for software exporters and this constitutes the beginning of the Indian software industry.

The first software exporting company from India was Tata Consulting Services (TCS) that started operations in 1968. Fortunately, after a few local orders, TCS bagged its first big export assignment in 1973-74, when it was asked to provide an inventory control software solution for an electricity generation unit in Iran. During this period, TCS had also developed a hospital information system in UK along with Burroughs Corporation (which was at that time the second-largest hardware company in the world) and it became a role model for other Indian IT companies to follow in the 1980s.

Despite the tough policy with respect to imports, by early 1980s, India was the only developing nation to have any significant software exports – USD 12 million – a substantial leap over the 1979 level of USD 4.4 million and 30 companies were already beginning to export software.

The main competitive advantage for Indian companies was obviously the cost and the ability to communicate using the English language. The total charges for a software developer in India varied from USD 16,000 to USD 24,000 annually whereas the corresponding charges of sending the same developer to the US varied between USD 32,000 and USD 42,000 annually. Comparing this to the total cost of a US software developer (USD 60,000 to USD 95,000 yearly) in 1980, the savings were clearly quite significant.

Inspite of the cost advantages and a relatively good proficiency in English, the Indian software industry continued to face the following challenges in 1970s and 1980s:

• Lack of availability of hardware: Import of hardware – especially mainframe computers was very tedious and expensive.

• Shortfall in trained manpower: Although the education system was producing substantial number of engineers who were very talented, very few colleges were offering any computer training or IT courses.

The following three unrelated incidents contributed heavily in shaping the Indian IT industry(Sarla V Nagala,2005):

• In late 1970s the Indian Government passed a controversial law (which was later repealed in 1992) that forced all multinationals to reduce their equity share in their Indian subsidiaries to less than 50 percent. Since IBM did not want to reduce its equity in its subsidiary, it decided to leave India, thereby, making Indian companies less reliant on mainframe computers.

• The advent of Personal Computers in 1980s reduced the cost of importing hardware substantially, thereby, spawning an industry that has over 2,700 companies today.

• Realizing that the Indian college system was unable to provide any computer training or IT courses, three Indian entrepreneurs (living in India) took it upon themselves to provide tutorials and training classes in Information Technology. Their early days were often

marked with one person driving a scooter or a motorcycle and the other riding behind with a PC in his lap so that they could impart this training in rented college and school spaces in the evenings. The training institute (NIIT) started by them is today a USD 167 million company and it continues to be number one in providing IT courses and training to Indians . Infosys, Satyam, Mastek, Silverline and Polaris, among numerous others, were started by software professionals and engineers with small savings and loans at very modest scales to begin with (Kumar 2001).N R Narayan Murthy acknowledges that several private banks refused to fund the setting up of Infosys, and it was the Public Sector financial institution that came forward and gave the seed capital. The example shows the critical role of government support in generating local entrepreneurs in the initial stages of a high technology industry.

With these as the humble beginnings, the Indian IT industry witnessed the Indian Government policies becoming more favorable in late 1980s, representative industry associations getting formed (one of which eventually became NASSCOM – the National Association of Software and Service Companies) and the IT training and education level gradually becoming strong enough for creating a full-fledged industry.

Finally, in the initial years, export of software initially meant a physical transfer – either of the programmer himself -sometimes called 'body-shopping(the provision of labor intensive ,low value added programming services, such as coding and testing at client sites') or of software on floppies. However, in 1985, Texas Instruments (TI) set up an office in Bangalore with a direct satellite link to the US and, in 1989, an Indian Government Telecom Company (VSNL) commissioned a direct 64-kbps satellite link to the US, thereby, offering software exporters a completely new way of functioning.

In terms of products and services, there have been continuous exports of software products since the early 1980s. These include enterprise systems, design software, and database management tools. However, such exports have consistently formed less than about 5% of total exports. Indian software exports have been, and remain, dominated by services .

Within the overall segment of software services exports, though, trends of change are detectable. Indian firms began with a strong emphasis on 'bodyshopping' In the late 1980s, around 75% of export earnings came from bodyshopping. By the early 2000s, this had dropped to nearer 60% (Dataquest 2001), indicating a slow but steady trend towards offshore working. The absence of reliable telecommunication links in 1980s forced Indian firms to be primarily " body shoppers" ,who provided programming services on site, typically in the US, to customers under contract.

This has been paralleled by a second trend: that of moving up the value chain from supply of programming services to addition of design/analysis services to complete turnkey project services. As with offshore working, the trend of change has been greater within individual client—vendor relationships than in the industry overall.

The 1990s – The Emergence of Offshore Outsourcing

In 1993, the US Immigration and Naturalization Service made changes that made it difficult to get B-1 visas and the new H-1 visa required a certification from the US Department of Labor that prevailing market wages were being paid to immigrant workers. As a result, US companies had less incentive to hire software engineers from India. Also, Indian software professionals who were brought under the umbrella of the Immigration Act, had to pay social security and related taxes to the US government, which added additional burden on the employees and the companies.

The two factors mentioned above led a few IT companies in India to gradually move to a mixed model, wherein some software programmers would work at the Client's premises (in the US) whereas others would continue to work in the IT company's back-office in India. As the Indian IT industry adapted to this new business model, Indian IT exports boomed from USD 128 million in FY 1990 to USD 485 million in FY 1994. It is worth pointing out that the shift to the new business model was gradual because the savings even after sending Indian IT programmers to the US were quite large and many IT companies continued to follow the old model and send their programmers to the US, the UK, and Canada.

And then came the 'Y2K problem', the Internet-Telecom boom and the Dot.com boom. All these forced companies in the US, UK, and Canada to hire lot of computer programmers and this caused such a shortage in the US that the US government had to increase its H-1 quota from 65,000 in 1998 to 130,000 in 1999 and then to 195,000 soon thereafter. Indeed, this was a very good opportunity for the Indian IT industry, which thrived by sending more and more IT professionals to the US, thereby creating a larger and larger Indian IT Diaspora.

In particular, the 'Y2K problem' presented a unique opportunity to Indian firms. Owing to this problem, the US firms needed software professionals with COBOL programming skills. COBOL had already become obsolete in 1990s and was no longer a part of university curriculum in the US. However, in India, COBOL was still taught, even in the 90s, since most of the local computer science curriculum was quite obsolete. This provided significant advantage to Indian IT services vendors, particularly because working on Y2K contracts helped Indian firms in entering new markets and building trust with their client enterprises.

Also, the use of alternative operating system since mid 1980s, UNIX , gave the Indian entrepreneurs better environment to deal with the Y2K problem. In fact, the 1986 report of the Rangarajan Committee on Modernization of India's largely state owned banking sector recommended standardized banking systems on UNIX . Subsequently government floated a tender for 400 UNIX systems setting off a scramble among Indian companies to come up with UNIX platform. . Later, in the 1990s,UNIX turned out be ideal for networked computing, and UNIX based systems still dominate the Internet server realm

By the end of 1999, the Indian IT industry was on an all-time high and the Initial Public Offerings (IPOs) of Indian software companies (in India) were getting oversubscribed. This, in turn, led to the creation of a venture capital industry in India.

Significance of Outsourcing Business & Millennium Years Performance of Domestic Market

While producing hardware in the 1980s was part of the manufacturing sector, the high technology jobs of the 1990s and present require a sophisticated enough skill set to write software and maintain computer systems. Only a few select countries have a ready supply of workers who are both technically trained and proficient in English to accept the opportunity American companies offer. For such reasons, China, Russia, and Vietnam are also prime locations; India, however, by far has become the leader of what has come to be known as the "outsourcing" revolution, as it captures a commanding 70% of the total spending on outsourcing

Outsourcing has been defined by two types of activities: (1) foreign companies launching "liaison, project, or branch" offices in India that retain the name of the founding corporation; and (2) foreign companies contracting out stages of their production processes to already-formed Indian companies as "a joint venture or wholly-owned subsidiary."
It is important to distinguish between these two types of outsourcing because the requirements that foreign companies pursuing offices in India must meet differ significantly from those placed upon multinational partnership firms. These types of offices are limited in scope and Indian law specifically prohibits branch offices of foreign companies from carrying out manufacturing activities on its own. Rather, it encourages the subcontracting of these manufacturing tasks to established Indian manufacturers.

This transnational work is made possible by technology. High-speed data connections and software tools have allowed for great distances to be bridged, making possible the collaboration between geographically disparate groups. This technology also changed the structure of the production process; rather than a few large vertically-integrated corporations in which hardware and software are produced together, a "more fragmented industrial structure" now allows for production processes to be performed in different locations. Global communication has thereby assisted the growth of the IT industry.

Domestic Market
India has emerged as the fastest growing and the fourth largest IT market in Asia Pacific, according to an IDC(International Data Corporation) study. The result has been that – for many years – India has been the developing world's software leader. There are few large firms that control much of the exports of the Indian Software industry.The top five firms account for 32 % of total software exports.The IT industry is concentrated in TN, Karnataka and AP. Almost 90% of the software development and export activity are confined to four metropolitan areas in India namely Mumbai, Banglaore, Chennai and Delhi but slowly and steadily increasing in other cities as well. The Indian software industry has grown at a compound annual rate of over 50% in the 1990s,the highest for any country during this period. The revenues have risen from $ 175 billion to $ 8.7 billion during the decade. Indian nationals account for 45% of HI visas issued by the USA every year and a large proportion of them go as software engineers. India is home to some 650000 software developers or about 10%b of the world's developers population. The

Indian software developer population is growing at an annual compound growth rate of 32% which means that in next three years the Indian developers will be the highest in the world. Among the Fortune 500 companies over 250 outsource their software's related work to India.

The industry has grown in depth and scope. It is no longer confined to producing and exporting low-end software products and services. Several multinational companies (MNCs), including many leading ones, have established software development centers in India. DataQuest (2004) reports that such MNC centers are filing for patents in large numbers It suggests that intellectual property revenues would constitute a major chunk of a software company's revenue in the future and Indian companies (other than MNCs), including some of the large ones, have not yet started preparing for it. Leading Indian IT firms, such as Infosys and Wipro, are multinational and have offices around the world and employ nationals in these countries. Infosys has alliances with the world's leading firms, including IBM, Intel, Microsoft and Oracle, and also has made strategic acquisitions of foreign firms.

NASSCOM (2004, p. 9) documents the increasing maturity of the industry following a large number of mergers and acquisitions It noted that traditional IT service players have added ITES-BPO portfolios to their existing offerings in order to provide a complete umbrella of end-to-end services. Multi-vendor and build-operate-transfer (BOT) contracts which offer customers advantages such as low risks, scalability and competitive pricing have increased. Indian vendors (IVs) are expanding the spectrum of their service offering in client locations and even setting up facilities in other low cost ITES-BPO destinations such as China and the Philippines in order to tap these markets. They are also moving up the value added ladder to offer high-end services such as equity research and analytics, insurance and technology support and development.

Moreover, Indian vendors have moved far beyond call centers into financial services, telecom, retailing and automotive segments of the ITES-BPO sector. In financial services, Indian companies are offering customers services centered around accounting, billing and payment services and transaction processing. Over the past few years, some Indian service providers have also been offering higher value services to customers in the areas of insurance claims processing and equity research support. They expect to gain from offshore-outsourcing: of customer and technical support and product development by global telecom industry; of process of transaction processing, billing, telemarketing and inventory management of large retailers; and of engineering activities, such as computer aided product and tool design, claims processing and accounting processes of automobile industry (NASSCOM 2004, p. 10).

The report also benchmarked the performance of Indian industry on key operational issues with global benchmarks. It finds that Indian industry is able to deliver at levels comparable to their international counterparts on parameters such as quality, customer satisfaction and people satisfaction. Complementing the continued growth in IT-ITES exports is a steadily evolving domestic market.(see Table I below)

Table I: IT Industry-Sector-wise break-up

USD billion	FY 2004	FY 2005	FY 2006E

IT Services	**10.4**	**13.5**	**17.5**
-Exports	7.3	10.0	13.2
-Domestic	3.1	3.5	4.3
ITES-BPO	**3.4**	**5.2**	**7.2**
-Exports	3.1	4.6	6.3
-Domestic	0.3	0.6	0.9
Engineering Services and R&D, Software Products	**2.9**	**3.9**	**4.8**
-Exports	2.5	3.1	3.9
-Domestic	0.4	0.7	0.9
Total Software and Services Revenues	**16.7**	**22.6**	**29.5**
Of which, exports are	**12.9**	**17.7**	**23.4**
Hardware	**5.0**	**5.9**	**6.9**
Total IT Industry (including Hardware)	**21.6**	**28.4**	**36.3**

Total may not match due to rounding off

** NASSCOM estimates have been reclassified to provide greater granularity*
- Revenues from Engineering and R&D services and Software Products reported separately (erstwhile clubbed with IT Services / ITES-BPO)
- Historical values for a few segments have changed
- For ease of comparison, details for two preceding years have been restated as per the new classification

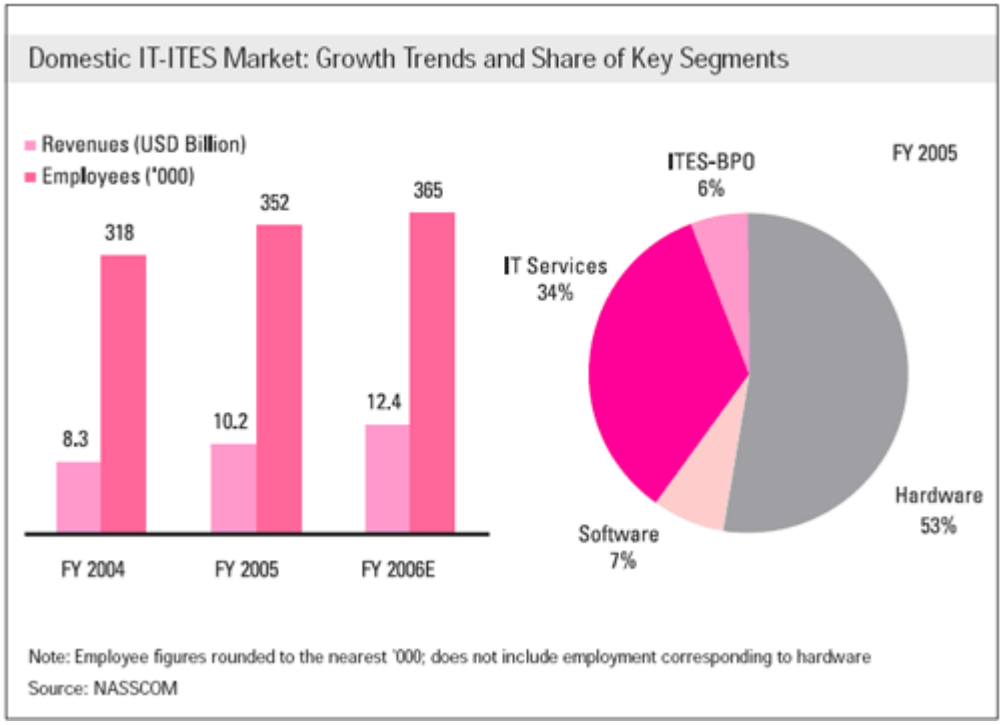
As stated above strong demand over the past few years has placed India amongst the fastest-growing IT markets in the Asia-Pacific region. While hardware still accounts for a majority share, with spending on services and the outsourced model gaining noticeable traction, growth in the domestic market is witnessing the early signs of service line depth that characterizes maturing markets.

BFSI, Telecom, Government and Manufacturing are the key vertical markets driving growth across categories including hardware systems, networking, storage, security, enterprise application products and related services. Education and healthcare are a few emerging areas expected to drive additional growth. ITES-BPO demand in the domestic market, though at a nascent stage with contact centre activities for customer care, and sales and marketing accounting for over two-third of current demand, is also witnessing increased levels of activity. BFSI, telecom and consumer durables are the early adopters of ITES-BPO in the domestic market and currently account for nearly three-fourths of the business in this space.

Recognizing its potential, leading global players (Indian as well as MNC) are also focusing some of their attention towards tapping the domestic market - with significant success. Revenue aggregate earned from the domestic market by the leading, predominantly export-focused Indian service providers have grown and several of the key IT outsourcing contracts awarded in the past year were won by MNCs. Global product companies are also looking to introduce localized versions of their software products to drive usability and penetration. This specific focus on the domestic business opportunity

is helping create an environment of healthy competition in the industry that augurs well for the development of the domestic market.

As depicted in the following chart, the domestic IT-ITES market was valued at USD 10.2 billion in FY 2004-05 and is expected to exceed USD 12.4 billion, growing at nearly 22 per cent in the fiscal (FY 2005-06).



The observed growth in the domestic market reflects the strength of the Indian economy, which has grown at an annual rate of nearly 7 per cent since 2002 and at more than 8 per cent over the first three quarters of the fiscal year (FY 2005-06).

INDIAN IT INDUSTRY IN GLOBAL PERSPECTIVE

Since the mid-nineties, software and computer services have been most dynamic component of Indian service exports. In 2001 they account for 10% of overall goods and services exports, for 40% of total service exports and for almost 60% of business service exports (Chauvin and Lemoine,2003).With 20 % of world exports, India was the world leading exporter of IT service in 2001 ,ahead of Ireland and the United States(see Table II Below).In this field, India far outpaced China and is in direct competition with developed nations at least till 2001.

Table II : Principal Exporters of IT services

US$ BILLION	1999	2000	2001
WORLD	31.1	31.8	35.1
INDIA	4	6.3	7.2

IRELAND	**5.6**	**5.5**	**6.5**
UNITED STATES	**4.8**	**4.9**	**5.1**
GERMANY	**2.9**	**3.8**	**4.7**
UK	**3.7**	**3.8**	**4.2**
SPAIN	**2.1**	**2**	**2.2**
CANADA	**1.6**	**1.6**	**1.4**
SWEDEN	**1.1**	**1.2**	**1.4**
JAPAN	**1.3**	**1.6**	**1.4**

Source: **CEPII CHELEM Database; RBI**

INDIAN ICT INDUSTRY IN GLOBAL PERSPECTIVE

India stands 40th in 'network readiness[9]' in the world, having slipped from the 39th spot it held last year. However, it is above China (50th) and Pakistan (67th) and Sri Lanka (83rd)

The United States tops the rankings in The Global Information Technology Report 2005-2006's 'Networked Readiness Index,' for the third time in five years, maintaining its eminent position as a leader in the area of innovation and confirming its position as an information and communication technology powerhouse.

Highlights

The United States regains the top position in the rankings, reflecting an impressive performance in the areas of ICT physical infrastructure, a broadly supportive market environment and high levels of business and government usage of the latest technologies. The United States continues to lead the world in technological innovation, helped by the excellent quality of its higher education institutions and extensive levels of cooperation between its research bodies and the business community.

