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EMERGENCE OF COMPUTER IN INDIA

Revolutions occur basically to throw away the old, slow and corrupt and to adopt the new and improvised for the betterment. Technological revolutions have always offered great opportunities for countries that have adopted these changes on right time, and have placed nations in the ranks of developed or developing countries bringing in more prosperity.

Nearly 2000 years back China invented a device for calculation i.e. ‘Abacus’ and more than 300 years back France invented the first ever-mechanical calculating machine. India, though late in importing and adopting these technological developments has earned goodwill in the field of Information Technology with its consistent efforts to compete with the innovative world since 1950. Indian Statistical Institute (ISI), Kolkata, had the distinction of developing the first Indian analog computer that solved a 10 x 10 single precision matrix in 90 minutes. It was built with military disposal. Soon, in the year 1955 India purchased First digital computer – HEC-2M developed by A.D. Booth at Birk Bak College, London for ISI. It was not just the first computer for India to be brought in but it was the first in Asia, outside Japan. By the year 1961 India started using computers for commercial purpose. Following Table 2.1 gives a brief history of installations of computers in India.\textsuperscript{2} & \textsuperscript{3}.
Table 2.1
History of Installation of Computers’ in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>First Analog Computer at the Indian Statistical Institute (ISI), Kolkata</td>
</tr>
<tr>
<td>1954</td>
<td>First digital computer – HEC-2M developed by A.D. Booth at Birk Bek College, London for ISI.</td>
</tr>
<tr>
<td>1955</td>
<td>HEC-2M operational at ISI in August</td>
</tr>
<tr>
<td>1958</td>
<td>URAL from the Soviet Union through the United Nation’s Technical Assistance for ISI.</td>
</tr>
<tr>
<td>1961</td>
<td>First commercial computer installed by ESSO Standard Eastern Inc., Bombay (Mumbai)</td>
</tr>
<tr>
<td>1962-64</td>
<td>14 computers in R&amp;D organisation</td>
</tr>
<tr>
<td>1963</td>
<td>IBM 1620 at IIT, Kanpur</td>
</tr>
<tr>
<td>1964</td>
<td>IBM 1401 by IBM for ISI to supplant the above two</td>
</tr>
<tr>
<td>1965</td>
<td>CDC 3600 acquired by TIFR, Mumbai</td>
</tr>
<tr>
<td>1965-66</td>
<td>30 commercial installations</td>
</tr>
<tr>
<td>1966</td>
<td>IBM 7044 at IIT, Kanpur</td>
</tr>
<tr>
<td>1967</td>
<td>10 Honeywell Computers at Department of Statistics, Cabinet Secretariat</td>
</tr>
<tr>
<td>1968</td>
<td>IBM 1401 at IIT, Kanpur</td>
</tr>
<tr>
<td>1969</td>
<td>IBM computer at Planning Commission under a grant of Ford Foundation</td>
</tr>
</tbody>
</table>

PIONEERING EFFORTS

India liberated in the year 1947; had a very tough beginning with a number of disturbances but the visionaries of modern India knew the importance of technology in the overall development of the nation. India taking a very quick start stepped up into the field of manufacturing telephone equipments and set up the Indian Telephone Industries Ltd. (ITI Ltd.) as its Public Sector Enterprises (PSEs) in the year. 1948. Realizing the potentials of electronics the Bharat Electronics Ltd. (BEL) was started in 1954.4 In 1960s, IBM and International Computers Limited (ICL) was allowed to operate in India.5

But as discussed in chapter I, technology played a vital role in military data processing during World War II, thus realizing the role of technology in national security the defense establishment emphasized to ensure access to electronics and computers. Similarly, after the 1962 war with China,
Government of India once again realized that electronics could have a strategic role in national security and overall development. Thus under the Chairmanship of the renowned nuclear scientist Dr. Homi J Bhabha, Atomic Energy Commission (AEC), also known as the Bhabha Committee was set up. Within a very short period of time India was dragged into another war with Pakistan in the year 1965. During this period the U.S. stopped the supply of electronics equipment, this accelerated the research and development programmes under the aegis of the Defense Ministry’s Department of Defense Supplies.