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[9] The Networked Readiness Index included in the Global Information Technology report produced by the World Economic Forum, Geneva provides the most comprehensive assessment of how prepared an economy is to capture the benefits of technology to promote economic growth and productivity. This study explicitly considers the roles played by the major stakeholders--individuals, businesses and governments, in relation to three dimensions: the environment for the development and use of ICT, the readiness of stakeholders to leverage the potential of ICT, and the degree of usage of ICT. The selection of insightful essays, detailed country profiles for more than 100 economies and data tables on approximately 50 different ICT indicators presented in the report provide a useful guide for the design and formulation of policy measures aimed at capturing the benefits of ICT. With record coverage of 115 economies worldwide and published for the fifth consecutive year, The Global Information Technology Report (GITR) has grown into the world's most respected assessment of the impact of information and communication technology (ICT) on the development process and the competitiveness of nations. The Networked Readiness Index (NRI) measures the propensity for countries to leverage the opportunities offered by ICT for development and increased competitiveness. It also establishes a broad international framework mapping out the enabling factors of such capacity. Please refer to Appendix Table III for variables which were used to construct the network readiness index.

The United States also stands out for the ready availability of venture capital -- key for start-ups to develop and prosper in what can be a risky sector. Also noteworthy is the prominent role assumed by the private sector in research and development as well as cooperation with the public sector in innovation and ICT penetration. Indeed, 17 of the 36 World Economic Forum Technology Pioneers 2006 (www.weforum.org/techpioneers) come from the United States.

Singapore, in second place overall, maintains its commanding position having achieved a top-three ranking for the fourth consecutive year. Singapore has an excellent regulatory environment, world-class levels of education and training, and a government that is committed to enhancing the use of the latest technologies across all sectors of the economy -- all in a context of excellent macroeconomic management and persistent efforts to improve the institutional environment for economic activity.

Nordic countries maintain their positions at the top of the rankings, with **Denmark, Iceland, Finland** and **Sweden** in third, fourth, fifth and eighth places, respectively. Nordic countries have registered consistently high ICT penetration rates and have occupied places in the top ten positions over the last five years.

Their high rankings reflect the same set of factors that have propelled these economies to the top of the world competitiveness league. These factors include highly developed educational institutions which have fostered a strong culture of innovation; transparency in government which has contributed to the emergence of a friendly climate for new business ventures; and a strong predisposition to adopt the latest technologies, in government, the business community and civil society.

Asia and the Pacific also do extremely well this year with **Taiwan**, **Hong Kong, Korea, Australia** and **Japan** occupying ranks 7, 11, 14, 15 and 16, respectively.

India broadly maintains its position with respect to last year (at 40th place), while China drops 9 positions to 50th place, widening the performance gap with respect to India.

Especially noteworthy is the showing of Taiwan, gaining 8 positions from last year and entering in the top ten for the first time. The rise of Taiwan as an ICT powerhouse in the last three decades, as a result of intelligent public policies and public-private synergies in the ICT sector, is indeed exceptional and is the object of a specific case study included in the Report this year.

Estonia leads the eastern European countries with a rank of 23 out of 115 (gaining two positions from last year), thanks to its excellent political and regulatory framework for ICT.

The highest ranking Latin American countries are Chile (29), Brazil (52) and Mexico (55). Compared with last year's generalized decreasing trend, the region displays a more varied performance this year, with several countries markedly improving their positions,

notably Chile (up 6), Mexico (up 5), El Salvador (up 11), Colombia (up 4) and Argentina (up 5).

This encouraging development is unfortunately accompanied by a further slide of countries such as Brazil (down 6), Costa Rica (down 8) and Guatemala (down 10).

Although South Africa drops three positions from 34 last year to 37 this year, the country leads sub-Saharan Africa in terms of networked readiness. Mauritius (ranked 45) and Botswana (ranked 56) follow South Africa. While Mauritius has improved its performance by two positions, Botswana has dropped six positions from last year.

In other markets, Israel remains the top performer in the Middle East. Posting a rank of 19 overall, Israel shows excellent scores in areas such as technological sophistication, the quality of scientific research institutions, the availability of venture capital, cellular telephones and the latest technologies.

Given Israel's excellent ICT performance, this year's report includes a case study exploring the role government policies had in the development of a first-class ICT industry in the country. The United Arab Emirates (UAE) is the top performer in the Gulf region, with a rank of 28. Tunisia, in position 36, has the highest ranking in North Africa.

Networked Readiness Index 2005					
Countries	**Score 2005**	**Rank 2005**	**Rank 2004**	**Evolution**	
United States	2.02	**1**	5	Up	4
Singapore	1.89	**2**	1	Down	-1
Denmark	1.80	**3**	4	Up	1
Iceland	1.78	**4**	2	Down	-2
Finland	1.72	**5**	3	Down	-2
Canada	1.54	**6**	10	Up	4
Taiwan	1.51	**7**	15	Up	8
Sweden	1.49	**8**	6	Down	-2
Switzerland	1.48	**9**	9	Steady	0
United Kingdom	1.44	**10**	12	Up	2
Hong Kong SAR	1.44	**11**	7	Down	-4
Netherlands	1.39	**12**	16	Up	4
Norway	1.33	**13**	13	Steady	0
Korea, Rep.	1.31	**14**	24	Up	10
Australia	1.28	**15**	11	Down	-4
Japan	1.24	**16**	8	Down	-8
Germany	1.18	**17**	14	Down	-3
Austria	1.18	**18**	19	Up	1
Israel	1.16	**19**	18	Down	-1
Ireland	1.15	**20**	22	Up	2
New Zealand	1.14	**21**	21	Steady	0
France	1.11	**22**	20	Down	-2
Estonia	0.96	**23**	25	Up	2

Malaysia	0.93	**24**	27	Up	3
Belgium	0.87	**25**	26	Up	1
Luxembourg	0.80	**26**	17	Down	-9
Portugal	0.56	**27**	30	Up	3
United Arab Emirates	0.54	**28**	23	Down	-5
Chile	0.52	**29**	35	Up	6
Malta	0.51	**30**	28	Down	-2
Spain	0.47	**31**	29	Down	-2
Czech Republic	0.36	**32**	40	Up	8
Cyprus	0.36	**33**	37	Up	4
Thailand	0.35	**34**	36	Up	2
Slovenia	0.34	**35**	32	Down	-3
Tunisia	0.33	**36**	31	Down	-5
South Africa	0.30	**37**	34	Down	-3
Hungary	0.27	**38**	38	Steady	0
Qatar	0.25	**39**	n/a	New	
INDIA	**0.23**	**40**	**39**	**Down**	**-1**
Slovak Republic	0.19	**41**	48	Up	7
Italy	0.16	**42**	45	Up	3
Greece	0.08	**43**	42	Down	-1
Lithuania	0.08	**44**	43	Down	-1
Mauritius	0.07	**45**	47	Up	2
Kuwait	0.06	**46**	n/a	New	
Jordan	0.03	**47**	44	Down	-3
Turkey	0.00	**48**	52	Up	4
Bahrain	0.00	**49**	33	Down	-16
China	-0.01	**50**	41	Down	-9
Latvia	-0.03	**51**	56	Up	5
Brazil	-0.04	**52**	46	Down	-6
Poland	-0.09	**53**	72	Up	19
Jamaica	-0.11	**54**	49	Down	-5
Mexico	-0.14	**55**	60	Up	5
Botswana	-0.16	**56**	50	Down	-6
Croatia	-0.23	**57**	58	Up	1
Romania	-0.23	**58**	53	Down	-5
El Salvador	-0.24	**59**	70	Up	11
Kazakhstan	-0.24	**60**	n/a	New	
Ghana	-0.25	**61**	65	Up	4
Colombia	-0.27	**62**	66	Up	4
Egypt	-0.29	**63**	57	Down	-6
Bulgaria	-0.31	**64**	73	Up	9
Uruguay	-0.31	**65**	64	Down	-1
Panama	-0.33	**66**	69	Up	3
Pakistan	-0.34	**67**	63	Down	-4
Indonesia	-0.36	**68**	51	Down	-17
Costa Rica	-0.37	**69**	61	Down	-8

Philippines	-0.37	**70**	67	Down	-3
Argentina	-0.38	**71**	76	Up	5
Russian Federation	-0.39	**72**	62	Down	-10
Azerbaijan	-0.40	**73**	n/a	New	
Trinidad and Tobago	-0.42	**74**	59	Down	-15
Vietnam	-0.47	**75**	68	Down	-7
Ukraine	-0.49	**76**	82	Up	6
Morocco	-0.51	**77**	54	Down	-23
Namibia	-0.53	**78**	55	Down	-23
Uganda	-0.60	**79**	77	Down	-2
Serbia and Montenegro	-0.63	**80**	79	Down	-1
Venezuela	-0.65	**81**	84	Up	3
Macedonia, FYR	-0.67	**82**	85	Up	3
Sri Lanka	-0.68	**83**	71	Down	-12
Tanzania	-0.69	**84**	83	Down	-1
Peru	-0.70	**85**	90	Up	5
Armenia	-0.72	**86**	n/a	New	
Algeria	-0.72	**87**	80	Down	-7
Gambia, The	-0.72	**88**	74	Down	-14
Dominican Republic	-0.73	**89**	78	Down	-11
Nigeria	-0.74	**90**	86	Down	-4
Kenya	-0.75	**91**	75	Down	-16
Mongolia	-0.76	**92**	n/a	New	
Tajikistan	-0.77	**93**	n/a	New	
Moldova	-0.78	**94**	n/a	New	
Mali	-0.78	**95**	92	Down	-3
Georgia	-0.82	**96**	91	Down	-5
Bosnia and Herzegovina	-0.87	**97**	89	Down	-8
Guatemala	-0.88	**98**	88	Down	-10
Cameroon	-0.88	**99**	n/a	New	
Honduras	-0.89	**100**	97	Down	-3
Mozambique	-0.94	**101**	96	Down	-5
Madagascar	-0.99	**102**	87	Down	-15
Kyrgyz Republic	-1.01	**103**	n/a	New	
Cambodia	-1.03	**104**	n/a	New	
Zimbabwe	-1.04	**105**	94	Down	-11
Albania	-1.04	**106**	n/a	New	
Ecuador	-1.07	**107**	95	Down	-12
Benin	-1.07	**108**	n/a	New	
Bolivia	-1.10	**109**	99	Down	-10
Bangladesh	-1.11	**110**	100	Down	-10
Guyana	-1.11	**111**	n/a	New	
Nicaragua	-1.14	**112**	103	Down	-9
Paraguay	-1.23	**113**	98	Down	-15
Chad	-1.36	**114**	104	Down	-10
Ethiopia	-1.39	**115**	102	Down	-13

Source: World Economic Forum

GLOBAL ICT Business

The global marketplace for information and communications technology (ICT) will top $3 trillion this year and reach almost $4 trillion by 2009, according to *Digital Planet 2006*, study released by the World Information Technology and Services Alliance (WITSA).

Total global ICT spending growth in 2006 slows to six percent, down from a pace of almost 13 percent in 2004. The marketplace posted an 8.9 percent average annual growth rate between 2001 and 2005 and added $1 trillion in new spending between 2001 and 2006. ICT spending volumes represent 6.8 percent of global Gross Domestic Product between 2001 and 2005. Among other key findings of this year's *Digital Planet* report:

- Communications products and services represent the largest single category of ICT spending in 2006 with $1.57 trillion, but software is the fastest growing category, up year to year by 9.9 percent;
- Consumers spend one out of every four ICT dollars worldwide. Per capita ICT spending increased almost $29 between 2005 and 2006, from $537.91 to $566.89. Per capita ICT spending has increased every year since 2001;
- ICT spending per employee is up almost 40 percent between 2001 and 2006. Global ICT spending per employee reached $1,277 in 2006 and is expected to top $1,500 by the end of the decade;
- In spending by country, the top ten ICT spending countries remain fixed in rank between 2001 and 2005. In descending order, these are: the United States, Japan, Germany, United Kingdom, France, China, Italy, Canada, Brazil and Korea. In 2006, China catches France in the total ICT spending race, with outlays of $142.3 billion. In 2007, China is expected to jump ahead of France and ahead of the United Kingdom in 2008. By 2009, China will be the third largest ICT spending country. India will replace Korea as a member of the top ten in 2007 with $65.5 billion;
- China is also a powerhouse in rates of spending, with a 20.9 percent annual increase in 2006 for outpacing any other member of the top ten. In fact, China ICT annual growth rates exceed 20 percent every year between 2001 and 2006. This trend is expected to continue through the decade, growing to almost 26 percent by 2009;
- The Americas will grow the slowest of the three broad regions charted in Digital Planet, at 4.4 percent between 2005 and 2009. The Americas' share of ICT spending will shrink from 44 percent last year to 39 percent in 2009. Asia-Pacific will grow at 11.1 percent from 2005 through 2009.

Strengths and Weaknesses of Information and Communication Technologies(ICT)Infrastructure :Cross Country Experiences

Global information Report lists the Strengths and Weaknesses of host of countries across the world in terms of ICT infrastructure. We compare Indian experiences with some selected countries of the world. According to the report **Indian** Strengths lies in availability of pool of scientists and engineers and quality of maths and science education along with quality of business schools. We are also ranked quite high in terms of cluster development , foreign technology licensing and Government prioritization of ICT. The weaknesses are the telecommunication infrastructure and speed of new business registration.

India

Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Availability of scientists and engineers	1	PC households online	114
Quality of math and science education	5	Cellular mobile subscribers	107
Quality of business schools	6	Speed of new business registration	103
State of cluster development	7	Personal computers	100
Foreign technology licensing	7	Electricity production	100
Government prioritization of ICT	9	Telephone subscribers	99
Market competition	11	Internet hosts	98
Success in ICT promotion	11	Television sets	97
Quality of scientific research institutions	17	Telephone lines	95
Government R&D subsidies	17	Internet users	95

Source: Global Information TechnologyReport,2006

Israel strengths lies in his capacity of innovation and production of scientific, availability of scientists and engineers, R&D, availability of venture capital, technology absorption and technical journal articles and government readiness in terms of its procurement of ICT.The weakness of Israel lies in their market environment of the ICT

Israel

Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Capacity for innovation	2	Tax Burden	74
Scientific and technical journal articles	3	Speed of new business registration	46
Availability of cellular phones	3	Internet bandwidth	39

Availability of scientists and engineers	4	Television sets	39
Technological Sophistication	4	Administrative Burden	38
Quality of scientific research institutions	4	Residential telephone connection charge	37
Venture capital availability	5	Availability of online services	34
Firm-level technology absorption	5	Internet users	33
Business investment in R&D	5	Government prioritization of ICT	33
Government procurement of ICT	5	Residential monthly telephone subscription	30

Source **Global Information Technology Report,2006**

Ireland strengths lies in their educational system ,judiciary, venture capital availability ,domestic environment and ease of new business registration. The weaknesses are the telecommunication and internet infrastructure and relatively low E-participation index.

Ireland			
Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Quality of educational system	3	Availability of cellular phones	66
Quality of public schools	3	Cable modem Internet subscribers	58
Venture capital availability	4	ISP competition	54
Independence of judiciary	4	Availability of new telephone lines	51
Ease of new business registration	6	Market competition	43
Foreign technology licensing	6	DSL Internet Subscribers	42
Government R&D subsidies	8	E-participation index	40
Availability of online services	8	Internet access in schools	37
Internet bandwidth	9	Government procurement of ICT	34
Tax Burden	10	Internet users	31

Source **Global Information Technology Report,2006**

Pakistan is rated high in Government actual usage of the ICT. Also, one could see state of cluster development and relatively easier registration of new businesses. It weaknesses lies in telecommunication and computer infrastructure, low investment in training and inability of legal framework to settle disputes.

Pakistan			
Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Success in ICT promotion	7	PC households online	113

Government ICT Vision	14	Cellular mobile subscribers	110
Government prioritization of ICT	17	Tertiary Education	108
State of cluster development	19	Personal computers	107
ISP competition	20	Investment in training	105
Speed of new business registration	25	Government R&D subsidies	104
Buyer dynamism	27	Telephone subscribers	104
Tax Burden	29	Legal framework to settle disputes	104
ICT productivity	29	Internet users	102
Venture capital availability	44	Electricity production	101

Source **Global Information Technology Report,2006**

Chile is rated high on online government services, E-Participation and mobile availability.The weakness of Chile lies in the quality of educational system and telephone lines.

Chile

Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Availability of online services	5	Quality of math and science education	88
Market competition	7	Quality of public schools	82
Web-measure index	7	Government R&D subsidies	78
Availability of cellular phones	8	Quality of educational system	73
ICT productivity	12	Residential monthly telephone subscription	65
ISP competition	14	State of cluster development	62
E-participation index	14	Telephone lines	56
Availability of new telephone lines	14	Telephone lines	56
Quality of business schools	15	Electricity production	54
Administrative Burden	18	Business monthly telephone subscription	52

Source **Global Information Technology Report,2006**

Philippines has been strong on getting foreign technology licenses for IT businesses. The E participation index is relatively higher and there are quality business schools. The problematic areas in Philippines are the quality of educational system and relatively higher cost of business and telephone subscription.

Philippines

Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank

Foreign technology licensing	19	Business monthly telephone subscription	114
Availability of cellular phones	19	Residential monthly telephone subscription	113
E-participation index	24	Quality of math and science education	111
ISP competition	26	Quality of public schools	103
Web-measure index	28	Electricity production	98
Quality of business schools	29	Scientific and technical journal articles	97
Tax Burden	31	Telephone lines	93
Investment in training	39	Telephone lines	93
Laws relating to ICT	42	Administrative Burden	93
Internet use by business	43	Effectiveness of lawmaking	92

Source **Global Information Technology Report,2006**

Taiwan does quite well in terms of overall ICT infrastructure with government playing a major role in vision and procurement. The weaknesses lies in speed of new business registration, law and judiciary in dealing with ICT cases.

Taiwan			
Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Residential monthly telephone subscription	1	Speed of new business registration	77
Foreign technology licensing	1	Web-measure index	57
State of cluster development	2	Availability of cellular phones	52
Government ICT Vision	2	Independence of judiciary	43
Government procurement of ICT	2	Residential telephone connection charge	42
Cellular mobile subscribers	2	Effectiveness of lawmaking	42
ICT productivity	2	Legal framework to settle disputes	31
US utility patents	3	Sophistication of financial markets	31
Telephone subscribers	3	Property rights laws	29
DSL Internet Subscribers	3	Ease of new business registration	29

Source **Global Information Technology Report,2006**

Bangladesh is new but upcoming in the ICT business. There is much to be done in relation to telecommunication, laws related to ICT and internet infrastructure.

Bangladesh	
Strengths	Weakness

Variable Name	Rank	Variable Name	Rank
Ease of new business registration	29	Availability of online services	115
Tax Burden	36	Residential telephone connection charge	115
State of cluster development	42	Telephone subscribers	114
Speed of new business registration	49	Availability of new telephone lines	114
Government prioritization of ICT	57	Internet hosts	114
Availability of scientists and engineers	59	Internet users	113
ISP competition	59	Cellular mobile subscribers	112
Market competition	71	Laws relating to ICT	112
Buyer dynamism	71	Availability of specialized training services	111
Quality of suppliers	76	Electricity production	111

Source **Global Information Technology Report,2006**

China has done relatively well in terms of Government procurement of ICT, and providing R&D subsidies. The problematic area secure internet servers and availability of telecommunication and internet infrastructure.

China

Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Government procurement of ICT	11	Secure Internet servers	97
Government R&D subsidies	24	Availability of cellular phones	94
Effectiveness of lawmaking	25	Residential monthly telephone subscription	92
ICT pervasiveness	25	Internet hosts	92
Business R&D collaboration with universities	26	Sophistication of financial markets	87
ICT productivity	26	Business monthly telephone subscription	85
Administrative Burden	30	Tertiary Education	85
Market competition	31	Ease of new business registration	82
Business investment in R&D	31	Personal computers	81
State of cluster development	32	Residential telephone connection charge	

Source **Global Information Technology Report,2006**

USA tops the list in most of the ICT indicators. The ICT sophistication of US markets lies in the availability of venture capital, sophistication of financial markets, technologically superior, IPR protection and good quality scientific research institutions. The weak areas are cellular mobile subscribers, quality of maths and science education, not that strong Government ICT vision and lack of relative success in ICT promotion.

United States of America			
Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Venture capital availability	1	Cellular mobile subscribers	40
Sophistication of financial markets	1	Quality of math and science education	39
Technological Sophistication	1	Business monthly telephone subscription	37
Quality of scientific research institutions	1	Residential monthly telephone subscription	30
Market competition	1	Telephone subscribers	29
Intellectual property protection	1	Government ICT Vision	27
ISP competition	1	Success in ICT promotion	24
Buyer sophistication	1	Quality of public schools	24
Availability of specialized training services	1	Foreign technology licensing	22
Internet use by business	1	DSL Internet Subscribers	22

Source **Global Information Technology Report,2006**

UK like USA tops the list in most of the ICT indicators. The ICT sophistication of UK markets lies sophistication of financial markets, in the availability of venture capital, e-Participation index, laws related to ICT ,higher usage among businesses and good quality scientific research institutions. The weaknesses lies in lack of success in ICT promotion by the Government, administrative burden and telecommunication infrastructure.

United Kingdom			
Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
Sophistication of financial markets	1	Success in ICT promotion	51
E-participation index	1	Administrative Burden	50
Availability of specialized training services	2	Quality of math and science education	47
Venture capital availability	3	Availability of scientists and engineers	41
Market competition	3	Government procurement of ICT	36
Quality of scientific research institutions	3	Quality of public schools	33
Effectiveness of lawmaking	3	ICT productivity	31
Web-meaure index	3	Government prioritization of ICT	27
Laws relating to ICT	4	Electricity production	27
Internet use by business	4	Availability of new telephone lines	26

Source **Global Information Technology Report,2006**

Japan's strengths lies in development of ICT through clusters, quality of suppliers ,buyer dynamism and overall an excellent market, regulatory and infrastructure environment. The weak areas are difficulty in starting new businesses, relatively higher residential telephone connection charge, availability of online services, among others

Japan			
Strengths		Weakness	
Variable Name	Rank	Variable Name	Rank
State of cluster development	1	Ease of new business registration	66
Quality of suppliers	1	Residential telephone connection charge	65
Availability of scientists and engineers	2	Availability of online services	47
US utility patents	2	Quality of business schools	42
Buyer dynamism	2	Tax Burden	41
Firm-level technology absorption	2	ICT productivity	38
Availability of new telephone lines	2	Speed of new business registration	38
Capacity for innovation	2	Internet bandwidth	35
Business investment in R&D	2	Cellular mobile subscribers	34
ISP competition	2	Government ICT Vision	33

Source: Global Information Technology Report,2006

Technical Efficiency of the ICT Sectors of Selected Countries : A Data Envelopment Analysis(DEA)

We have worked out technical efficiency of the ICT sector for selected 12 countries around the globe using Data Envelopment Analysis[10]. Data Envelopment Analysis uses linear programming to calculate technical efficiency of each decision making unit in respect to the ' best practice production frontier'**. A score of one means most efficient among the countries**. Technical efficiency means how judicious a particular country is in transforming inputs into outputs. We have used two inputs and one output in our model. The two inputs are ICT Environment index(averaged over the variables defining the index and each variable defined on a seven point scale) and ICT Readiness

[10] DEA is a LP Problem (using simplex method):LP Primal Problem is- Maximize ratio of weighted outputs to weighted inputs subject to the condition that such ratio for each decision making unit is less than equal to one. The solution is the weights of both outputs and inputs. Weights are assumed to be greater than zero and universally applied. Such exercise is repeated for each decision making unit. We most of the time work with the dual of this primal problem because it gives how much orientation in inputs and outputs is needed for each DMU to maximize the ratio of weighted outputs to weighted inputs AND THERBY REACH ITS BEST PRACTICE FRONTIER (attainable by assumption). The value of the objective function comes out to be same due to duality theorems. If technical efficiency of each decision making unit works out to be one then he is on the best practice frontier. If technical efficiency is less than one say .89 then he needs .11 units more to reach the best practice frontier. Weights can help us to determine the orientation of inputs and outputs (answers what needs to be done).

index(averaged over the variables defining the index and each variable defined on a seven point scale).The one output is ICT usage(averaged over the variables defining the index and each variable defined on a seven point scale).For definition of the variables defining each of the three indices please refer to Appendix Table III at the last or the Global Information Technology Report,2006.

Our results show that Taiwan has got a score of one among the 12 countries included in our sample. Taiwan is the most judicious of all in converting its ICT inputs into ICT output (usage).India has got a score of 0.72 the lowest among all the countries due to its relatively poor telecommunication infrastructure(PCs availability, Electricity Generation, internet penetration, among others).

Countries	Fi(y,x | C,S)	Y1	X2 (S,Yes)	X1 (S,Yes)
	TECHNICAL EFFICIENCY	OUTPUTONE(ICT USAGE)	INPUTTWO(ICT ENVIRONMENT)	INPUTONE(ICT READINESS)
India	0.72	3.2	3.81	3.94
Pakistan	0.86	2.91	2.88	3.19
UK	0.95	5.2	4.65	4.73
USA	0.91	5.41	5.44	4.98
Japan	0.93	5.01	4.63	4.54
Ireland	0.92	4.73	4.36	4.29
Chile	0.97	4.13	3.65	3.69
Bangladesh	0.77	2.32	2.57	2.9
Israel	0.96	4.94	4.38	4.5
China	0.93	3.44	3.16	3.46
Taiwan	1	5.47	4.66	4.58
Phillipines	0.93	3.24	2.96	3.56

Source: Technical Efficiency is calculated using Onfront software. A score of one means most efficient among the countries.

Note: Global Information Technology Report 2006 constructs ICT Usage ,ICT Environment and ICT Readiness indices all on a seven point scale. We have used average of each index defined over number of variables defining each index (see Appendix II)

If one regresses ICT usage(V2) on Technical Efficiency of ICT(V1) andV3(ICT Environment) and V4(ICT Readiness) we get the following results.

Dependent Variable: ICT Usage
Number of Observations:12
Coefficients:

	Value	Std. Error	t value	Pr(>|t|)
(Intercept)	-4.0748	0.4983	-8.1780	0.0000
V1	4.5283	0.5616	8.0629	0.0000
V3	0.7813	0.2400	3.2558	0.0116
V4	0.2672	0.3305	0.8085	0.4422

Residual standard error: 0.1311 on 8 degrees of freedom
Multiple R-Squared: 0.9896

F-statistic: 254.3 on 3 and 8 degrees of freedom, the p-value is 2.84e-008

ICT technical efficiency and ICT Environment positively and significantly impacts the ICT usage across businesses, individuals and government across countries.

INDIAN IT INDUSTRY STRUCTURE: A DEA & Regression Analysis of Technical Efficiency and Net Exports

Appendix Table IV presents the list of the top 19 IT Software and Service exporters and their export volumes during 2004-05 from India. Note that the top three exporters have crossed the one billion dollar mark. Also, note the feature that the top five exporters are exclusively Indian. However , at present the Indian IT services industry comprises a diverse group of companies-large, near billion dollar global companies and small start ups, Indian companies and multinationals. Growth rate across companies is quite varied

Tier 1 companies (i.e the top 5 firms) account for about 32 % of total software exports (NASSCOM Strategic Review 2004) and have benefited from customer's recent scaling of operations

Tier 2 companies(with revenues between Rs 1 Billion and Rs 10 Billion) account for about 24 % of the industry, and face the challenge of differentiation from Tier I players. The revenues of these companies are under pressure because of fierce bidding by those in Tier 1

MNC Back ends account for about 26% of the industry

Focused companies(about 3-4 % of the industry) include those with a focus on a particular domain/service line/products, who are facing the challenge of cutbacks in key markets such as telecom, and managing to diversify their offerings

Small companies, with revenues of less than Rs 1 billion, account for 12-14 % of the market.

The key to survival and growth is innovation and ability to spot market discontinuities. Scale of business does matter in IT services business. However, constant technological churn and the lure of entrepreneurial success has led to many small and medium companies flourishing in the IT services market.

Appendix Table V benchmarks the performance of 92 Indian Software firms (as in 2005-2006) in terms of technical efficiency- how judicious are firms in converting inputs into outputs. We have used Data Envelopment Analysis for working out technical efficiency. Data Envelopment Analysis uses linear programming to calculate technical efficiency of each decision making unit in respect to the ' best practice production frontier'**. A score of one means most efficient among the software firms**. Technical efficiency means how judicious a particular firms is in transforming inputs into outputs .We have used two outputs namely sales and net exports as outputs and number of employees , years in

business and total costs as inputs. We have used data of 2005- 2006 of the Prowess data base published by CMIE.16 firms out of the total are operating at the 'best practice frontier' i:e are most efficient and have scored one. These include Infosys Technologies, Tata Consultancy Limited, Patni Computers, NIIT Technology, HCL, Wipro , Hewlett Packard, among others(see Appendix Table V). The average technical efficiency of 92 firms works out to be 0.69 as in 2005-2006.

Technical efficiency of the 92 firms was further regressed on its explanatory factors using tobit regression. Tobit regression or censored regression was used as values of technical efficiency is constrained by the upper limit of one.

Sales of the firm (proxy for size of firm) and net exports had positive and significant impact on the technical efficiency while total cost had negative and significant impact on technical efficiency. Number of employees and total number of years had insignificant impact on technical efficiency. However, R square could only explain only 20 % of the variation in the dependent variable signifying that rest 80 % variation in the dependent variable is explained by other factors which could not be included in our study. These may be affiliation to the MNC , R& D intensity, advertising intensity, HR policy, organization climate and culture and technology imports in terms of royalty paid , among others. This will be taken up by researcher in future. The results are summarized below.

Dependent Variable: SER01(Technical Efficiency)
Method: ML - Censored Normal (TOBIT)
Date: 09/21/06 Time: 05:01
Sample: 1 92
Included observations: 92
Left censoring (value) series: 0
Right censoring (value) series: 1
Convergence achieved after 6 iterations
Covariance matrix computed using second derivatives

	Coefficient	Std. Error	z-Statistic	Prob.
C	0.739256	0.066925	11.04600	0.0000
SER02(Sales)	0.000155	8.85E-05	1.746333	0.0808
SER03(Net Exports)	6.19E-05	3.44E-05	1.800198	0.0718
SER04(Number of Years in Business)	-0.004087	0.004238	-0.964382	0.3349
SER05(Number of Employees)	-1.99E-05	1.82E-05	-1.089722	0.2758
SER06(Total Costs)	-0.000185	0.000101	-1.831703	0.0670
Error Distribution				
SCALE:C(7)	0.284898	0.024606	11.57830	0.0000

R-squared	0.208708	Mean dependent var	0.694239
Adjusted R-squared	0.152852	S.D. dependent var	0.269094
S.E. of regression	0.247676	Akaike info criterion	0.764012
Sum squared resid	5.214178	Schwarz criterion	0.955887
Log likelihood	-28.14453	Hannan-Quinn criter.	0.841454
Avg. log likelihood	-0.305919		
Left censored obs	3	Right censored obs	16

Uncensored obs	73	Total obs	92

Regressing net exports on its determinants yielded the following results. We find that size of the software company (in terms of sales of the software company), number of employees and total costs(negatively) do matter for net exports. Years in business and technical efficiency are insignificant factors in explaining variation in net exports across the 92 software firms. While net exports have a significant impact on technical efficiency, technical efficiency does not seem to have an impact on net exports. Also, while number of employees statistically worked out to be insignificant factor in explaining variation in technical efficiency across the 92 software firms, the same factor is significantly impacting the net exports of the software firms. R square worked out to be 0.98 signifying that 98 % variability in net exports can be explained by the variation in the explanatory variables.

Dependent Variable: SER03(net exports)
Method: Least Squares
Date: 09/25/06 Time: 04:13
Sample: 1 92
Included observations: 92

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	139.0825	421.3352	0.330099	0.7421
SER01(technical efficiency)	276.8291	476.6002	0.580841	0.5629
SER02(sales as proxy for size of the company)	1.742858	0.215244	8.097113	0.0000
SER04(years in business)	-3.169337	16.44017	-0.192780	0.8476
SER05(number of employees)	0.109599	0.033098	3.311350	0.0014
SER06(total costs)	-1.684311	0.265260	-6.349671	0.0000

R-squared	0.983575	Mean dependent var	2482.118
Adjusted R-squared	0.982620	S.D. dependent var	8870.783
S.E. of regression	1169.478	Akaike info criterion	17.02950
Sum squared resid	1.18E+08	Schwarz criterion	17.19396
Log likelihood	-777.3568	F-statistic	1029.956
Durbin-Watson stat	1.477421	Prob(F-statistic)	0.000000

Future of IT industry

In India, the software boom started somewhere in the late 1990s. Most of the Indian software companies at that moment offered only limited software services such as the banking and the engineering software. The business software boom started with the emergence of Y2K problem, when a large number of skilled personnel were required to fulfill the mammoth database-correction demand in order to cope up with the advent of the new millennium

The profile of the Indian IT Services has been undergoing a change in the last few years, partly as it moves up the value chain and partly as a response to the market dynamics. Ten years ago, most US companies would not even consider outsourcing some of their IT projects to outside vendors. Now, ten years later, a vast majority of US companies use the professional services of Indian Software engineers in some manner, through large, medium or small companies or through individuals recruited directly.

The market competition is forcing organizations to cut down on costs of products. The professional IT services on the other hand are becoming increasingly expensive. The offshore software development model is today where onsite professional services were ten years ago. There is a high chance that in less than ten years, the vast majority of IT services (software development being just one of them) from developed countries, will be, one, outsourced and two, outsourced to an offshore vendor.
The Indian IT software and services industry is maintaining a steady pace of growth. Software development activity is now not confined to a few cities in India. Software development centers, such as Bangalore, Hyderabad, Mumbai, Pune, Chennai, Calcutta, Delhi-Noida- Gurgaon, Vadodara, Bhubaneswar, Ahmedabad, Goa, Chandigarh, Trivandrum are all developing quickly. All of these places have state-of-the-art software facilities and the presence of a large number of overseas vendors. India's most prized resource is its readily available technical work force. India has the second largest English-speaking scientific professionals in the world, second only to the U.S. It is estimated that India has over 4 million technical workers, over 1,832 educational institutions and polytechnics, which train more than 67,785 computer software professionals every year. The enormous base of skilled manpower is a major draw for global customers. To become a global leader in the IT industry and retain that position, India needs to constantly keep moving up the value chain, focusing on finished products and solutions, rather than purely on skill sets and resumes. India needs to be able to package their services as products, rather than offering them as raw material

It was earlier feared that the Indian software industry might witness a slow-down in the post-Y2K period, but corporate results and other industry data point to robust growth in the future.

The net cost of hiring Indian programmers is still less than one-third the equivalent cost in either Europe or North America, though there has been a gradual bridging of the salary gap between India and developed countries. Demand for Indian software professionals is increasing rapidly in existing and new client countries. For instance, the US is likely to absorb further 50,000 software engineers every year from India once the proposed Bill to increase visa quotas for technical workers is passed by the US Congress, and both Germany and Japan are now seeking to hire as many as 30,000 yearly workers.

Rapid growth of Internet will create a whole new category of demand in software and allied services in future, such as in internet service applications, web design, internet call centers, validations systems, yellow pages and data mining. India is well positioned to

capture a significant share of global business in these areas, even with its relatively low-tech skill base.

Domestic demand will perhaps become another key driver of future growth. Increasing penetration of IT and Internet, pro-active government support and changes in technology will all combine to lower costs in computer hardware, software, telecom and Internet access in the short term. Personal computer sales are already registering double-digit growth in segments such as Government, Insurance, Banks, Public Tax System, Education and Small Office Home Office. India is expected to cross the one million PC shipment mark in 2000 and will have a total base of over 12 million PCs by 2006. These developments will create large domestic demand over the next few years for programmers, training institutes, web designers, system administrators and network engineers. In fact, domestic IT revenue is already increasing faster than exports and currently accounts for almost 30 percent of total industry turnover. Over the next 2-3 years, exports will continue to be the main pillar of the Indian software industry but domestic sales will also attain critical mass in importance and macro-economic impact.

Based on current and future trends, we expect overall revenue growth in software and allied services to be in the region of 40-50 percent annually for the next five years.

Studies of IDC points out that India will be a potential star in bioscience field in the coming years after considering the factors like bio-diversity, human resources, infrastructure facilities and government's initiatives. According to IDC, bioscience includes pharma, **Bio-IT** (bioinformatics), agriculture and R&D. IDC has been reported that the pharmaceutical firms and research institutes in India are looking forward for cost-effective and high-quality research, development, and manufacturing of drugs with more speed.
Bioinformatics has emerged out of the inputs from several different areas such as biology, biochemistry, biophysics, molecular biology, biostatics, and computer science. Specially designed algorithms and organized databases is the core of all informatics operations. The requirements for such an activity make heavy and high level demands on both the hardware and software capabilities.

This sector is the quickest growing field in the country. The vertical growth is because of the linkages between IT and biotechnology, spurred by the human genome project. The promising start-ups are already there in Bangalore, Hyderabad, Pune, Chennai, and Delhi. There are over 200 companies functioning in these places. IT majors such as Intel, IBM, Wipro are getting into this segment spurred by the promises in technological developments.