**Electronics Corporation of India Limited (ECIL)**

The Bhabha Committee in its report in February 1966 focused on computers as tools “to the development of a new outlook and a new scientific culture” and suggested the establishment of a National Computer Center and five regional centers. To fulfill the needs of nuclear projects in the field of instrumentation another PSE, Electronics Corporation of India Ltd. (ECIL), under the aegis of the Atomic Energy Commission was set up in 1967.

Considering the important role being played by computers the Bhabha Committee constituted a Working Group under Prof. R. Narasimhan of the Tata Institute of Fundamental Research (TIFR), Bombay. This Working Group wisely called for a national effort to attain self-sufficiency within 10 years in small and medium computers in its 1968 report.

In 1968, Dr. Vikram Sarabhai, the then Chairman of the Electronics Committee, suggested the formation of National Informatics Organization towards fulfilling the goal of a self-reliant electronics industry.

The continuous aggressions by its neighbours and the potentials of electronics, computers and communication attracted the attention of the then government at the same time recognizing the need for rapid progress, the Government of India set up a separate Department of Electronics (DoE) with effect from 26th
June 1970 with Professor M.G.K. Menon, a solid-state physicist and earlier director of TIFR, as the Secretary of the Department. The department functioned directly under Prime Minister as a scientific department. In the 70s, ECIL started producing television and computers. Minicomputer TDC-12, a 12-bit machine. By the year 1974, ECIL delivered an advanced version TDC-312 (16 bit machine) and TDC-316. But TDC-316 lacked the required software and this resulted in a significant attempt for the first time to write software on a commercial basis in the country. This job was given to the TIFR, Bombay, the Indian Institute of Management, Ahmedabad, the Indian Institute of Science, Bangalore, and the Administrative Staff College of India, Hyderabad. The ECIL also constituted its own team of 100 engineers.

Although writing all the software from scratch, including the operating system, compilers and applications, proved to be a formidable task ECIL succeeded in designing customized packages for several applications including data acquisition systems for the DoE, data loggers for the steel industry, few applications for Electronic Data Processing (EDP), and E-COBOL, its own version of COBOL.

**Department of Electronics (DoE)**

In February 1971, the government constituted the Electronics Commission (EC), under the Chairmanship of Professor M.G.K. Menon. The Electronics Commission replaced the Electronics Committee and emerged as the primary policy making body. Prof. Menon led emphasis on reshaping the Electronics Commission by calling in people from the scientific community. For instance, Ashok Parthasarathi and N. Sheshagiri, who were engaged in the Atomic Energy Program, were eminent members of his team. Now the Electronics Commission was in full control of electronics policy making in the country, which till now was under the control of the Ministry of Defence. The scientific establishment was technologically ambitious and committed to self-sufficiency and self-reliance. To achieve its ambition and to attain self-sufficiency Information, Planning and Analysis Group (IPAG) of the
Electronics Commission was constituted in October 1971 with Dr. N. Sheshagiri as its Director.

The Electronics Commission and the DoE jointly chalked out a plan to build up national databases and develop methodologies to use it in decision-making at the national level. For implementing this plan it was decided to set up a National Computer Center in Delhi. And to meet out the financial constraints a proposal was submitted to the United Nations Development Program (UNDP). A UNDP team visited Delhi in March 1975 to study the proposal and agreed to provide financial assistance to the tune of US $4.4 million for the purchase of a large computer system.

**National Informatics Center (NIC)**

The National Computer Center established in 1970 by the Electronics Commission, administered by its IPAG (Information, Planning and Analysis Group), with financial assistance from the UNDP; started functioning in 1977 as National Informatics Center.  

The long-term objective of the National Informatics Center, as approved by the Planning Commission, Ministry of Finance and the Electronics Commission, is ‘to establish the feasibility of a system for the provision of detailed information to government ministries and agencies to assist them in making decisions relating to the country’s economic and social development planning and programme implementation’.  