E-Governance

E-government is the application of Information and Communication Technology (ICT) by government agencies. Its use promises to enhance the effectiveness and efficiency of government and alter its relationship with the public. E-government is evolving through four stages: from posting information to a two-way communication, and from exchange

of value to an integrated service and exchange. Introduction of Digital Governance is a way to ensure that common citizens have equal right to be a part of decision-making processes which affect them directly or indirectly, and influence them in a manner which best improves their conditions and the quality of lives. The new form of governance will ensure that citizens are no longer passive consumers of services offered to them and would transform them to play a decisive role in deciding the kind of services they want and the structure which could best provide the same. ICT can influence the process of Governance in various ways and in varying degrees, from improving the current mechanisms of delivery of services to transforming the entire mechanism and the nature of services themselves. The role could be:

ð Technical role, in terms of automation of tedious tasks earlier done by humans.

ð Facilitating role, leading to participatory and all encompassing decision-making and implementation processes.

ð Innovative role, involving new services and mechanisms to deliver these

Computerisation of the Indian Railways' Passenger Reservation System may be branded a success (Heeks, 1996). Not only did it significantly increase the efficiency of the reservation process, but it also reduced corruption (though did not eliminate it), increased rail staff morale, and improved the quality of customer service. Beyond these reform components, it also gave Indian Railways (and India more widely) a more modern image, and it helped to build information age capabilities within the country.

E-Parliament as a tool for fostering parliamentarian networks

The reasons why ICTs and the new media environment matter for parliaments and governments alike are the following : the declining confidence in political institutions, including legislature and laws calls for the establishment of a Parliament and government's public relation strategy; then, this new dynamically changing environment will require new strategies for political planning and action. It is quite obvious that the press and electronic media make a contribution to making political decision making process more transparent as well as simplifying the political and legislative information to the ordinary citizen.

Electronic Commerce

E-Commerce primarily refers to buying, selling, marketing and servicing of products or services over internet and other computer networks. E-Commerce in India is just taking off with the advent of Railway and Online Air bookings and Net banking. The business is likely to grow to Rs 2300 crore by 2007 according to Internet and Mobile Association of India. For instance, 29 % of Indian internet users book airline tickets online and the figure is expected to touch 46% next year. Online rail ticket booking stands at 39% of the total booking. As far as banking is concerned, there are 4.6 million online banking users

in India. The figure is expected to go up to over 16 million by 2007-08 that will include both internet and mobile banking users. Currently online travel industry is contributing 50% to revenue generated by e- commerce in India. To add to it online travel industry is growing at 125 % (CAGR) .Generating revenues of around $ 300-500 million (Rs 1350-2250 crores) currently, the size of online travel industry is around 2% of the entire travel industry. Online travel industry is expected to become $2 billion industry by 2008.

Increasingly the development of electronic marketplaces will become an intrinsic feature of any government's success in a global economy. Electronic commerce allows efficient interactions among customer, suppliers and development partners cutting down on transaction time and reducing the costs of doing business.

The role of government will be to enable its business community to obtain the most valuable information and apply it in a timely manner to the production and sale of goods and services. However there are a number of legal issues related to E-commerce which need to be immediately addressed. Issues relating to taxation of goods and services traversing over electronic networks have to be resolved without further delay.

The Ministry of Commerce is supporting "Electronic Commerce (EC) / Electronic Data Interchange (EDI) for Trade" project for facilitating international trade. The community partners of this project are various trade regulatory and facilitating agencies like the Customs Department, the Directorate General of Foreign Trade (DGFT)Ports, Airports, the Reserve Bank of India (RBI), Export Promotion Organisations (EPOs), Exporters, Importers, Agents, Container Corporation of India (CONCOR) and Banks. The objectives of this project are to (i) facilitate electronic delivery of services; (ii) simplify procedures; (iii) provide 24 hour access to users with their partners; (iv) make procedure transparent; (v) reduce the transaction cost and time, and (vi) introduce international standards and best practices.

Overall Forecast and Internet Revolution

From a macro perspective, the IT & Internet revolution in India is quite real. With a whole array of knowledge-based skills and legacy to draw upon, India is very well suited to integrate Internet into its industry, public institutions and education system. Perhaps more so than any other country in Asia, Internet will have a profound impact on India's progress towards a more open and accessible business environment. However, the potential of Internet in the corporate sense of profit making has being overstated, and many pure web-based Indian businesses are likely to fail. But even though Indian society is not yet ready to adapt to the 'new economy' in a consumer sense, the increasing ubiquity of Internet technology will create new global opportunities for India on the supply side, and especially in software. There will very likely be an acceleration in the pace of domestic IT penetration, and this will help in increasing productivity and efficiency in the larger economy. At a minimum, continued growth in software exports and inbound investments will provide a comfortable source of hard currency, which in turn will act as a hedge against any adverse changes in India's balance of merchandise

trade. Even more, the direct and indirect impact of all Internet-related benefits could be as high as an extra 1 to 1.5 percentage point GDP growth over the medium term.

In the near future, India may become a front runner in the age of information revolution to be a Global IT superpower. The following are the some of the emerging trends in IT services:

(a)Providing access to Internet through authorised cable TV without additional licensing

(b)Provision of *'last mile'* linkages either by fibre optic or radio communication for IT application enterprises, IT promotional organisations and ISPs

(c)Setting up of *spread spectrum* based non-interference type wireless data/multimedia communication equipment viz., public wireless, subject to a maximum of 4 Watts EIRP with a radio frequency band in the range of 2.4-2.483 GHz

(d) Public Tele Info Centres (PTIC) having multimedia capability specially for ISDN services, remote database access, Government and community information systems, market info, desk top videoconferencing, tele info and internet/web access services

(e)Promotion of *'Hi-tech Habitats'* of high quality in the rural hinterland of the cities

(f)Technological advancements in wide area computer-communication networks which may result into *'Virtual Technology Parks'* where IT software and IT services are developed through on-line integration of software and services sub-systems from widely separated locations in the country

(g)Using *International Credit Cards (ICC)* to paying for IT software and IT services purchased over internet or extranets and also for registering domain names

(h)Maximum flexibility in organising the marketing of package software from India through internet

(i)Advanced network to enable organisations and companies to identify, explore and plan strategies for large *Niche markets* like *Euro*, corporate-wise as well as nationally

(j)Emergence of *'India Pavilions'* in several major IT exhibitions around the world through the initiative and co-ordination of *Electronics & Software Export Promotion Council (ESC) & NASSCOM*

(k)Creation of *'Mega Web-sites'* on Internet for promoting marketing and encouraging Indian software products and packages under multiple initiatives

(l)Encouraging creation & hosting of web-sites on servers located in India

(m) Setting up of value-added network services including ATMs, electronic Kiosks, telephones, smart cards etc. for providing a *'one-stop non-stop'* service to the public

(n)Mobilising IT in Indian languages based on multi-pronged approach, involving fiscal and other incentives for R&D, production, marketing and popularisation of IT products in Indian languages

(o)Development of indigenous technologies in wireless tele-communication such as *CorDECT, remote access switch,* etc. to achieve the national objective of rapid, low-cost expansion of telephone & Internet connectivity in rural and remote areas

(p)Promotion of *electronic commerce* in sea ports, Airports Authority of India, DGFT, banks, container services, customs & Indian railways

(q)On-line upgradation of Court Information System (COURTIS), Parliament Information System (PARLIS), Computerised Rural Information Programme (CRISP) and other such databases over NICNET

(r) Adoption of telecommuting, a new modality of doing work, in the framework of *'Management by Objectives (MBO)'*

(s)Creation of Information security agency at the national level

(t)Wider dissemination of *Cryptology & Cyber security* knowledge in the country to improve information security, network security and bring about a greater degree of secure use of EFT, digital signature, etc.

(u)Software products: emerging 'slivers', productization, and embedded software

(v) Web enabling legacy systems, e-commerce/extended enterprise applications, standards based application integration, knowledge management and convergence applications

(w*) IT enabled services*: HR services, remote customer interaction, data search ,integration and analysis, and engineering and design services

In addition, while online *electronic newspapers* have already become a reality in India on a limited scale, its wide-spread impact would be felt only with the technological advances in telecom services

Multimedia technology enabling simultaneous exchange of voice, text and data would prove to be a major medium of advertisement. Spending on advertisement is expected to be around 5 per cent by 2000 and to reach 12-15 per cent by 2020 AD. Ultimately the market would see an increase from Rs. 350 million to Rs. 120-150 billion by 2020.

Around 50-75 million households are expected to be potential users of multimedia by 2020.

Geographical Breakdown of Exports

An interesting industry trend that has been noticed in recent years is the expansion of the Indian IT industry's presence from beyond traditional destinations, to newer geographies. The industry's focus is no longer on English-speaking countries alone, and a key strategy for Indian IT majors has been to harness local talent to tap domestic markets and de-risk the revenue model by reducing their dependence on one geographical region.

Americas and Europe remain the key markets, accounting for over 90 per cent of IT-ITES exports. However, export earnings from markets other than the US and the UK are also witnessing significant double-digit year-on-year growth.

While Indian service providers have built delivery centers in key source markets (e.g. US), they are expanding their footprints in specialist locations like China for engineering and design; South Africa for insurance, and near-shore locations like Eastern Europe and Mexico. Apart from companies in the US, organizations from Europe, South East Asia, Australia, Japan, Hong Kong, New Zealand, etc. are also reaching out for Indian software expertise, supported by the conducive policy environment and incentives for software exports offered by India(see Table III).

Table III: Geographical Breakdown of Exports

Location	FY 2004	FY 2005
Americas	69.4%	68.4%
Australasia	22.6%	23.1%
Europe	7.4%	8.0%
Others	0.6%	0.5%

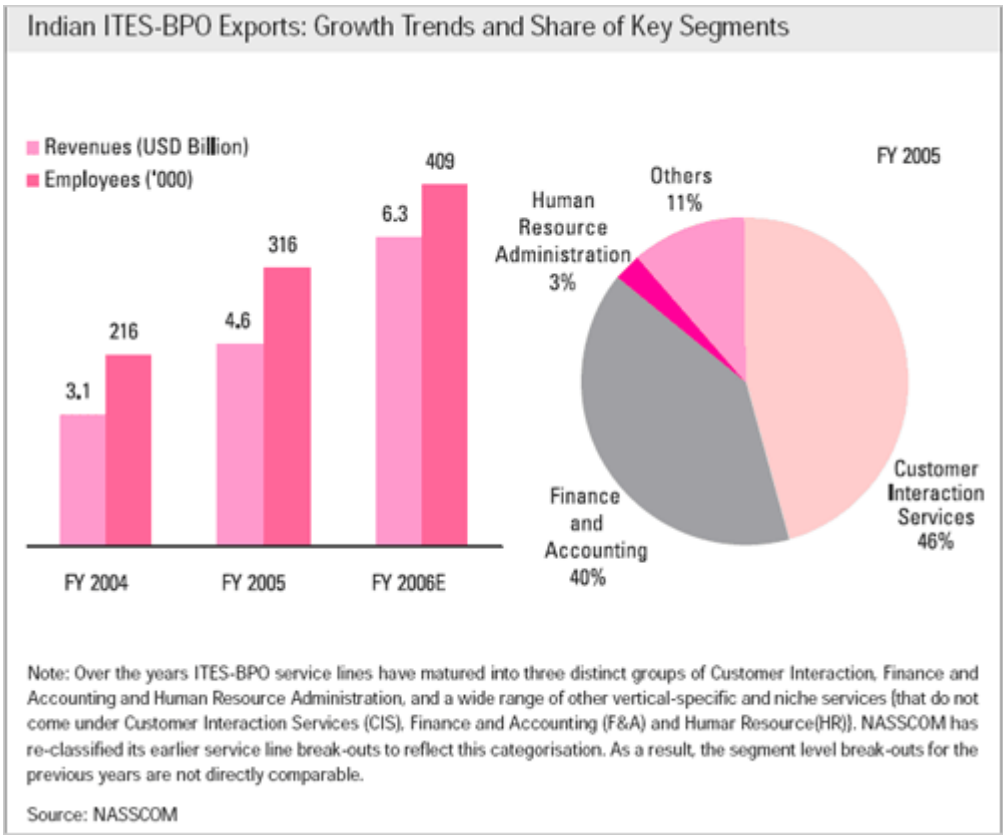
IT Services Exports by Verticals

Services exports in FY 2004-05 witnessed continued strength in traditional vertical market segments including BFSI, manufacturing and telecommunications.

Underlying the increasing geographic and vertical market penetration is the continuing supply-side maturity of the Indian industry. This is reflected in the ongoing scale expansion without compromising on quality or productivity and growing deal sizes; demonstrated abilities of India-based firms to broaden their service portfolio, leverage productivity and utilization levels to sustain competitiveness and enhance their global service delivery capabilities - while maintaining high levels of growth.

The Indian IT-enabled Business Services (referred to as ITES-BPO) segment continues to chart strong year-on-year growth, estimated at 37 per cent for FY 2005-06. Growth is being driven by a steady increase in scale and depth of existing service lines, and by the addition of newer vertical-specific and emerging, niche business services.

Indian ITES-BPO (re-classified) exports are estimated to have grown from USD 3.1 billion in FY 2003-04 to USD 4.6 billion in FY 2004-05, recording a growth of nearly 48 per cent, and are estimated to reach USD 6.3 billion by the end of the current fiscal year (FY 2005-06)[11].



Net employment in the ITES-BPO segment is estimated to have grown by approximately 100,000 in FY 2004-05, taking the total direct employment to 316,000. Based on hiring trends observed over the year, this segment is likely to end the current financial year (FY 2005-06) with total employment projected to reach 409,000. Employee turnover/ attrition levels appear to be stabilizing with the talent acquisition, development and retention initiatives being undertaken by the players, beginning to deliver results.

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11 To better reflect how the industry and customer markets view the portfolio of services sourced from India, NASSCOM has re-classified the manner in which it reports the various segments included within IT-ITES. For instance, this year onwards, engineering and R&D services are being identified as an independent service line and will be reported separately. Consequently, some of the services (e.g. GIS), earlier included under ITES-BPO, will now be reported under engineering and R&D services. Further, NASSCOM has increased its overall estimate of industry exports for the previous year (FY 2004-05), based on the details reported to NASSCOM and STPI by individual companies. As a result of the re-classification and the revision of estimates, the historical values for a few segments have changed..

Factors Responsible for IT Boom in India: A Closer Look

The study will discuss in detail three initiatives which were responsible for the present IT status for India: policies that mobilize the Indian Diaspora, the formation and work of the erstwhile DoE and Ministry of Information and Communication Technology,& software technology parks .The fourth initiative is the pattern of spatial agglomeration in the IT sector.

Government-Diaspora Partnership

The Role of Diaspora in the Emergence of the Indian IT Industry –The Indian Diaspora has been very successful in Knowledge-intensive sectors in the US, and more so in the IT sector. Almost simultaneously, a very competitive and successful IT industry emerged in India. This section analyses various factors that helped in the emergence of the successful IT industry in India (during the last 35 years) and the role that the Diaspora community played in this evolution. Very few attempts and investments that were made by PIOs(Persons of Indian Origin) in the 1970s and early 1980s were quickly abandoned because of bureaucratic obstacles by the Indian government and the limited capabilities of Indian partners. Hence, the only crucial role played by these PIOs was limited to being tolerant mentors of early Indian software development companies

In early 1980s, several small Indian companies came to Silicon Valley in search of low-end contract software development work. Several PIO executives were willing to help but most found the Indian companies' work to be unsatisfactory and many suffered from deficient development tools and computers. This is partly because even until 1985-86, the Indian government was promoting Russian computers over American computers and Indian companies had just started working with PCs; hence, the companies' professionals could not meet, or sometimes even understand, US standards for quality and timeliness. To mitigate this problem, the Diaspora executives sometimes created programs within their US companies whereby Indian programmers could work in the US and with US technology (at Indian wages plus travel related costs). Further, they coached and guided the Indian companies to enable them in improving their quality and performance standards.

Hence, during the 1970s and 1980s, the role of Indian Diaspora in the evolution of Indian IT industry was limited to that of a patient mentor and brand ambassador in most of the cases.

1990s

Many Indian engineers, who had started moving to the US in 1960s, had by now either become entrepreneurs, or Venture Capitalists or high-level executives in large and medium sized companies. And, these professionals had started to coalesce especially because many had graduated from the same top-notch colleges in India (such as the IITs) and most of them also knew their counterparts in India (who were often also alumni of

the same colleges). Some of these relationships quickly matured in forming non-profit associations such as TiE and SIPA (Silicon Indian Professional Association).

TiE, originally designed as a Silicon Valley organization provided mentoring to promising young expatriate IT professionals, soon developed into a worldwide network of Indian professionals which has had a substantial influence on the Indian IT industry and government policies towards it. Currently, TiE[12] has 38 chapters and over 6,800 members, worldwide.

Since many in these people knew their counterparts in India and since most were closely observing the growing Indian IT industry, in the mid and late 1990s, some of them started their own IT companies in India (e.g., Cognizant, Techspan, Mphasis) whereas others invested in nascent IT and Dot.com companies in India. Further, since US, Canada and UK were facing a shortage of IT professionals during 1996-1999, many in the Indian Diaspora convinced their companies to hire Indian IT professionals and this resulted in the 'Indian IT Diaspora' becoming stronger and the Indians constituting 24 percent of the entire Silicon Valley IT professional population by late 1999.

All these developments in turn permitted another crucial Diaspora role. Some Indians had become senior executives at many major US corporations, like IBM, GE and American Express. In nearly every instance where these companies invested in or outsourced work to India a well placed expatriate executive crucially influenced the decision. In part the individual's own success supported the emerging positive reputation of Indian engineers. And in part the individual's direct experience of India gave them credibility in vouching that the well-known problems of India's infrastructure and bureaucracy could be overcome. The US investment and outsourcing partly drove Indian software industry annual growth to 40 percent during the 1990s .

There were other Diaspora roles as well. Some younger Indians in the US moved to India as 'Expatriates' and started IT Research and Development Laboratories (e.g., IBM India Research Laboratory was started in April 1998) whereas others moved to supervise US investments, outsourcing contracts, and to train and manage Indian professionals to US efficiency and standards.

2000 & Beyond and Government Programs to Strengthen Diaspora Relationships in Promoting IT sector

By 2000 Indian engineers were at the helm of 972 Silicon Valley-based technology companies, which accounted for approximately $5 billion in sales at 25,811 jobs. Moreover, the pace of Indian entrepreneurship accelerated rapidly in the 1990s: while

[12] The Indus Entrepreneur.-The organization currently has established chapters in Bangalore, Bombay, Delhi, Hyderabad, Calcutta, and Chennai. The global connections have paid off, as the non-resident Indians "in turn invested in promising start-ups and venture funds and have begun to serve as role models and advisors for local IT entrepreneurs."

Indians were running only 3 percent of the technology companies started between 1980 and 1983, they were running 10 percent of those started between 1995 and 2000.

The success of these former Indian nationals is evident, and the Indian government recognizes that connections with these individuals can help promote the domestic market for IT. The Indian Diaspora of IT professionals in Silicon Valley has established social networks like The Indus Entrepreneur (TiE) and the Silicon Valley Indian Professionals Association. The existence of these organizations shows that Indian immigrants maintain close ties to those of their own origin and value the professional connections that such a network can offer. To address the effects of brain drain, then, the Indian government began with mechanisms that strengthened the ties between the diaspora and its roots.

India's Ministry of Science and Technology formed a High Level Committee on the Indian Diaspora in 2000 in order to facilitate communication and interaction between the expatriates and their home nation. The organization's 2002 report recognizes that scientists of Indian origin abroad "are keen to contribute to their country of origin." One obvious way in which these immigrants can contribute to outsourcing in the Indian IT industry is to encourage their companies to partner with Indian firms for software development or other production processes, thus alleviating the effects of brain drain. If individuals hold leadership positions within their corporations and make managerial decisions, there is no better way to encourage outsourcing than to engage it firsthand.

The government is pursuing a number of different bilateral programs simultaneously. The first of these programs is an exchange program called "The Transfer of Knowhow Through Expatriate Nationals" (TOKTEN). The concept, formed by the United Nations Human Development Program (UNDP), encourages expatriate nationals to undertake short-term consultancies in their home countries. In India, TOKTEN has enabled 650 professionals to visit 250 institutions from 1980-2001. The alumni networks of the government-funded Indian Institutes of Technology (IITs) have been another method of encouraging interaction. Alumni from America have recently given 60 crores in Indian Rupees to IIT Kanpur and 30 crores in Indian Rupees to IIT Karagpur "for upgrading infrastructure and human resource development" and "tracking…alumni to other Indian premier academic-cum-research institutes." Investing in the IITs has helped in some way in tackling the problems caused by the shortage of computer professionals that has been predicted for the next several years.Two other notable initiatives have been taken by the government to connect with the diaspora. One of these is advisory panels with eminent non-resident Indians that have spurred investment and led to several IT joint ventures. The next is the placement of many non-resident Indians in honorary fellowships at universities, funded by professional scientific and technical societies.

Through these various programs and incentives, India has found a viable method for fighting the "brain drain" which could so easily strip the country of one of its most valuable resources, a skilled labor force. Short of working extremely hard to entice Indian nationals back to the country, fruitful interaction with the Indian Diaspora is an excellent way to push the IT industry in India to even higher levels and mitigate the shortage of IT

professionals there.

Indian IT Industry: Role of Government Institutions and Ministry of Information Technology

Before 2000

In India, the Department of Electronics (DOE) was the primary agency overseeing government IT policy formulation and implementation. Three government-funded computing organizations played important roles in new technology development: the National Centre for Science and Technology (NCST) in Bombay, the Centre for Development of Advanced Computing (C-DAC) in Pune, and the National Informatics Centre (NIC) headquartered in New Delhi. C-DAC is now one of the most advanced IT development centres in India. The NIC was the second major Indian computer-related project funded by the UNDP in 1977. It operates the largest data communications network (NICNET) in India with more than 600 earth stations linking government agencies at all levels. There are many lessons to be learnt from the two decades of NIC operations in the country. NIC has done a pioneering work in popularising the use of computers in the government sector, breaking the geographical boundaries and encompassing all sectors of economic activity. In the process, it has carved out a niche for itself among the public sector organisations. It has taken upon itself the job of creation of IT applications for different government departments. In 1990,DoE devised a scheme called DOEACC jointly with the All India Council for Technical Education(AICTE) to provide accreditation according to specified level of course. The Government has supplied trained manpower for software development.

It appears that potential of software exports from India was recognized as early as 1968(as stated above).The Electronic Committee group's report in 1968 recommended the promotion of the industry for exports(Subramaniam,1992).

In the early 1970s department of electronics was created. A few software vendor firms came into the market mainly to serve the public sector: the investment by the department of electronics in the public sector R & D projects, which involved software development. Public Sector contracts for custom software development were given to private sector firms. The government also initiated software related training courses in the Indian Institutes of Technology and universities around this time. The Software Export Scheme was launched in 1972. In addition, there was an emphasis on computer and software education and training. Any institutions that focused on training were allowed to import hardware at much lower import duties . In parallel, the DOE began to encourage public sector projects that dealt with software development. Public procurement of software gave priority to Indian companies.

As far as Hardware is concerned in the 1970s, the state-run Electronics Corporation of India (ECIL) was the main beneficiary as very few licenses were issued to private producers of microcomputers. However, the microcomputers developed by ECIL were

too expensive for general consumption and lacked an adequate range of software. To meet with the growing demand for computers, the DOE gave permission to ICL's Indian subsidiary, ICIM to produce microprocessor-based computers. This decision was extremely unpopular with the domestic private sector. In 1978, the Sondhi Committee Report on the state of the computer industry pushed for the issuance of more licenses for the private sector . As a result, by the time Rajiv Gandhi became Prime Minister in 1984, there were a few very strong domestic computer companies including HCL and Wipro[13].

The DOE's role underwent a transformation in the mid-1980s It became increasingly apparent to high level policy makers at the DOE and in the Government of India that the public sector was not able to supply the computer hardware and software that was needed by the domestic market . The new approach was more supportive of the domestic software industry rather than the previous more restrictive and regulatory one. It also encouraged software exports and export-oriented foreign investment. In response to the success of companies like HCL and Wipro, a new Computer Policy was introduced in November 1984 which reduced many constraints on the industry . Further liberalisation came in the form of the new Software Policy, which was implemented in 1986. The new policy advocated what was called a `flood in - flood out' approach, allowing imports to `flood in' in the hopes that eventually exports would `flood out.

Further evidence of this changed attitude came in 1986 when Texas Instruments (TI), proposed to establish a 100 per cent export-oriented, foreign owned and operated subsidiary (its first outside the United States). The DOE and the GOI were fairly quick in the processing of the license

The DOE's support for exports did not, however, extend to the export of know-how in the form of Indian programmers going abroad to provide onsite services to clients, which in 1989 accounted for over 90 per cent of software revenues (Schware, 1992, p. 151). In 1987, a decision was taken to impose a 15 per cent tax on foreign exchange expenditure on travel. This had substantial implications for the software industry because of the "body shopping" activities (Heeks, 1996, p. 47). The importance of body shopping in terms of establishing the Indian software industry's reputation and allowing Indian programmers and engineers to gain first-hand knowledge of the latest technologies.

TI's(Texas Instruments) fully equipped software development centre, inclusive of satellite connectivity, made it clear to the DOE and the GOI that in order to foster the development of a vibrant software industry in India, it was necessary to provide an environment which would facilitate such activities. This realization acted as a catalyst for the establishment of the Software Technology Parks of India Scheme in 1988. These STPs were envisioned to be like export processing zones, where the government provided

[13] Another way to get around the high duties and elaborate licensing procedures was to set up a training or educational facility dedicated to software and hardware training. The Delhi-based company, NIIT got its start in this way in 1981. In order to have access to computer hardware, NIIT got into the market as a training facility and essentially entered the market where there was no market. It was only in 1985, when the law with respect to the purchase of hardware was amended that NIIT changed its strategy somewhat. It added to its portfolio computer software development and technical support, initially for the domestic market but in 1988 the company earned its first dollar from on-site professional services, and in 1990/91 the emphasis on foreign markets became a core activity.

infrastructure, buildings, electricity, telecommunications facilities and high speed satellite links .

Until this time, telecommunications policies came under the auspices of the Department of Telecommunications. The DOE, however, saw an opportunity to boost the software industry and took the responsibility and the risk to install the appropriate telecommunications equipment so that Indian software companies would have an easy access to their clients and so that the delivery of software exports would be expedited.

While the Department of Telecommunications took commercial approach to the provision of telecommunications , the DOE took a development approach.

In the early 1990s the Finance Ministry made concerted attempts to consciously give thrust to software exports (Kumar and Joseph,2005). Accordingly, the following measures were initiated (a) the removal of entry barriers against foreign companies (b) the removal of restrictions on foreign technology transfers (c) the participation of the private sector in policy making (d) provisions to finance software development through equity and venture capital (e) measures to make available faster and cheaper data communication facilities and (f) the reduction and rationalization of taxes, duties and tariffs.

Recognizing the potential of IT related industries and software for India's development, the Prime Minister created the National Task force[14] on information technology and software development (NTITSD).NTITSD submitted a report outlining a national IT Action plan comprising 108 recommendations for software and 87 recommendations for hardware(India,NTITSD,1998).These recommendations have since been notified by the Government in the Gazette of India dated 25 July 1998(India,MIT,2000)

The Indian Action Plan makes stimulation of the software and IT services industries a basic objective, with a goal of $50 billion in exports and a commensurately large domestic IT market. These measures will have a direct impact upon business use of the Internet since networking is integral to the activity of software and IT service companies. The Action Plan lists 38 steps to assist IT firms with venture capital, credit, subsidies, reduced taxes, duties, and fees and fewer bureaucratic roadblocks. (These measures will of course have secondary effects on all of our dimensions.).The Action Plan also supports offshore programming services with a call for diplomatic pressure to make it easier for Indian programmers abroad to obtain visas. This is a double-edged sword. If the United States or other nations ease visa and work permit restrictions, programmers emigrate. While this brain drain hurts the domestic software industry, professional nonresident Indians are an important source of hard currency and business contacts.

While most of the business emphasis in the Action Plan is in support of software and IT service, there are also measures to encourage other electronic business, such as by

[14] The 18-member task force had representatives of industry (telecommunication, software, and IT), government, and education, but not health. This may explain the lack of emphasis on health care in the action plan

ordering the Department of Telecommunication to meet "communication requirements" for electronic commerce and electronic data interchange, expediting electronically based export orders, and mandating bar coding. To the extent that this traffic flows on the Internet, it will add to penetration; however, related legislation concerning privacy, digital signatures, and encryption is not yet specified.

Intellectual property laws and customs will also have a major impact In both nations, poverty and limited familiarity with credit cards and other banking services among the general public will also constrain the level of consumer-oriented electronic commerce, but this should be less of a problem in business-business transaction processing. Still, it should be noted that Internet commerce is in early stages of development in India, and it will be some time before it significantly impacts the Internet.

In 2000 and Beyond

In 2000 India set up a science and technology bureaucracy to coordinate government-administrated projects relating to information technology. A number of different government agencies, formerly under the Ministry of Science and Technology that are concerned with IT, were brought together into an integrated Ministry of Information Technology including the DOE (also referred to as MIT). It has since undertaken a large number of projects aligned with its vision of "making India an IT Super Power by the year 2008."Among the objectives identified are "creation of wealth, employment generation, and IT-led economic growth." As a policymaking body, the organization's leadership consists of a minister, a minister of state, a secretary and additional secretary, a controller, and several group coordinators and senior directors. This ministerial hierarchy fills a previous void in the Indian government; until the Ministry of Information Technology was formed, there was no "single apex institution or focal point for formulating national policies and strategies for the IT sector…and the lack of any central oversight and a critical mass of in-house expertise in the public sector often hinder[ed] the sharing of information…and the development of information standards and protocols and common information infrastructures." It is further recognized that "in general, the institutional framework [was] underdeveloped for dealing with systemic problems of computer and software requirements, planning, procurement, coordination among agencies, and IT diffusion." The Ministry of Information Technology has been India's solution for strengthening that framework.

Software Technology Parks of India : A Business, Academia & **Government of India Initiative**

The Department of Electronics introduced the scheme of Software Technology Parks(STP) in the early 1990s.An STP is an analogue of an export processing zone. Firms in STPs were allowed tax exemptions, guaranteed access to high speed satellite links and were provided with reliable electric power, including core computer facilities, ready to use office space, as well as communication facilities. They were allowed to import equipment duty free and without licenses .Full(100%) foreign ownership was permitted in exchange for an export obligation. Firms were allowed to repatriate capital investment

,royalties and dividends free once they paid the taxes due. China on the other hand provided all these incentives and more in its special economic zones to attract investment ,particularly foreign direct investment that was oriented towards export markets.

The concept of software technology parks (STPs), which provide the technical infrastructure necessary for IT development, emerged from a growing problem that policymakers began to notice in the early 1980s. The New Computer Policy of 1984 and the 1986 Policy on Computer Software Export, Software Development, and Training set out the objective of expanding the Indian software export and development through data communication links. The policies' aim was to develop software in India using Indian expertise on sophisticated computers that were being imported duty-free. Protectionist policies had, until then, stunted the growth of the industry by imposing duties of up to 200% on the imported hardware needed for advancement of both the hardware and software components of the industry

The next and more significant difficulty firms faced was the high cost of the data communication links needed for software development. The poor telecommunications infrastructure India had at the time was inadequate. Foreign corporations were looking to expand their global production networks to India because the country offered a skilled, English-speaking workforce, but the corporations could not be accommodated at a reasonable cost. Though companies were allowed by law to establish the data communication link through their own initial investment, few companies could pay the high price without other incentives. From this necessity, the idea of software technology parks was born. The Ministry of Information Technology developed the concept of STPs and lists the following as the objectives of the project:

To establish and manage infrastructure resources such as Data Communication facilities, Core Computer facilities, built-up space and other common amenities; to provide 'single window' statutory services such as project approvals, import certification, software valuation, and certification of exports for software exporters; to promote development and export of software services through technology assessments, market analyses, market segmentation and marketing support; to train professionals and to encourage design and development in the field of software technology and software engineering.

The STPs now serve as intersections where a viable business model, strong Internet infrastructure, and government interface come together for a successful enterprise: "The infrastructure facilities include modern, high-speed, broad-band telecom links, powerful computers and network systems beyond the reach of individual firms, consultancy, and training support." The first of these parks were established in 1991 at Bangalore, Pune, and Bhubaneswar. In nearly all of the literature on the subject STPs have been heralded as one of the most profitable institutional initiatives for developing the IT industry.

Institutional Infrastructure and Patterns of Spatial Agglomeration in the IT sector

The Indian experience has shown that the cities with a high concentration of software development activity enjoy a disproportionate share of innovative infrastructure, the skill

base and other resources for technology development. Because of significant agglomeration economies present in skill and knowledge intensive activities, such as software development, the fact that these cities have this disproportionate share of the national innovative infrastructure has served as a magnet for software development activity. These cities also had the highest concentration of public sector R&D establishments (especially defense) as well as publicly funded engineering colleges With the Indian states realizing the importance of improving the urban and rural Infrastructure sector the IT industry has been spreading to other smaller cities of India.

IT diffusion innovations in the Indian economy can be seen in terms of typical definitions of innovations, namely, a new industry, new business, new market, new organization and new intellectual capital. These diffusion innovation are classified into four stages. The first three refer to the pattern of adoption. These are socio-economic innovations at the national level that emerge during technology adoption. First seen are adaptation-diffusion innovations; the transfer of IT to sectors not previously influenced or administered by IT, also known as traditional sectors or non –IT sectors. Second, we see infrastructure diffusion innovations: supportive infrastructure innovations, mainly in communications, telecommunications and connectivity areas that augment adaptation diffusion innovations. The third stage is more subtle but powerful; human- skill- diffusion innovations in the human capital knowledge base. This stage brings growth to human capital, namely to knowledge, skills and competencies. This stage is pre-requisite for the fourth stage, which emerges as human capital masters IT. Success of the first three stages of IT diffusion innovations in terms of adaptation –diffusion innovations, infrastructural diffusions innovations and human skill diffusion innovations will trigger the fourth the technical IT innovations and inventiveness. After the initial adoption success with IT entry, IT generation innovations and inventions, in the form of intellectual property, product, process and service, typically emerge. This last or fourth stage refers to the ultimate state in which R&D supports technological innovation and inventions.

Causes of Indian IT Industry BOOM today and India's edge
This boom is largely fuelled by the following factors: a)The Role GOI played in providing impetus to promotion of software exports since 1980s-in industrial development and in creating an enabling environment for the integration of local industries in the global economy, b) India has a vibrant news and entertainment industry, and a large domestic audience which is hungry for content, c) Indian success stories in Silicon Valley, which by now are legion, are inspiring entrepreneurs and young people in the homeland, and d) venture financing to India’s information technology sector has grown dramatically in the last year, aided in part by Indian net-millionaires from overseas playing a key role (e) its low cost -high quality-scalability model, which gives it an edge over other emerging ITES-BPO destinations such as Ireland, the Philippines, China and some Latin American countries. (f) a high quality, pool of knowledge workers who have English Speaking and relevant domain skills give India an edge over other offshore outsourcing locations.(g) The ability to focus on core competencies and use offshoring to access new technologies and talent to strengthen and expand existing business offerings.(h) high quality and competitive pricing of Indian software and services(i) availability of a large pool of knowledge workers with requisite computing and language

skills(j)flexibility and adaptability of Indian professionals(k)ability to undertake offshore software development through data com links, availability of local enterprise and skills, the Indian diaspora , especially the active and productive two way links between Indians and Indian Americans in the US(Baru,2006)
Major global players who have recently invested in Indian IT and Internet firms include Walden, Draper, Chase Manhattan Bank, Citibank, Microsoft, Intel, Pacific Century Group, News Corp and Kerry Packer Ventures. Approximately US $ 1 billion has already been invested or pledged by these and other venture capital firms, and industry reports suggest that a further US $ 10 billion is waiting to be tapped in the next 4 years.

Indian businesses are also moving aggressively to have a web presence, and over 200,000 large and medium sized firms are expected to launch net-based operations in the next year. Some private banks have already started on-line banking and advisory services, and regulatory authorities are expected to allow on-line stock brokerage in the next few months. Many of these companies are motivated more by a fear of losing out than by any cogent business strategy, but a positive spin-off which is likely is that it will bring into focus the importance of service quality in business. On-line transactions and customer relations are just the beginning, and in time this will lead to bigger and better ideas. Internet is already aiding a gradual process of de-intermediation in many areas, such as in recruitment, business research, travel, real estate and insurance, and e-governance initiatives at different levels of government are now being planned. In future, interacting with various authorities for routine permits and information will become simpler and quicker, and MNCs will probably waste less time in low-level tasks.