NIC was set up with the objective to promote economic, social, scientific and technological activities, and also for macro-economic adjustment programme of the Government, through the applications of IT. The mandate given to NIC as laid down in the Annual Reports of DoE 1976-77 and 1977-78, follows:

- Provide this informatics service to various user agencies in Government
- Play a promotional role in creating appropriate information systems in Government
- Act as a focal point for developing, managing and operating information system in Government
- Act as a focal point for development of methodologies for designing and implementing national information systems and data management techniques
- Act as a focal point for maintaining inventories of primary data and computer-based systems for data collection and dissemination
- Train users in information systems, data management and computing techniques

NIC planned to develop ten information systems in the following sectors:
- Agriculture
- Construction and Transport
- Education and Manpower
- Energy
- Finance
- Industry
- Small-Scale Industries
- Socio-Economic Index
- Trade and Media
- Government Archival Information

With this, NIC embarked on a grandiose mission to develop various national databases for use in planning and decision making by the government. The Organization employs a large pool of more than 3000 efficient technical manpower. Starting from its Headquarters at New Delhi, NIC has networked the entire nation with state units in all the 28 State capitals and 7 Union Territory Headquarters and District centers in almost all the Districts of India. It has grown by leaps and bounds promoting Informatics-led Development, which has helped to usher in the required transformation to cope with the
trends in the new millennium. NIC’s large number of Application Divisions is providing total Informatics Support to the Ministries and Departments of the Central and State Governments including Apex Offices of the Prime Minister, the President and the Parliament House. NIC was instrumental in processing very large volumes of data related to the 1991 Population Census and Industrial Census. NIC has also developed a number of network-based applications, most notable being the 1996 General Election in India.  

- Technical Applications Divisions/Cells

**NIC** is playing important role in creating knowledge societies – societies that can exploit knowledge to derive competitive advantage using the opportunities provided by digital technology. Through its Technical Applications Divisions NIC is contributing in Social and Public Administrations to 87 various areas; few of them are listed below:

1. Prime Minister’s Office, Parliament Informatics & Cabinet Secretariat Cell
2. Audit Information and Central Pension Accounting Office Division
3. Billing Division, Revenue and Receipt Section
4. Computer Aided Paperless Examination System (CAPES) Division
5. Civil Aviation Information Division
6. Commerce Informatics Division
7. Court Information System (COURTIS) Division
8. Computerized Rural Information Systems Project (CRISP) Division
9. Customs Division
10. Cyber Security Group
11. Disinvestments Informatics System Division (DISD)
12. EDI Application Unit and EDI Co-ordination Division
13. e-Governance Division
14. Energy Information Systems Division
15. External Affairs Informatics Division
16. Human Resource Development Division
17. Information & Broadcasting Informatics Division
18. Industry Information Systems Division
19. Land Records Information Systems Division
20. Ministry of Defence
21. Ministry of Home Affairs Information Systems Division
22. Planning Commission Informatics Division
23. Satellite Communications Division
24. Science & Technology Division
25. Water Resources Informatics Division

EVOLUTION OF SOFTWARE INDUSTRY

Until the mid-1960s, there was virtually no software development going in India. Software available in the market was bundled with computers sold by multinational companies like IBM. The early software development efforts focused on producing in-house applications for efficient use of these computers. State owned hardware companies, such as the Electronic Corporation of India Limited, attempted to produce computers for domestic academic and commercial use, and these efforts included development of operating systems, compilers and application packages. Most of these efforts, however, were not very successful.

The industry actually got its start with the establishment of Tata Consultancy Services (TCS) in 1968. The first software company in this country; a wholly owned subsidiary of Tata Sons, itself the holding company of the Tata Group, a diversified business group and the archetype of concentrated ownership. TCS was the first commercial organization to subscribe to the export-commitment related terms under which the Indian government allowed the import of hardware. Tata’s apparent purpose was to computerize the operations of its diverse companies.

To increase its US clientele TCS entered into an alliance with Burroughs Corporation for whom TCS was working as an exclusive sales agent for
Burroughs hardware in India. This alliance proved fruitful and the Detroit Police Department was the first US client of TCS.

In 1978, failing to cope up with the Foreign Exchange Regulation Act (FERA) of India, IBM shut down its operations in India and this triggered the rise of TCS.

The closure of IBM left 1200 employees of the company with no other option but to exploit their skills. This event played a major role in expansion of the Indian software industry. Many of the IBM employees set up small software consulting companies, which would offer software development and maintenance services to former IBM customers. The departure of IBM also offered an opportunity to many smaller hardware companies to expand into India, exposing Indian software programmers to a variety of software platforms.