Private sector developments have actually gone hand in hand with official measures to give a boost to the IT sector, including rapid adoption of Internet in various government departments, removal of irritants in tax rules for venture capital, reduction of import duty on computer parts, duty free import of software, laying of 8,000 kilometers of optical fiber cables between cities, and strengthening the domestic Internet backbone. Just recently, the Indian parliament passed a new cyber law that provides legal sanction to e-commerce.

Many of these initiatives are still many months away from being fully implemented, but their overall impact will be to sustain and perhaps even accelerate the IT momentum over the medium term by lowering costs and increasing access. For instance, more than 80 percent of India’s corporate websites are currently located in USA because Indian servers are costlier and less reliable, but many of them are expected to shift to India once optical fibers and broadband become a reality.

India: ICT as a Tool for Development and Researchable Issues

Any government will have a dual role in the ICT sector and India is no exception. It acts as a regulator and formulates long term policies for the promotion and development of various industrial and service sector reforms including the ICT related activities; and at the same time, it deploys these services for the governance and improving the efficiency of its decision making and administrative control. The government's reform agenda is

also affected by bilateral and multilateral agreements. This is particularly true of the ICT because of its international outreach and impact. The recent advances in ICT will have a profound impact on the way the governments function in the coming years. While the move towards decentralized planning and management will gain momentum, the need for high quality of information for decision making, control, monitoring and evaluation will increase in all sectors of social and economic activity. To what extent the Government of India can benefit from the development and application of emerging technologies for information storage, processing and communications? What has the Government of India done in this context? Has it kept pace with global trends in ICT and to what extent it has been active in policy formulation? Has it been an effective user of ICT in its day-to-day administration and decision making? These are some of the questions, the answers to which are difficult to get.

India is a predominantly rural, agro-based country with about two thirds of its population based in villages. Rural transformation was led by the green revolution of the late sixties and the white revolution of late seventies. The next step phase of rural transformation can be brought about by a Knowledge Revolution facilitated by ICT (Information and Communication Technology).

We have seen emergence of ICT-based rural e-Governance applications in the recent past, that have demonstrated the important role ICT can play in the realm of rural development. Several of these ICT projects have attempted to improve the reach, enhance base, minimize processing costs, increase transparency and reduce cycle times. Several states have initiated the creation of SWAN (State Wide Area Networks) to facilitate electronic access of the state and district administration services to the citizens in villages.

Information and Communications Technology (ICT) has become the most exciting set of technologies today, thanks to developments like Internet growth, e-commerce proliferation, the mobile computing revolution and the arrival of broadband. At this juncture, it is appropriate to study the use of ICT in rural India and how it addresses the needs of the common man.

We discuss below a few case studies of ICT applications in a development context. Most of the cases are pilot projects undertaken either directly by Government departments or done with heavy Government support and funding. The cases concentrate on applications of ICT for rural development.

Computer Assisted Deeds Registration system of Andhra Pradesh which attempts to reengineer the Registration Process involving about 120 million documents a year. The pilot project, already implemented, has reduced registration time from several days to just 60 minutes and Encumbrance Certificate issue time from five days to 10 minutes.

Integrated Certificate Distribution across Andhra Pradesh is another high-profile experiment being implemented. The technology is simple; yet the benefits immense. The

system builds up Social Security Identification (SSI) for most citizens–a unique way of identifying every individual citizen, cost-effectively.

Rural Postal System in Hyderabad, Andhra Pradesh represents an interesting way to reengineer the multiple functions in a Post Office counter in India using simple, PC-based technology. Thanks to near-zero investments in Post offices, such relatively simple and straightforward applications work.

IT at Milk Collection Centers in Cooperative Dairies in Gujarat brings real benefits to more than 60,000 farmers daily, who are involved in the milk collection project spread over 600 milk collection centers. Using relatively simple technology (PC, Weighing machine with PC interface and online milk tester), this system has delivered results over many years.

Same Language Sub-titling experiment in Gujarat has been another novel, intuitive way of improving literacy among children. In this experiment, synchronized sub-titling of film music song lyrics has been undertaken. As a result of this implementation, children have shown significant improvement in literacy. The fact that children like to co-sing the songs and read the text of the lyrics, indicates the success of the experiment.

The Warana Wired Village Project in Maharashtra is a very recent experiment which provides Internet connections using satellite communication to rural India. This experiment leverages the relative prosperity gained by the region over the past few decades through a Sugar Factory. Spreading over 70 villages, the project attempts to use Web technology for self-improvement through skills development and employment generation.

Moving on to a much sustainable model is the **"e-Choupal**." Launched in June 2000, it has already become the largest initiative among all Internet-based interventions in rural India."e-Choupal" services today reach out to more than 3.5 million farmers growing a range of crops, including soya bean, coffee, wheat, rice, pulses, and shrimp, in over 31,000 villages through 5,200 kiosks across six states (Madhya Pradesh, Karnataka, Andhra Pradesh, Uttar Pradesh, Maharashtra and Rajasthan).

ITC's "e-Choupal" empowers over 3.1 million farmers by enabling them to access crop-specific, customized and comprehensive information in their native village habitat and language. Vernacular web sites, relating to each agricultural crop that ITC deals in, provide even marginal farmers with ready and real-time information on the prevailing Indian and international prices and price trends for their crops, expert knowledge on best farming practices, and micro-level weather forecasts. The "e-Choupal" model and movement has helped aggregate demand by creating a virtual producers' co-operative, thus facilitating access to higher quality farm inputs at lower costs for farmers.

Various corporates like Wipro have also been undertaking programs for the rural communities. The company has launched its Applying Thought In Schools Program,

even as giant chip-maker Intel has introduced its Intel Innovation in Education initiative and Microsoft its project Shiksha. With all these interventions, corporates are now targeting school students in a major way, in order to leverage technology in education.

The **CBFL program**, developed by Tata Consultancy Services, is another case in point. It operates under the aegis of the Tata Council for Community Initiatives and uses a mix of methods-such as teaching software, multimedia presentations and printed material-to teach an uneducated person. The method is implemented using computers, which deliver the lessons in multimedia format to the learners. Supplementing computers in this process are reference textbooks of the National Literacy Mission. Today, the CBFL project is operational in more than 1,000 centers in Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Maharashtra, Uttar Pradesh and West Bengal, and it has touched the lives of over 20,000 people. More centers are in the process of being set up.

One of the best examples of ICT improving the quality of rural India comes out of the work of a nonprofit organization called **Drishtee** (2002) which has created a need identification survey that is undertaken at the district level. The data has been rendered electronic and is widely accessible by administrators. It enables villagers to have access to government programs and benefits, market related news, and information on private exchanges and transactions. Drishtee has created over 50,000 information kiosks in six years which serve 500 million. The organization has trained members of households who are mainly village entrepreneurs who use inexpensive and very simple software. They own these kiosks which are financed through government sponsored programs. These kiosks have led to a new breed of IT literate village populations with the number of kiosks rising to 45,000 in 2003. Drishtee is also allowing the filling of grievances online which are accessed by district and local officials. These kiosks exist in large states such as Haryana, Punjab, UP, Bihar, Rajasthan, and Orissa and use standalone, extremely user friendly software that gets updated whenever the Kiosk is connected to the district server. The district server holds vital information such as market prices.

Central Government has recently approved setting up of 100,000 rural common services centres(providing internet and mundane services through kiosks) across the country at a cost of Rs 5742 crores. The private players are also eager to contribute for cementing the effort of the government. Microsoft Corporation India and Hughes Network Systems announced a partnership(**Saksham initiative**) to roll out 5,000 braodband enables ICT kiosks across the country by 2007. The ICT kiosks will be deployed across 200 cities in tier –B,C and D towns as well as rural regions across the country.

Gyandoot is a program that uses ICT for development in rural areas of Madhya Pradesh. Computers in several village centres in one of the districts of the state were wired for the internet which made several government services available to the people to establish better relationships between the rural people and traders of agricultural commodities.

One of the most widely cited problems in Indian agriculture is the lack of technology and credit availability. The farming community does not have adequate information regarding

agricultural techniques, market prices, and supply and demand of commodities. Several efforts to deal with this information asymmetry have been launched in India which are cooperative relationships with local universities, businesses and government. An example is a project called **Indiagrilline, theAgriPortal,** created in collaboration with an agricultural university, the National Horticulture Board, and the Indian Institute of Technology, Chennai. An online information database assisted in the dissemination of information regarding the latest developments in agricultural science and technology. The content is in the local language Tamil.

To facilitate and bring about change as a part of transformation of India's villages, the NASSCOM Foundation has taken initiatives in the States of Orissa, West Bengal, Tamil Nadu, Karnataka, Kerala, Andhra Pradesh and Maharashtra to build capacity for ICT through the creation of VKCs (Village Knowledge Centers). A part of a Rural Knowledge Network (RKN), the project engages the industry, civil society, multilateral agencies and the governments in synergistic interventions through the creation of partnerships for change. The ICT interventions from the foundation have been focused on enabling the ICTs for the three Ps: Purpose, People and Prospects.

At the end of the day, it is clear that citizens must find the ICT services relevant and beneficial to them. It would be better if the user interfaces are in local languages and there is more localized content available. This will minimize the need of the local communities to look outwards for the information. The objective is to build on partnership networks by engaging and involving major private sector players and a network of grassroot civic society organizations to engage more and more villages and enable ordinary people to access ICT.

India is in a relatively better position as compared to many South Asian/SAARC countries with regard to the development and applications of ICTs. Nevertheless, there are large imbalances in the development and use of ICTs within the country. China, which has a larger population base than India, has better availability of ICTs. Sri Lanka stand out clearly as compared to other countries of the region. The high level of socio-economic development are associated with the high availability of ICTs. The World Development Report has also shown that there is a positive relationship between literacy and the application of ICTs for development purposes.

The Software Export Success Model

We analyze the experiences of three successful major software exporters

A summary of the export success(Table IV)

Table IV: Export Success of the Three Leading Software Exporters

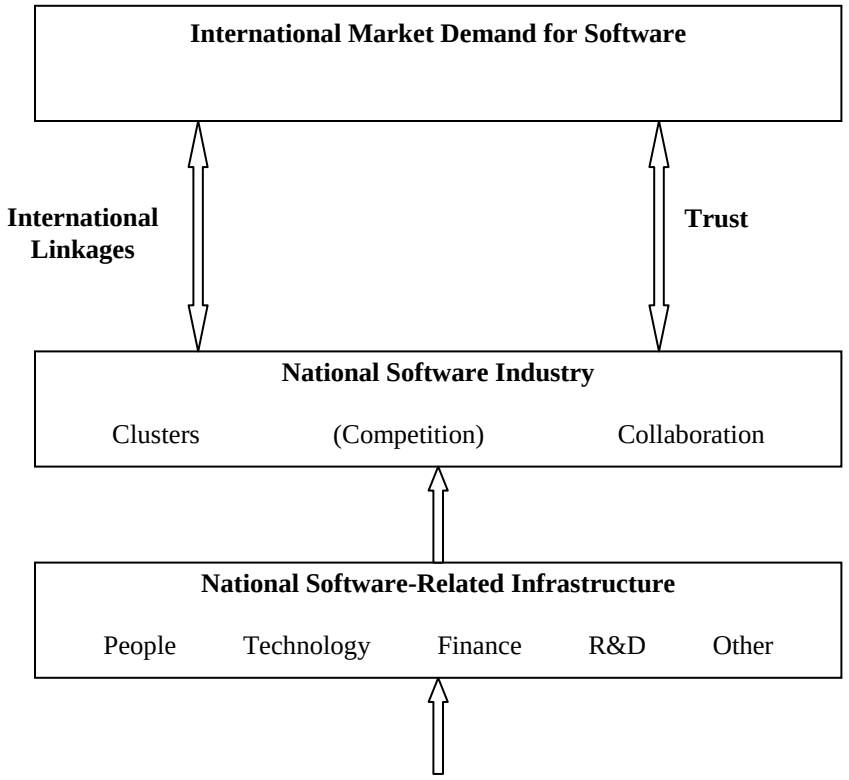
	India	**Ireland**	**Israel**
Demand	High external demand; weak domestic	High external demand; weak domestic demand	High external demand; strong domestic

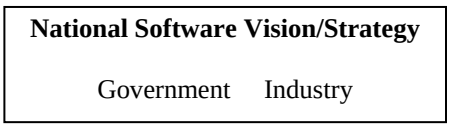
	demand		demand
National Vision and Strategy	Vision and strategy present: software services, then climbing the value chain	Vision and strategy present: product-related services for multinationals, then diversification	Vision and strategy present: home-grown product exports, then innovation and differentiation
International Linkages and Trust	Diaspora and state-funded links; reputation and trust, partly through ISO and anti-piracy	Diaspora and state-funded links; reputation and trust, partly through ISO and anti-piracy	Diaspora and state-funded links; reputation and trust, partly through ISO and anti-piracy
Software Industry Characteristics	Some competition; clustering and collaboration	Some competition; clustering and collaboration	Strong competition; clustering and collaboration
Domestic Input Factors/ Infrastructure	Strong, low-cost human capital; catching-up in telecoms; access to capital; limited R&D success	Strong human capital; strong telecoms; access to capital; some R&D base	Strong human capital; strong telecoms; access to capital; strong R&D base

Source: Heeks and Nicholson(2002)

On the basis of this analysis, the dimensional model presented earlier can now be drawn in greater detail. It is shown in Figure IV as the 'Software Export Success Model'. It shows drivers at top (pull) and bottom (push), and enablers in the middle.

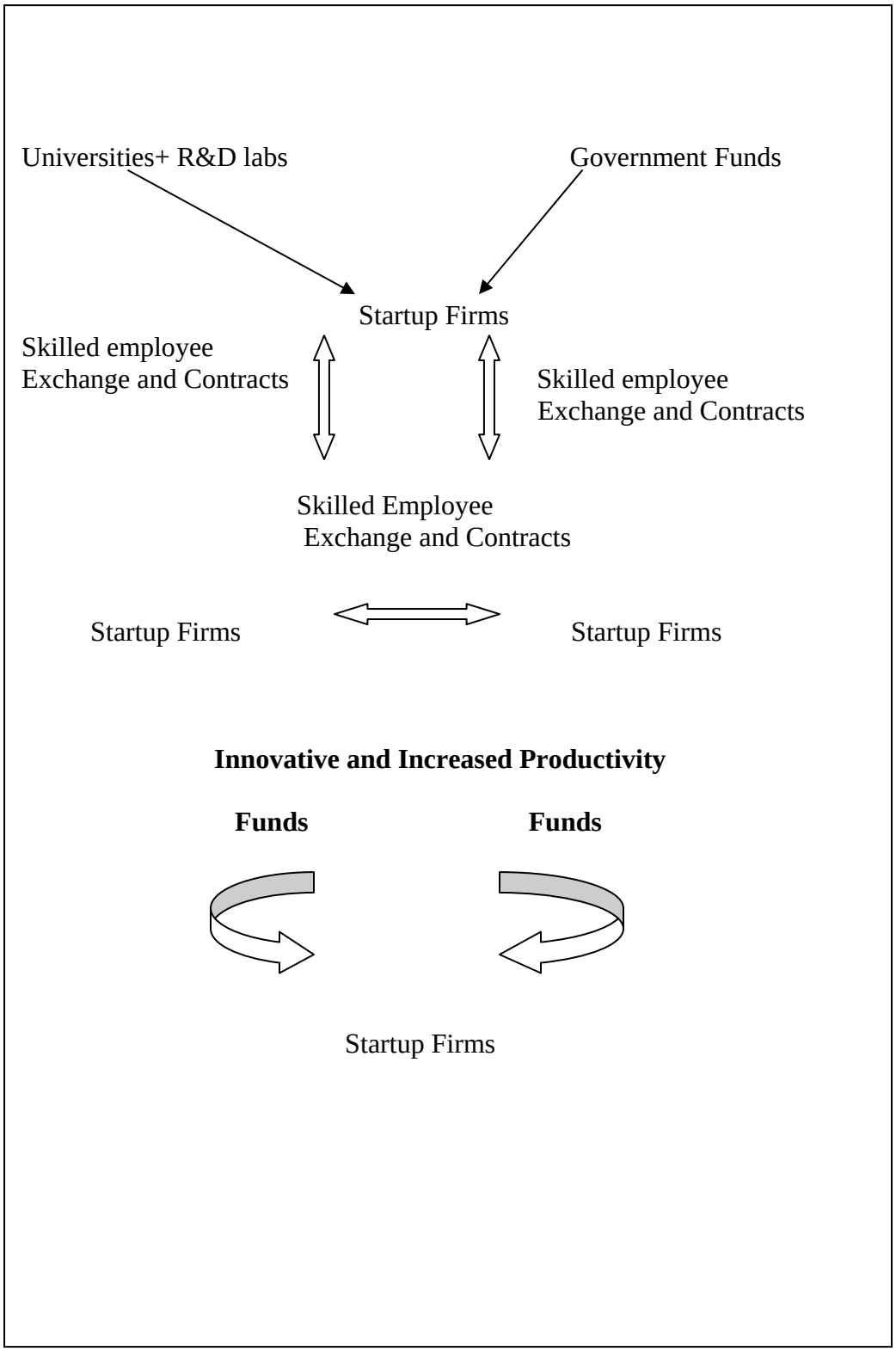
Figure IV: Export Success Model





Source: Heeks and Nicholson(2002)

In a general sense, the software export success model has proven useful as a way of understanding the experiences of developing and transitional economies. It offers a template against which to analyze national strengths and weaknesses. It also offers some more general guidance for countries seeking to increase their software exports.
Indian IT model can be emulated by other governments of the NAM countries and industry collaborations assisted by the free flow of venture capital and talent flow . Universities and R& D labs(both government and private) in conjunction with Government funds can provide seed money for start up firms who would be ingrained in a cluster where sustained regional development ,network building, skill transfers and innovation can take place with efficient knowledge exchange(see box below).


Universities+ R&D labs
Government Funds
Startup Firms
Skilled employee
Exchange and Contracts
Skilled employee
Exchange and Contracts
Skilled Employee
Exchange and Contracts
Startup Firms
Startup Firms
Innovative and Increased Productivity
Funds
Funds
Startup Firms

As a start focus can be on 5 main areas that lay foundation for a vibrant IT economy
1)**E-infrastructure**-Success will depend on the links between the main city hubs. The focus is to strengthening such links through the development of Trust Marks and Public Key Infrastructure, which could support the greater use of online transactions and facilitate E-Commerce.
2)**E-Markets**: The focus would be on strengthening business relationships between the IT industries of different cities through the promotion of internet based facilitators, such as e-business interoperability standards. For example, the Pan Asian E-Commerce Alliance is an industry alliance among private companies from Korea, China, Taiwan, Singapore and Japan. They are collaborating in areas such as secure cross border transaction services, Mutual Recognition of Public Key Infrastructure, and the creation of pan-Asian portal focusing on trader directories.
3)**E-Capital**: This focuses on free investment flows to give entrepreneurs greater access to funding support from across South countries. In the longer term, it may be feasible to create incubation centres funded by venture capitals for innovative start ups through the South countries. Thus, for example, Temasek Capital's InCubate Programme in China and India provides start ups with seed funding, facilities, management services, branding and network support.
4)**E-Talent**: The focus here is on facilitating of cross border IT talent movement, such as mutual recognition of IT qualifications, in order to facilitate free flow of talent and develop human resources of South countries. One example is cross certification of IT skills.
5)**E-Ideas** : Leveraging on South's large talent pool and cultural diversity, this focus is on South Countries as a hotbed for new ideas and as a credible, future though leader in international IT. An example would be where industry associations form networks to stimulate progress in areas such as ASP/IDC, wireless applications and E-Learning Further, some capacities can be build for harnessing fruits of modern technologies (RIS Policy Brief,2006, No 27,August). In particular, the South-South Cooperation could cover the following areas (a) Education and Training through building institutions of research and higher learnings (b) Joint development of Hardware and Software in local languages and open source platforms like LINUX.(c) Exchange of experiences in Electronic Governance programs for poor and the under-privileged. It could be organized through NAM Information Clearing proposed in RIS Policy Brief,2006, No 27,August.China has been given an observer status at the forthcoming NAM meet. India can learn from the Chinese experiences from their software industry. One is the focus on developing software products. At another level, the strength of Chinese policy towards research and innovation has allowed Chinese companies to compete head to head with the US and other countries on Linux, translation and even security software on their own home ground. India has not really provided such strong research support .The enactment of an appropriate research policy requires a significant body of scientific advice, which Indian firms are quite well positioned to give, given their connections to multinational partners and the latest knowledge. Indian firms and their government will have to form a new basis for cooperation. Joint university-industry-government research centres would be one such model.

HURDLES AHEAD the sector would have to overcome several problems, including inadequate quality and skills of graduates, rising salaries and weak infrastructure, which resulted in frequent power shortages, low level of PC use and internet penetration ,low level of domestic technology development, limited bandwidth, inadequate availability of venture capital and limited domestic market for knowledge based technology and products. Indian Government has a continued role to play in addressing such issues. The new IT policies enunciated through the new Indian IT Bill(May 2000) should help create the legal framework within which these issues can be addressed better. The bottom line, however, is new investment in high speed data networks, improved telecom and power infrastructure and sustained improvement of the human capital infrastructure- in the schools and technical institutions(Baru,2006).

There are several constraints besides a potential manpower shortage that could preclude their realization in full. Reliable electric power, efficient and inexpensive telecommunications and access to venture capital are essential infrastructures for the IT sector. Although telecommunications infrastructure has vastly improved there are still some unresolved issues relating to the authority of the regulatory agency (Telecommunications Authority of India (TRAI)) vis-à-vis Department of Telecommunication and the state-owned providers. The situation regarding electric power continues to be abysmal. In fact, the large IT firms, like other large enterprises, had to invest in their own captive power generation facilities. To the extent that the unit cost of power from small scale captive plants is much higher than what it would have been had their supply come from an efficient large-scale utility, the failure of India's public power system adds an avoidable cost and dampens the competitiveness of its IT sector.
India's labor and bankruptcy laws could be counterproductive in the IT sector as in other sectors of the economy. A report in 2000 of the Subject Group of Knowledge-Based Industries in the Prime Minister's Council had recommended the exemption of the IT sector from some of the draconian provisions of labor laws. Whether or not it is wise to exempt one sector from dysfunctional law rather than repealing it is arguable. In any case, political support for a repeal is not there yet. However, some de facto exemptions do exist. For example, in ITES, states often exempt call centers and the like from working hour type restrictions, allowing women to work at night. Also, it is likely that programmers in large firms are not subject to the same provisions as industrial workers. Along with increased presence of Indian IT companies across the globe, new services lines are emerging and the Industry has reached the next level in services offered. Mergers and acquisitions by Indian players is also a key trend. Inspite, of the growth seen so far, it is estimated that less than 10 percent of the addressable market for globally sourced IT-ITES has been captured till date, indicating significant headroom for growth

India is not the only country with a pool of English speaking workers for employment in the IT/ITES sector. Other countries include Bangladesh, Ireland, Pakistan, Sri Lanka and the Philippines. Except for Bangladesh, the wages costs are higher than India's in the other countries. English speaking ability can, of course, be acquired and, as such, potential future competition for India from countries currently without a significant pool of English speaking workers cannot be ruled out.

Despite India's emphasis on import-substituting industrialization, it has not developed a robust, world-class manufacturing industry, and this includes IT hardware. Much of India's hardware industry consists of assembly tasks, almost entirely for the domestic market. India's software industry is, of course, more robust – at least in certain areas. While selling packaged software to consumer (and most business) markets requires economies of scale and scope, as well as marketing and customer support muscle, project-oriented components of software development do not do so, to quite the same degree. To some extent, therefore, India's software industry remains narrowly focused. For example, of India's 2001-02 software and services exports of Rs. 365 billion, two thirds came from IT services, and close to 88% of that amount came from custom application development and application outsourcing

IT Imports

Two thirds of the domestic IT industry is accounted for by hardware and packed software that comes from abroad .The growth potential of this sector and its impact on the overall economic development must be tempered with the fact that this sector has a very high, and growing, import intensity. The import liberalization has virtually wiped out domestic producers (Sitaram Yechury,2006).Unless this trend is reversed, India may well produce only domestic sales agents for international firms. Thus, India's hopes for channelizing the potential of this sector to change the overall Indian economy rests mainly on the export of software services.

Hardware

Despite India's emphasis on import-substituting industrialization, it has not developed a robust, world-class manufacturing industry, and this includes IT hardware. Much of India's hardware industry consists of assembly tasks, almost entirely for the domestic market. India needs to have a positive agenda rather than merely adopting laissez-faire policy, at least in IT manufacturing. The Government needs to take immediate corrective steps to augment IT hardware manufacturing. One of the steps could be the creation of stable investment climate. Second , could be removal of bureaucratic delays in hardware exports

Conclusions, Discussion and Suggestions

The domestic market in India has come of age now and beyond 2006 it is expected to show faster growth compared to the IT/ITeS exports revenue. This makes India a great market with significant domestic consumption and not just a sourcing base. The study believes that the critical mass has been achieved and one can expect a phenomenal growth of IT adoption by all sections of the IT market by 2010. The twin play of 'IT going deep into enterprises with dynamic IT adoption being the driver' and 'IT spreading wide into the Consumer and Business space', is slowly gaining momentum and manifesting itself in the form of healthy market growth. The domestic BPO market is maturing and gaining increasing traction and visibility. The market for domestic ITeS/BPO segment has been estimated at Rs. 3,800 crore in 2005 and is expected to grow at a 55% CAGR to touch Rs. 30,000 crore by 2010. Emergence of rural BPOs can provide

adequate employment to rural youth as well. Growth in the domestic market is witnessing the early signs of service line depth that characterizes maturing markets. Global product companies are also looking to introduce localized versions of their software products to drive usability and penetration. India has been able to thrive in OECD markets by concentrating on honing their process and project management skills. NASSCOM McKinsey Reports that the IT industry is likely to create over nine million jobs by 2009.More than that every IT job creates three more jobs in the transport, catering and maintenance services. However, in coming years large growth in IT sector will increasingly demand educated professionals, apart from the efficient telecommunication, power and venture capital needs, and if they are not forthcoming, then there is a possibility of increase in wages and salaries in times to come. This may alter our cost advantage in relation to other front runners (countries) in the IT business of software exports of products and services.

For India to fully capitalize on the opportunity and sustain a disproportionate lead in the global IT-ITES space, it needs to focus on five key areas: Enhancing the talent pool advantage -- focus on skill development to better leverage the world's largest working population. Strengthening urban infrastructure in existing (tier I) and emerging (tier II and tier III) cities and continued emphasis on proactive regulatory reform to facilitate greater ease of doing business. Driving a philosophy of operational excellence amongst industry players (across the board) to ensure that India based delivery sustains world-leading benchmarks in performance, fourthly, one needs to catalyze domestic market development with particular attention paid to hardware and software product development. This will help the Indian IT industry to grow dynamically by establishing more close links with industrial and commercial users. Also, this will foster intensive learning in the area of product development for a large and rapidly growing domestic market. Current HR trends within the IT-ITES industry point to the following scenario in the future: the Indian industry will require 850,000 IT professionals and 1.4 ITES-BPO professionals by 2010; the Indian IT industry has to take adequate steps to develop talent, particularly among college students. Lastly, improving E-Governance, E-Commerce, E-Banking models for the benefit of all and reaching out telecommunication and communication Infrastructure to remotest places for developing IT industry and for effective business & governance is required.

The success of the IT industry is intertwined with information and communication technologies as most of the ITES services use such technologies for providing their services. Lack of information infrastructure is considered to be one of the major impediments in the diffusion of Information and Communication Technologies. Government can play an important role in building global, national and local information infrastructure. In the era of networking and distributed computing, communication technologies have a pivotal place in the diffusion and production of IT. The communication sector as a whole has been growing 24% per year in real terms since 1999-00. Its share in the GDP has more than doubled from 1.6% in 1999-00 to 3.5% in 2004-05.The story in telecommunications is the same. In 1990-91, India had just five million telephone lines in total. Currently, telephone lines are expanding at the rate of more than 5 million per month. In urban areas, tele-density has reached 31% .However, tele-density in the rural areas at 2 % remains low.

Governments can influence the growth of IT industry by embarking on economic policies aimed at affecting not only supply side but as well on demand side factors. Supply side factors consist of telecommunications network, power, transport, human resource development, PC penetration and developing computer keyboards in local languages, internet for all(where power and net can be accessed at the same time) and improving bandwidth and export- import policies, where as demand side factors include encouragement of use of IT in domestic market. Demand elasticity of IT products in the domestic market can be greatly influenced by proper monetary and fiscal

policies. For instance, banks and other financial institutions can provide loans for the purchase of IT products to individuals and corporations, at a competitive rate of interest. Government has a continued role in developing quality human resources and building research institutes and organizations of excellence. In particular Government can play an important role in promoting and coordinating R& D in developing world with focus on web based software .In this way India can move up the ladder by developing high valued added software's and simultaneously there is a real growth in offshore development businesses. Government can play an important role in expanding internet and bandwidth and promote use of web based business and consumer software's.

The Data Envelopment Analysis (DEA) model is used to work out technical efficiency of Information and Communication Technology (ICT) Industry in host of countries which are front runners as far as ICT is concerned. India lags behind the most as far as ICT (not IT) is concerned. However, information and Communication technology industry has brought revolution in India because it has reduced intermediation in business and society, provided solutions across sectors and is increasingly becoming an important tool for national development. DEA is also applied to benchmark the performance of the 92 Indian Software Companies for 2005- 2006. 16 Software companies turn out to be most efficient among the total. The impact of various determinants of technical efficiency of the Indian Software is worked out using tobit regression. Sales of the firm (proxy for size of firm) and net exports had positive and significant impact on the technical efficiency while total cost had negative and significant impact on technical efficiency. Number of employees and total number of years had insignificant impact on technical efficiency. We also find that size of the Software Company (in terms of sales of the software company), number of employees and total costs do matter for net exports. Years in business and technical efficiency are insignificant factors in explaining variation in net exports across the 92 software firms.

The maturing ecosystem of offshore service delivery has witnessed a growing number of locations emerging as contenders for a piece of the global sourcing pie. With global sourcing demand estimated to increase ten-fold, it is expected that this phenomenon will continue to expand in scope, scale as well as geographic coverage. As a result, most offshore markets – both established as well as emerging – are expected to record significant growth over the next few years. The global offshore markets will surely grow in size, India is likely to remain the leading destination. India is well positioned to further extend its leadership in the global IT-ITES industry by leveraging its fundamental advantages of a disproportionately large talent pool, developed depth of service offerings and demonstrated process excellence at a continued cost advantage.

The profile of the Indian IT Services has been undergoing a change in the last few years, partly as it moves up the value chain and partly as a response to the market dynamics. Ten years ago, most US companies would not even consider outsourcing some of their IT projects to outside vendors. Now, ten years later, a vast majority of US companies use the professional services of Indian Software engineers in some manner, through large, medium or small companies or through individuals recruited directly.

Software development activity is now not confined to a few cities in India. Software development centers, such as Bangalore, Hyderabad, Mumbai, Pune, Chennai, Calcutta, Delhi-Noida- Gurgaon, Vadodara, Bhubaneswar, Ahmedabad, Goa, Chandigarh, and Trivandrum are all developing quickly. All of these places have state-of-the-art software facilities and the presence of a large number of overseas vendors. India's most prized resource is its readily available technical work force. India has the second largest English-speaking scientific

professionals in the world, second only to the U.S. It is estimated that India has over 4 million technical workers, over 1,832 educational institutions and polytechnics, which train more than 67,785 computer software professionals every year. The enormous base of skilled manpower is a major draw for global customers. India's software industry is more robust in certain areas. While selling packaged software to consumer (and most business) markets requires economies of scale and scope, as well as marketing and customer support muscle, project-oriented components of software development do not do so, to quite the same degree. To some extent, therefore, India's software industry remains narrowly focused. For example, of India's 2001-02 software and services exports of Rs. 365 billion, two thirds came from IT services, and close to 88% of that amount came from custom application development and application outsourcing.

To become a global leader in the IT industry and retain that position, India needs to constantly keep moving up the value chain, focusing on finished products and solutions, rather than purely on skill sets and resumes. As stated above India needs to be able to package their services as products, rather than offering them as raw material.

Since Independence in 1947, the goal of self-reliance has guided all spheres of policy making in India. Until the mid-1980s, India's development strategy was characterized by import substitution policies, which were aimed at nurturing domestic industry, including the computer hardware and software industry. These included extensive quantitative restrictions and high tariffs on imports, elaborate import licensing procedures, export subsidies, controls on foreign direct investment and an overvalued exchange rate . The goal of self-reliance also led to a strong commitment to the role of science and technology in India's development strategy. These were areas that were emphasized in industrial policy as well as in the field of education. In addition to establishing the Indian Institutes of Technology, which were educational institutions located in various cities around India aimed at creating a large pool of technical skills, the Government of India (GOI) has had a computer policy since the creation of the Department of Electronics (DOE) in 1970. It was the first developing country to do so and to explicitly target software as a "thrust area", for its high skill requirements, its labour intensity, and its foreign exchange earnings potential.

India's presence in the software industry dated back to 1970 when the TATA consultancy services entered the IT business sector. The foundation for the intellectual capital for software industry was laid by the establishment of the IISc in 1909 ,IITs, IIMs. However, in the 1970s the deployment of mainframe computers was interrupted when IBM withdrew from India in response to a 1976 law limiting foreign ownership of business to 40 percent. Rajiv Gandhi assumed leadership in 1984 and identified telecommunications and information technology as a "core sector" along with traditional industries such as power, steel, oil, and automobiles. The presence of a national strategy for software exports, particularly since 1980s is therefore be recognized as a vital part of software export success (Balasubramanyam & Balasubramanyam 1997). Indeed, it goes beyond this – critical to each country's success has been a vision of what software could achieve for the country; a vision shared by a relatively small but committed group of government officials and private entrepreneurs. Such visions first emerged in the 1970s, were sustained through lean early years in the 1980s, and only truly came to fruition in the 1990s.The study believes that the initiatives on three different levels(as discussed above) served and continue to serve as the backbone of the government's approach in promoting the Indian IT sector since its formative years[15]. The fourth initiative is the pattern of spatial agglomeration in

[15] Complete definition of IT includes telecom sector. Realizing the importance of telecommunications in the overall development of the economy in general and that of the IT and software service sector in particular, the Government of India initiated a number of policy reforms that

the IT sector. The patterns of concentration in the software development industry in and around select cities illustrates the key importance of institutional infrastructure for the activity. With the Indian states realizing the importance of improving the urban and rural Infrastructure sector the IT industry has been spreading to other smaller cities of India. Also, the public good nature of production in a digital economy, along with the presence of network externalities, may suggest a larger role of government with a sure role in handling security matters.

The first of these initiatives is the Ministry of Information Technology, formed as an umbrella organization to coordinate the activities of the multiple government agencies that deal with the information technology. The second is the implementation of software technology parks where business, government, and academia can come together both for networking and production. The establishment of the Software Technology Parks (STPs) scheme in the late 1980s gave export-oriented software firms in designated zones tax exemptions for five years and guaranteed access to high-speed satellite links and reliable electricity. The national economic liberalization that began in 1991 greatly improved the climate for the software industry as well. Last, there is the set of initiatives that urge communication and interaction with the global Indian diaspora with hopes of encouraging investment in the country from those who have emigrated and become successful in other nations. Indian immigrants are a significant presence in the US information technology industry. There are at least 30,000 Indian professionals working in Silicon Valley today and they have developed strong collective identity based on their common educational and professional backgrounds. Many were graduates of the prestigious Indian Institutes of Technology. Professional associations such as The Indus Entrepreneur (TiE) and the Silicon Valley Professionals Association (SIPA) provide opportunities for networking and information sharing as well as role models and sources of finance for entrepreneurs. However this community remains local rather than a transnational one. Very few US-educated Indian engineers have returned to start companies or work for established firms.

This study is not comprehensive of the efforts taken by the government of India to promote outsourcing in the IT industry for one realizes that a myriad other public policies and private initiatives have fueled the growth of the sector as well. Nor does study attempt to argue that the four policies discussed are the best or most successful institutional projects with regards to promoting outsourcing. Rather, studying these three specific policies sheds light on potential components of a model that possibly could be replicated in other developing countries operating under similar conditions to those India faces

As evident from this study much before the first generation of reforms, that is, 1991, the government was pursuing a structuralist approach toward economic development. After liberalization in 1991, the government embarked on pro-active economic policies for the diffusion and production of IT although the platform was laid for the development of vibrant software industry in the 1970s and 1980s(explicit in Kumar and Joseph,2004) Consequently, the IT industry experienced an unprecedented growth rate in domestic as well as export markets. However, foreign direct investment (FDI) policies have not been successful in attracting the desired level of foreign investment, which is very important for a high-tech sector such as IT

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helped create a highly competitive environment, leading to a drastic reduction in telecom costs but also increased access and better services (Kumar and Joseph, 2005). To promote the use of Information Technology, the following mission targets have been spelt out. PC penetration of 10 per 1000 of the population .All colleges and schools are to be hooked to internet .Presence of Internet kiosks in every Panchayat ward and Modernization and integration of Government functions using Information Technology are policy decisions to favor IT sector. At present, the Internet is confined to large cities in both nations. While these groups are far from saturated, high levels of pervasiveness will require service to the lower urban classes and villages, which raises issues of public access, service in villages, education and language, and affordability .Please refer to the study paper of the Indian Telecommunication Regulatory Authority which compares the Indian and the Chinese Telecommunication Market (Appendix II).For ICT sector in India as compared to IT sector much needs to be done.

hardware manufacturing. The study suggests that immediate corrective measures need to be taken to augment the IT manufacturing industry, which can significantly contribute to national economic development and employment generation. To achieve sustained growth in the IT sector, high-quality professionals in adequate numbers are required. The new policy envisages continuous upgradation of standards at the school level with emphasis on physics, mathematics and English; make microelectronics and biology the new focus areas of tertiary education, updating the syllabus of computing engineering, electronics and IT in various technical institutions in line with the demands of industry. There were several initiatives taken up in the IT sector. The Ministry of Information Technology, set up in October 1999, was rechristened as the Ministry of Communication and Information Technology in September 2001.