But Indian software firms failed to generate much demand for their services in the domestic market for number of reasons. The foremost cause was the fear of loss of employment. And more importantly the rigidity of Indian government policy in those days also played a vital role in slowing down the growth pace of this blossoming industry. The government failed to encourage the adoption of computerization in government and state-owned enterprises on the other hand offered little incentive to adopt information technology to improve operations and productivity, to the Indian private sector companies. The severe import restrictions on hardware, extremely high tariffs, high customs duties, and control of foreign currency badly affected the domestic market, which forced Indian software companies to ship off their programmers to the client site and work on their computers. This practice received the derogatory title of ‘bodyshopping’ but it also helped in building relationships with their clients that were then to play a major role in shaping the industry.11
STATE OF IT INDUSTRY DURING 1980s

1980 – 1984: Regulatory Measures
The evolution of IT sector in India during the second half of the 80s clearly indicates the strong and proactive role of the state. Between 1980 and 1984, some measures were taken to toughen control over hardware imports. To boost domestic production of hardware – the weakest link in the IT sector, customs duties for imported hardware were raised to 135 percent (See, Table 2.2), and export enterprises were recommended to import hardware under a new pattern – by leasing.

Table 2.2
Rates of Customs Duty From 1970 to 1990 On Software and Hardware Imports in India

<table>
<thead>
<tr>
<th>Year</th>
<th>Hardware</th>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>1976</td>
<td>40%</td>
<td>100%</td>
</tr>
<tr>
<td>1980</td>
<td>135%</td>
<td>100%</td>
</tr>
<tr>
<td>1981</td>
<td>0% -for Export Processing Zones (EPZ) and Units</td>
<td>0% -for Export Processing Zones and Units</td>
</tr>
<tr>
<td>Late 1984</td>
<td>60 % on some peripherals - 5%</td>
<td>60% Zero customs duty on source codes on paper</td>
</tr>
<tr>
<td>1986</td>
<td>High export obligations (350% of imported hardware) – customs duty - 35% Low export obligations (250%) – 65 %</td>
<td>107%</td>
</tr>
<tr>
<td>1990</td>
<td>Temporary import – equipment lease: For a 6-month period export obligations were 25% of imported hardware, customs duty – 18% For 1 year – 50% and 20% respectively</td>
<td>Unaltered</td>
</tr>
</tbody>
</table>

Source: R. Heeks, «India’s Software Industry» [3]. Nasscom

In 1981, the Ministry of Trade established the status of an export-oriented unit. – EOU (Export-Oriented Units, See Appendix, List of Acronyms and Basic Terms). These EOUs too were given the same rights and benefits that were
awarded to the units under EPZs. The only drawback EOU had been insufficient infrastructure.

The Rajaraman Committee Report recommendations were quite stringent and advocated tight conditions for import-export. Importers were required to sign a legal bond with the Chief Controller of Imports and Exports (CCI&E) and those failing to meet their obligations could face legal action.\textsuperscript{12}

Despite unfavourable policies of the government, the DoE promoted conditions for software and services export growth. For example, it was at that time that the \textit{Engineering Export Promotion Council} (now the Electronics and Computer Software Export Promotion Council) began to assist software and services exporters in marketing. Later the Trade Development Authority was entrusted with these functions.

Despite such adverse conditions the industry grew by recording total (estimated) revenue of Rs. 100 crore during the year 1982-83. The ICIM secured Ist position in the Dataquest Top Ten Club by registering revenue of Rs. 24.69 crores.\textsuperscript{13}

In 1983 HCL Introduced its Integra machines, ICIM introduced two of its 101 minis at TCIL, Indian Airlines, ONGC, and Punjab National Bank planned first phase of computerization, SCL starts manufacturing LSI circuits, DCM DP gives India its first multi-lingual word processing system, Indonet – the country’s first communication network was announced. An agreement is signed between the employees union and the Bank management for the computerization of Banks. The Deputy Governor of Reserve Bank of India (RBI) was appointed as the Chairman of the Rangarajan Committee, formed to advise the government on the computerization roadmap for Nationalized Banks. Compaq launched it first portable computer with Winchester drive, IBM PC-Jr too made its entry in November 1983, IBM announced its new micro-XT PC and the Copyright laws extended from the realms of literature to
computer software. During this year the software exports touched the $ 12 million mark.\textsuperscript{14} And in the year 1983-84 the Indian Computer Industry was worth Rs. 183 crores.\textsuperscript{15}


Around this time the Indian software industry was still struggling to attain self-reliance. It became clear that the government policies failed to meet the requirements of the developing industry and there was an urgent need to work out a new concept. Cumbersome Import procedures, high customs duty and difficulties in obtaining foreign exchange were the main hurdles in the development of the Indian IT Industry. The election of Rajiv Gandhi as Prime Minister proved to be a turning point for the growth of Indian software and computer industries. Though he had to face a lot of misconceptions out of fear of loss of jobs for instance Bhartiya Mazdoor Sangh, opposed NICNET, a project of NIC. This project was about connecting the center with states using INSAT. March 1, 1984 was observed as an anti-computer day. Amidst such opposition he approved a New Computer Policy on November 19, 1984. This policy recognized software as an “Industry” making it eligible for an investment allowance and other incentives, reduced import duties for peripherals and import of computers liberalized.\textsuperscript{16}

In 1985 the Rangarajan Committee released its report on computerization of banks. The report recommended mechanization at branch, zonal and head office levels. Stage I of the computerization was to cover 2,500 branches and stage II 6,000 branches. CMC helped the RBI to get 100 minis from foreign vendors and 400 from indigenous sources. An ardent supporter of computerization and high technologies, the new Prime Minister implemented computerized railway reservation system and several other government processes in 1985. PC prices were going down, which encouraged more and more use of computers by organization but at the same time computerization process was facing opposition. This was only out of fear of loss of jobs. The computerization of banks was stalled by fresh agitations by bank employees.\textsuperscript{17}
His most innovative contributions to the Indian IT Industry was the creation of the Center for the Development of Telematics (C-DoT) that pioneered indigenous digital switching technology to facilitate India’s shift from electromechanical to digital switching and transmission.18

The main points of his drive for computerization laid stress on computer production in India, it also included measures to liberalize the software and services industry. In particular, it aimed:

- To simplify procedures related to hardware imports;
- To reduce the price of imported hardware by lowering the basic customs duty on imported hardware from 135% to 60%, and on some peripherals from 80% to 5%;
- To lower duties on imported software from 100% to 60% and to permit duty-free imports of source code software on paper;
- To recognize software production as an industry and to delicense software development;
- To simplify procedures related to hard currency accounts and transactions;
- To allow the use of international telecom links to export software and services;
- To place software under the Copyright Act (which brought the threat of fines or imprisonment for software pirates).

The role of certain government officials interested in formulating the present-day policy with the aim to place India at leading position in information technology deserves special attention.

During the year 1984-1986 Dr. H. Sheshagiri, Additional Secretary, DoE, played a major role in formulation of this policy. He had the Lion’s share in liberalization of the software industry. He had an advantage of a close affiliation with Rajiv Gandhi, as the duo worked together on information
systems for the 1982 Asian Games. Moreover, Rajiv Gandhi believed in Dr. Sheshagiri’s sincerity and determination for liberalization, which attracted his personal interest. Dr. Sheshagiri envisioned India’s future as that of a strong competitive software power, which would gain access to a vast economic and technological potential.

Some of Dr. Sheshagiri’s initiatives failed to be implemented at that time, however, they laid the basis for further reforms made in India in the late 80s and the early 90s. It was this man’s efforts that provided a foundation for the further development of the DoE and for its transformation into a promoter of the software industry, into a technocratic rather than bureaucratic authority.

1986: Software Development as a Priority

In 1986 India realizing the importance of IT industry in the nation’s economy started concentrating on its development. The Government of India announced its Policy for Computer Software in 1986, with the main objective of promoting software sector in the country and broadening the base of computer application areas. Key policy changes targeted at the software sector to simplify the procedures for setting up software units in India. These policy changes also targeted at helping entrepreneurs to start software businesses with special incentives. Some of these are the EPZ (Export Processing Zones), the 100% EOUs (Export Oriented Units), the Software Technology Parks (STP) and the EHTPs (Electronics Hardware Technology Parks). Each of these was provided with improved data communication facilities and single window clearance of approvals so that businesses may start operations in a matter of weeks. The major obstacles like license for import of capital goods, raw materials, components, consumables, etc. were removed. Excise duty was lowered and companies were exempted from profits earned on export of software. It also delicensed the import of software allowing anyone to import it by paying 60 per cent import duty. Software exporters’ cash compensatory support was raised to 10% of their total exports.
To give impetus to the software industry the government constituted various expert committees to study problems faced by entrepreneurs and to suggest their solutions. The brainstorming sessions of these committees helped in reforming various policies governing the industry.