Information and Communications Technology (ICT) can be used as an effective tool for rural development in India. The study spells in detail about the various programs meant to address the core development concerns of the Indian states.

E-government is the application of Information and Communication Technology (ICT) by government agencies. Its use promises to enhance the effectiveness and efficiency of government and alter its relationship with the public.

E-Commerce primarily refers to buying, selling, marketing and servicing of products or services over internet and other computer networks. E-Commerce in India is just taking off with the advent of Railway and Online Air bookings and Net banking. The business is likely to grow to Rs 2300 crore by 2007 .Electronic commerce allows efficient interactions among customer, suppliers and development partners cutting down on transaction time and reducing the costs of doing business. The role of government is to facilitate the development of E-Commerce.

Towards the goal of IT for all by 2008, government policies are provided for setting base for a rapid spread of IT awareness among the citizens, networked Government, IT-led economic development, rural penetration of IT applications, training citizens in the use of day-to-day IT services like tele-banking, tele-medicine, tele-education, tele-documents transfer, tele-library, tele-infocentres, electronic commerce, etc.

Another important consideration is whether lessons we can learn from India's success can be applied to other developing countries. The study outlines an export success model which can be adopted by other countries. India's skilled and English-speaking workforce was a clear contributory factor in the development of the IT industry. A starting point for other countries may be to launch education programs with focus on mathematics and science subjects and which can teach their citizens marketable skills for this and other industries, while being careful to distribute training among industries in case there are economic changes. In particular, the South-South Cooperation (RIS,2006) could cover the following areas (a) Education and Training through building institutions of research and higher learnings (b) Joint development of Hardware and Software in local languages and open source platforms like LINUX.(c) Exchange of experiences in Electronic Governance programs for poor and the under-privileged. Kumar and Agarwala (2006) discusses further a number of examples of ICT for pro poor use. These are community owned computers with visual or graphic interface, use of public fixed line and mobile telephone bureaus as sources of rural employment as well as for increasing the virtual tele-density , use of mobile phones by fisherfolks, use of internet for e-governance such as computerization of land records, among many other applications.

Also, the ICT industry in tandem with the Right to Information can act together in addressing core in competencies like corruption is an issue worth researching.

Furthermore, an interesting future area of research into this subject could examine if the growth of a white-collar industry has ramifications for India: drastic poverty, poor healthcare, national security and widespread hunger. If such growth is found to have positive effects, other developing countries would be well-advised to study the policies that the Indian government has undertaken and emulate them within the contexts of their own national goals. Though information technology is certainly not a panacea for the problems of developing countries, it may be a good first step.

The new structure of competition in IT provides unprecedented opportunities to leapfrog economically and the brain drain can be turned from a curse into an advantage in this process. Indian policymakers have a tremendous resource in the US to draw upon for policy advice, technical expertise, and managerial and entrepreneurial know-how. The challenge is to create an environment that will attract these immigrants back home as entrepreneurs, investors, and advisors. This will require actively addressing the regulatory, infrastructure and institutional constraints that have thus far limited their return a process in which they can also play a role.

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Appendix Table I: Targets for the Year 2008

Opportunities in Software Sector by the Year 2008 (McKinsey Report, in Department of IT webpage http://www.mit.gov.in/dbid/eproduction.asp)

Software Sector

	Total Market	Exports
IT Services	$ 28-30 billion	$ 28-30 billion
Software Products	$ 8-11 billion	$ 8-11 billion
IT Enabled Services	$ 21-24 billion	$ 21-24 billion
Domestic Market	$13-15 billion	
Total	**$ 70-80 billion**	**$ 57-65 billion**

IT Industry by the year 2008

Employment Generation Year 2003-04
IT Exports • **35% of India's Total Exports in 2008** • **from 21.3% during 2003-04**
Share of IT Software & Services Industry in GDP • **Likely to be 7% of GDP in 2008** • **from 2.64% of GDP during 2003-04**

Hardware Production Projections for Tenth Plan

Rs. Crore

	Realistic Scenario	Optimistic Scenario
2001-02	32,750	32,750
2002-03	39,500	41,600
2003-04	45,000	50,500
2004-05	52,000	61,500
2005-06	60,000	74,700
2006-07	69,000	90,900
CAGR	**15**	**22**

Employment Generation Year 2003-04	
Software Sector & Service Sector	813,500 245,000

of which ITES& BPO Sector	
Hardware Sector Direct Employment Indirect Employment	 395,000 250,000

Employment Generation Year 2008	
Software Sector ITES / BPO Industry Indirect Employment	2.2 million 1.1 million 2-3 million
Hardware Sector Direct Employment Indirect Employment	 1.6 million 3.2 million
Total Employment Generation	**over 9 million**

Appendix Table II

Telecom Regulatory Authority of India

Press Release No59/2006

Study Paper on Financial analysis of Telecom Industry of China and India

Salient features of Study Paper

i. The Growth of mobile services in India over the past few years has been phenomenal. Mobile subscribers are growing at a CAGR of around 85% since 1999. Now over 4 million mobile subscribers are added every month. On the other hand China is registered a growth of 16% in the mobile subscriber base in the year 2005 with monthly addition of 5 million subscribers every month.

ii. Total telecom revenue of Chinese telecom companies increased from $ 65 billion to $ 72.70 billion during the calendar year 2005. Telecom revenue in India during 2005-06 was $19.50 billion

iii. ARPU(Average Revenue Per User) in India and China is comparable in GSM pre-paid segment but ARPU for post paid segment in China is much higher. ARPU for CDMA services are also higher in China in comparison to India.

iv. ARPU for Basic Telephone Services is higher in India when compared to ARPU for Basic Telephone services in China.

v. Minutes of Usages (MOU) of cellular mobile Telephone services are much higher

in India when compared to China's Cellular mobile telephone services.

vi. Minutes of Usage of GSM and CDMA based cellular mobile telephone services in India are 32% and 70% respectively higher when compared to Chinese cellular mobile telephone services.

vii. Lower ARPUs in India inspite of higher usage due to much lower tariffs in India.

viii. The capital employed per subscriber for the Basic Service is much lower when compared to India. However capital employed for the cellular segment is lower in India.

ix. Chinese companies are able to generate higher rate of EBITDA margin than Indian companies

x. Chinese Companies earn higher rate of return on the capital employed(RoCE) than Indian companies

xi. Indian mobile market is much more competitive when compared to the Chinese mobile market.

Appendix Table III: VARIABLES REQUIRED FOR CONSTRUCTING NETWORK READINESS INDEX,GLOBAL INFORMATION TECHNOLOGY REPORT 2006

Environment	Readiness	Usage
Market Environment	**Individual Readiness**	**Individual Usage**
Availability of scientists and engineers	Quality of math and science education	Cellular mobile subscribers
Venture capital availability	Quality of educational system	Telephone subscribers
Sophistication of financial markets	Quality of public schools	Personal computers
Technological Sophistication	Internet access in schools	Telephone lines
State of cluster development	Buyer sophistication	Television sets
Quality of scientific research institutions	Buyer dynamism	DSL Internet Subscribers
US utility patents	Residential telephone connection charge	Cable modem Internet subscribers
Tertiary Education	Residential monthly telephone subscription	Internet users
Administrative Burden	**Business Readiness**	PC households online
Tax Burden	Investment in training	Internet bandwidth
Speed of new business registration	Availability of specialized training services	**Business Usage**
Ease of new business registration	Quality of business schools	Foreign technology licensing
Market competition	Business investment in R&D	Firm-level technology absorption
Political/Regulatory Environment	Business monthly telephone subscription	Capacity for innovation
Effectiveness of lawmaking	Quality of suppliers	Availability of new telephone lines
Laws relating to ICT	Business R&D collaboration with universities	Availability of cellular phones
Independence of judiciary	Scientific and technical journal articles	Internet use by business
Intellectual property protection	**Government Readiness**	**Government Usage**
Legal framework to settle disputes	Government prioritization of ICT	Success in ICT promotion
Property rights laws	Government procurement of ICT	Availability of online services
ISP competition	Government ICT Vision	ICT productivity
Infrastructure Environment	Government R&D subsidies	ICT pervasiveness
Telephone lines	E-participation index	
Secure Internet servers	Web-meaure index	

Internet hosts
Electricity production

Appendix Table IV: The Top 19 IT Software and Service Exporters (Excluding ITES-BPO) from India, 2004-05

Rank	Company	Rs Crore	US $ Million
1	Tata Consultancy Services	7449	1644
2	Infosys Technologies	6806	1502
3	Wipro Technologies	5426	1198
4	Satyam Computer Serices	3377	745
5	HCL Technologies	2664	588
6	Patni Computer Systems	1548	342
7	I-Flex Solutions	1110	245
8	Mahindra British Telecom	913	202
9	Polaris Software Lab	697	154
10	Perot Systems TSI(India)	657	145
11	Hexaware Technlogies	583	129
12	Larsen and Toubro Infotech	557	123
13	MASTEK	546	121
14	iGATE Global Solutions(Formerly Mascot Systems)	534	118
15	Siemens Information Systems	502	111
16	Mphasis BFL	465	103
17	Tata Infotech	463	102
18	NIIT Technologies	448	99
19	Flextronics Software Systems	424	94

Source: Balakrishnan ,Pulapre(2006) based on NASSOCOM data (www.nasscom.org)

Appendix Table V: Technical Efficiency of Some Indian Software Firms in 2005- 2006

	Fi(y,x | C,S) Technical Efficiency	Sales(Rs Million) Output	Net exports (Rs Million) Output	Years in business Input	No. of employees (input)	Total costs (Rs Million) Input
3D P L M Software Solutions Ltd.	1	596.2	467.8	5	0	411.9
3I Infotech Ltd.	0.81	2898.2	29.6	9	0	2785.3
Aftek Infosys Ltd.	0.96	1951.9	1038.1	20	325	1386.2
Allsec Technologies Ltd.	0.89	922.6	571.9	8	0	723.4
Aptech Ltd.	0.51	1002.9	384.3	6	500	1445.4
Aptech Software Ltd.	0.1	43.3	6.3	3	0	300.2
Aztecsoft Ltd.	0.84	1286.1	1013.6	11	0	1099.5
B 2 B Software Technologies Ltd.	0.43	17.7	9.1	12	0	21.6
B 2 K Corp. Pvt. Ltd.	1	137.9	115.5	0.1	0	185.9
B S E L Infrastructure Realty	1	459.7	-0.6	11	0	286

Ltd.						
Blue Star Infotech Ltd.	0.72	651.9	329	9	583	611.2
Brels Infotech Ltd.	0.5	183.4	0	21	0	180.7
C M C Ltd.	0.75	8288.2	-1124.6	31	3431	8122.3
California Software Co. Ltd.	0.76	374.3	255.5	14	0	310.1
Compucom Software Ltd.	0.71	231.4	36.3	11	0	189.4
Core Projects & Technologies Ltd.	0.63	210.1	88.1	21	0	158.2
Cranes Software Intl. Ltd.	0.97	1870.2	300.4	21	517	1300.9
Datamatics Softworld Pvt. Ltd.	0.44	18.4	-2.9	16	0	19.5
Datamatics Technologies Ltd.	0.94	616.3	580.5	19	1247	456.3
E-Eighteen.Com Ltd.	1	95.5	38.5	6	0	44.5
European Software Alliances Ltd.	0.48	5.8	0	20	0	5.6
F C S Software Solutions Ltd.	0.78	1154.1	256.9	13	745	1015.9
Federal Technologies Ltd.	0.23	47.5	-5.3	12	0	102.8
Geodesic Information Systems Ltd.	1	922.5	713.7	24	160	519.9
Geometric Software Solutions Co. Ltd.	0.69	1181	866.9	22	0	1148.6
Godrej Global Solutions Ltd.	1	82.3	81	0.1	0	97.2
H C L Technologies Ltd.	1	14470.1	8731.7	15	0	11847.1
Hewlett-Packard Globalsoft Ltd.	1	10312.1	6854.1	6	0	9445
Hexaware Technologies Ltd.	1	3583.9	3274.4	14	0	2910.7
I-Flex Solutions Ltd.	0.94	11538.2	7422.7	17	6044	9426.4
Igate Global Solutions Ltd.	0.75	5634.8	2188.5	13	5152	5645.7
Infosys Technologies Ltd.	1	90390	50590	25	44658	68560
Intellvisions Software Ltd.	0.65	165.5	-14.3	11	0	138.9
Javelin Technologies Ltd.	0.14	0.6	0	12	0	2
Jetking Infotrain Ltd.	0.65	612.6	-3.2	22	0	589
K P I T Cummins Global Business Solutions Ltd.	0.68	31.6	24.1	0.1	0	39.3
K P I T Cummins Infosystems Ltd.	0.79	2577.2	1342.4	16	2122	2360.8
Kale Consultants Ltd.	0.62	625.8	425.5	20	0	646.5
Kernex Microsystems (India) Ltd.	0.8	413	-34.7	6	355	344.2
Mastek Ltd.	0.82	2554.1	1627.9	24	0	2164.8
Mastek-D C Offshore Devp. Co. Pvt. Ltd.	0.87	1056.9	754.6	5	0	941.8
Max Ateev Ltd.	0	0	0	12	0	1.6
Megasoft Ltd.	0.96	553.1	290.2	7	437	383.5
Mindteck (India) Ltd.	0.74	194.8	188.3	15	241	184.5
Mphasis B F L Ltd.	0.9	3806.7	1842.3	14	11414	3110.3
N I I T Ltd.	0.75	3397.4	542.1	25	2259	3249.8
N I I T Technologies Ltd.	1	2227.2	2008.9	14	0	1686.2
Netlink Solutions (India) Ltd.	0.52	8.1	1.2	22	0	7.3
Netvista Information Technology Ltd.	0.45	154.6	44.5	13	0	196.6
Nipuna Services Ltd.	0.57	885.9	314	4	0	1228.5

Nucleus Software Exports Ltd.	0.89	943.7	593.8	17	1068	677.7
O C L Infomatics Ltd.	0.36	3.9	0	12	0	5.1
Onward Eservices Ltd.	0.57	96	4.7	0.1	0	143.5
P S I Data Systems Ltd.	0.54	598.1	-3.3	30	573	615.4
Patni Computer Systems Ltd.	1	8756	7319	28	11808	7015.1
Polaris Software Lab Ltd.	0.76	6839.4	2993.2	13	6092	6749
Powersoft Global Solutions Ltd.	0.8	66.7	48.7	14	0	54.7
Quintegra Solutions Ltd.	0.65	377.9	131.3	12	206	349.4
R S Software (India) Ltd.	0.7	915.6	326.9	19	0	865.1
R Systems International Ltd.	0.82	812.8	645.5	13	0	688.6
Ramco Systems Ltd.	0.56	1174.7	21.1	9	0	1549.4
Raynolds Software Solutions Ltd.	0.45	15.3	0	10	0	15.9
Rolta India Ltd.	1	3459.7	-243.9	17	0	2523.1
S Q L Star International Ltd.	0.33	302	4	19	0	586.9
S R G Infotec Ltd.	0	2.4	0	22	0	1672.1
S S I Ltd.	0	0	-1.6	15	0	83.5
Saksoft Ltd.	0.83	262.9	203.8	7	300	188.6
Sankhya Infotech Ltd.	0.67	152.2	26.6	9	0	126.7
Sasken Communication Technologies Ltd.	0.83	2694.3	1663.8	17	0	2406.2
Satyam Computer Services Ltd.	0.93	46343.1	16722.8	19	26511	37626.5
Scintilla Software Technology Ltd.	0.48	2.7	0	21	0	2.6
Silverline Technologies Ltd.	0.13	19.3	15.1	14	0	103.2
Software Technology Group International Ltd.	0.47	135.3	38.2	14	268	144.2
Sonata Information Technology Ltd.	0.81	3360.8	-1453.5	6	0	3348.2
Sonata Software Ltd.	0.74	1616.9	981.4	12	1452	1566.4
Subex Azure Ltd.	0.89	1812.2	375.8	12	325	1445.3
Sun Beam Infotech Ltd.	0.66	405.6	0	18	0	370.2
Synergy Log-In Systems Ltd.	0.28	54.4	0.9	22	0	89.5
T Spiritual World Ltd.	0.63	539.2	0	20	0	530.8
Tata Consultancy Services Ltd.	1	112360.1	56995.1	11	62832	86048.7
Tata Elxsi Ltd.	0.84	2389.5	875.8	17	0	2045.1
Tech Mahindra (R & D Services) Ltd.	1	1215	649.9	0.1	274	1098.1
Tech Mahindra Ltd.	0.96	12052.6	7105.9	19	0	10163.3
Transworld Infotech Ltd.	0.69	96.8	-43.9	6	0	77.1
Usha Martin Infotech Ltd.	0.27	5.4	-0.3	9	0	9.3
V & K Softech Ltd.	0.52	74.9	0	7	0	76.3
Vakrangee Softwares Ltd.	0.78	511.5	-0.1	16	0	407.9
Valuemart Info Technologies Ltd.	0.15	1.9	0	7	0	5.9
Wipro Ltd.	1	102640.9	36100.7	61	0	84128.9
Zenith Infotech Ltd.	0.89	353.7	134.7	10	0	247.5
Zensar Technologies Ltd.	0.75	2290.8	1658	43	0	2045.5
Zenu Infotec Ltd.	0.5	13.5	0	14	18	12.6

Source: Sales, Number of Employees, Total Costs, Net Exports and age of firms in years data is from the Prowess data base published by CMIE, March 2006.Technical Efficiency of the Software Firms is calculated using onfront software(available freely through internet at the university of Lund,Sweden website) using the Data Envelopment Analysis. A value of one means that the particular firm is most efficient in converting inputs into outputs and is operating on the 'best practice frontier'. Although there are 388 software firms reported in prowess data base for 2005-06, we have taken only 92 because of availability of uniform data.