In the same year the DoE constituted a Software Development Agency (SDA) to formulate, implement and coordinate government software policies and also to assist the country’s software industry development. Now it was supposed to be an advisory body with more thrust on R & D and technological development.  

For exploring the potentials of IT through education the DoE with the help of the Indian Institute of Science, Bangalore, and the IITs at Bombay, Delhi, Kanpur, Madras and Kharagpur launched the first dedicated computer network for academic institutions in 1986. This project was named as Education and Research Network (Ernet), integrated 150 institutions across the country and facilitated the users access to the global library networks through the National Center for Software Technology, Bombay. It also offered facilities like e-mail, file transfer and remote login. This project was funded by the UNDP (approximately Rs. 18 crores) and the Central government shared the expenses to the tune of Rs. 10 crores.

During 1986 the DoE started its first Software Technology Parks. India launched a telecommunications satellite to ensure fast communications between the software companies and their overseas clients. The aim was to promote offshore programming and get faster and easier access to international telecommunications. STPs rights and benefits in international economic activities and in tax concessions were equal to those of EPZs and acquired the status of EPZs under the control of DoE. The setback to the growth of IT industry during 1986 was the refusal from US Department of Computer to grant export license as a result India failed to acquire a
supercomputer. Despite such setbacks; the industry grew remarkably by registering gross industry revenue of Rs. 234 crores.


When Rajiv Gandhi first took over as prime minister, DoE officials were agog with excitement at the prospect of software becoming the newest “cottage industry”. There was also speculation about software replacing diamonds as the country’s largest export item and of India becoming the new Mecca of the world’s software activity. Four years later, much of those dreams remain just that. The Railways freight computerization plans got delayed by one more year as the installation cost went up to Rs. 1,200 crores, which was estimated to be Rs. 500 crores.

According to the findings of an ITC (International Trade Commission) study the world software industry suffered a loss of approximately US $5.7 billion in sales due to piracy. It was disturbing when India did not figured prominently in another study conducted by the US Department of Labour because the levels of computerization itself were considered too small to make piracy in this country an issue of international concern.

An insurance scheme was introduced in 1987 to cover the clients of Indian software companies against malpractice, besides, export shipment credit and credit guarantees were made available. During the same period venture capital funding for software companies was first introduced.

In 1987, a Bangalore branch of the U.S. company Texas Instruments installed the first land-based satellite communication station in India to organize export-import transactions related to software development (for voice and fax communication and for data transmission). And the industry kept its upward progress in terms of gross industry revenue, which grew to Rs. 347 crores in 1986-87.
In 1988, the Indian IT industry’s revenue crossed the Rs. 500 crore mark with an average growth rate of 25%. This year brought in encouraging feats when the National Software Center was inaugurated, Coal India Ltd., country’s largest organization in terms of manpower, stepped ahead towards computerization, for the first time in India, Vijaya Bank introduced Automated Teller Machine (ATM), National Crime Record Bureau decided for a computerized database for tracking criminals and National Association of Software and Services Industry (NASSCOM) is formed with a aim to become a catalyst for the growth of software driven IT industry in the country.  

**National Association of Software and Service Companies (NASSCOM)**

In 1988, almost 100 software members of MAIT quit to form its own trade body, the National Association of Software and Service Companies (NASSCOM), to promote its interests. When it was formed, NASSCOM had 38 members who accounted for 65 percent of the industry’s revenues. A decade later i.e. in 1999, it had 464 members, accounting for 95 percent of industry revenues. NASSCOM is represented on various committees of the Government of India in the DoE, the DoT, the Ministries of Commerce, Finance, External Affairs, Human Resources Development and Labour. NASSCOM has been influential in shaping the DoE’s strategy of working with software companies to provide critical infrastructure, while explicitly avoiding more detailed regulation or intervention. Apart from its interaction with the state, NASSCOM has tried to cultivate a public constituency for the industry. For instance, regular “club” meetings are held in major cities. It also sponsors high profile conferences and studies, consults for state governments, and promotes the Indian software industry around the world through a very effective web site as well as attendance at international trade shows and foreign visits. NASSCOM also acts as a consulting body for various state governments. By the late 1990s, virtually every state had an IT policy, at least on paper, and promoted itself as the next Silicon Valley. In addition to an IT
policy, state governments typically try to attract the industry by providing infrastructure either on their own or by encouraging the private sector.

NASSCOM’s constant interaction with the government had helped formulate policy changes and initiatives for the software industry. The result of such efforts was the creation of an awareness of the policies needed to promote IT industry, and their potential benefits, among the political leadership, the upper echelons of the bureaucracy and the urban intelligentsia. A leading business weekly describes NASSCOM as an “organization” that has lobbied for policy changes openly, transparently, and in a well-planned manner in India and abroad on a wide variety of subjects and achieved considerable success.”

NASSCOM is also one of the reliable sources of IT industry data in India. Its annual Strategic Review provides detailed and up-to-date figures on employment, revenues, exports, and market share for the software and other IT industries.

The government formed *Electronics and Computer Export Promotion Council* to support electronics and software exporters mainly in the area of marketing. Business India’s 22August-4September, 1988 issue reported about the government’s decision to set up an exclusive software exporting park at Pune in Maharashtra, which would have satellite link with key cities in the US and possibly Europe. The Maharashtra Industrial Development Corporation (MIDC) consented to provide 10 acres of land and the Videsh Sanchar Nigam Limited (VSNL) to set up a Rs. 1 crore direct satellite link via Intelsat.

The results at the end of the year 1989 were more attracting when the industry crossed the Rs. 1,000 mark. The Electronics Commission was abolished as the government felt that its role is being duplicated by the DoE.

In 1990, N. Vittal, who was an Atomic Energy Personnel, took over as Secretary of DoE. In the same year Telecom Restructuring Committee was
formed under the Chairmanship of Dr. M.B. Athreya. The committee recommended that the DoT be corporative, this once again created hue and cry. The software industry was wholly exempted from tax on export profits received from software and services exports. During this year DCM DP bagged $11 million US order – one of the largest export order ever bagged by an Indian firm. Now the IT market was more attracting than ever before, the total industry turnover was at Rs. 1,675 crores.

The overall efforts on the part of the government and business organizations during late eighties were encouraging. Results of leading IT companies in terms of revenues year after year were very impressive. Below given Table (2.3) is an excerpt of the Growth Pattern of Top Ten IT companies’.

Table 2.3
Revenue Growth Pattern of Top Ten IT Companies’ From 1984-85 to 1988-89

<table>
<thead>
<tr>
<th>Company</th>
<th>Revenue (Rs. Crores)</th>
<th>CAGR %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>84-85</td>
<td>85-86</td>
</tr>
<tr>
<td>HCL</td>
<td>18.50</td>
<td>25.89</td>
</tr>
<tr>
<td>Wipro</td>
<td>10.61</td>
<td>19.58</td>
</tr>
<tr>
<td>ECIL</td>
<td>10.87</td>
<td>21.33</td>
</tr>
<tr>
<td>TCS</td>
<td>15.00</td>
<td>19.10</td>
</tr>
<tr>
<td>ICIM</td>
<td>26.20</td>
<td>36.90</td>
</tr>
<tr>
<td>DCM DP</td>
<td>11.20</td>
<td>15.70</td>
</tr>
<tr>
<td>ZENITH</td>
<td>2.00</td>
<td>4.60</td>
</tr>
<tr>
<td>ESPL</td>
<td>4.11</td>
<td>10.00</td>
</tr>
<tr>
<td>Hinditron</td>
<td>5.21</td>
<td>12.45</td>
</tr>
<tr>
<td>OMC</td>
<td>2.00</td>
<td>4.98</td>
</tr>
</tbody>
</table>

Source: Dataquest July 1991, p 16

POLICY REFORMS AFTER 1990s

The decade of 90s witnessed significant steps in the direction of reform. Basic services like, national and international long distance services, cellular
telephony were opened to private sector. The government has decided to open up Internet telephony.

In June 1991, the Software Technology Parks of India (STPI) was registered as an autonomous agency, reflecting the desire of the DoE to avoid direct government involvement in the industry. By 1998 there were 25 STPs under various stages of planning and development in different parts of the country (in addition to those sponsored by the DoE).  

Software Technology Parks of India (STPI)

Though the STPI was established in 1986 and the intention of the government to promote software was made clear in the ‘New Software Policy’ but exports remained at a slow pace. One of the most important reasons behind this failure was insufficient infrastructure; the industry lacked high-speed data communication link, the backbone of this industry, with which software units can connect, communicate and transfer their work to clients all over the world. Other major hindrance was various time-consuming approvals, clearances and certificates needed from the government. These delays were resulting in loss of orders, which floated the concept of single window clearance for all administrative requirements. These conditions called for detailed discussions on policy issue, which concluded with a thought that there was a need for creating a centralized in house infrastructure scheme, which could be managed, regulated and monitored by people who spoke the same language as the software-exporting units.

In 1990 these brainstorming sessions gave a more specific shape to the concept of STP reaffirming its status of an export-processing zone under DoE. The first software technology park was opened in Pune in 1990 and within a few months two other parks were opened in Bangalore and Bhubaneshwar. In a short period of time four more parks were opened as well as the other parks were brought under its operations. STPI was formed with a very clear mandate - to help in the setting up of software firms. It is an autonomous organization
with delegated powers under the Department of Electronics (DoE), Government of India.\textsuperscript{33}

With the objective of encouraging, promoting and boosting the Software Exports from India STPs have set up earth stations through which it provides wide band High-Speed Data Communication (HSDC) facilities on rental basis for software units. This facility on the one hand has added to the growth of offshore development centers on the other is providing opportunities like high skilled job to Indians. It provided with space and other infrastructure to most of the new entrepreneurs. It offers consulting, training and implementation services. Services cover Network Design, System Integration, Installation, Operations and maintenance of application networks and facilities in varied areas ranging from VSATs to ATM based networks. The policy of STPI is to continuously strive and delight customer through total quality performance of all its services in terms of quality culture, quality cost and quality delivery schedule.

In 1992, with a view to expedite decisions for promoting Indian Software, the World Bank report suggested to set up a ‘Development Board’. The concept of single window was implemented and the Director of the STPs was empowered to give all required clearances and approvals to this industry. All companies exporting software from India were required to fill a form called the ‘Software Declaration form’, which is to be filed with the RBI. This helped STPs to maintain exact record to software exported every month.

STP’s unique role however is in getting approvals for a project and getting an entrepreneur started. In financial terms, projects where the amount involved is less than Rs.100 million (US $ 2.4 million) and the proposal is viable, approvals are generally given in a few hours across the table with the Director of a STP. When the project cost is more than Rs.100 million (US $ 2.4 million) then the proposal needs more review and typically takes between three to four weeks. In cases where foreign investment involved is less than
51% of the total project cost decisions are made and recommended at the level of the Director of the STP. Where it is more than 51%, those cases are sent for approval to the Foreign Investment Promotion Board (FIPB).

STP has over the years stepped in to provide various services as and when they have been needed. They try to connect foreign investors with Indian software developers. They also help in getting finance by trying to stand between the entrepreneur and lenders and in certain cases give financial guarantee on behalf of the entrepreneur. The number of STP units has grown from 164 to 667.

Various objectives of the STPI are listed below:

**Goals & Objectives**

- To act as front-end to the Software Industry for the Govt. Policies and approvals.
- To establish and provide Data Communication facilities, Computer facilities and Infrastructure facilities like Office Space and General amenities.
- To promote development and export of software & the services through technology assessments, market analysis, marketing segmentation, marketing support & related areas.
- To train professionals and to encourage design and development in the field of Software Technology and Software Engineering.
- A catalyst and facilitator for the high growth of software exports from the country.

**Quality Objectives**

- To strive for the upgradation of the technology to meet customer requirements in ever changing market
- To upgrade the technology knowledge of all STPI personnel through continuous improvement training
To provide state-of-art data communication services as per acceptable international standards

To provide comprehensive service including project approvals, import attestation, software export certification etc., in a time bound manner

Achieving customer satisfaction through the combined efforts of planning the infrastructure and executing the projects through dedicated workforce

**Future Plans**
The STPI has developed future plans to promote software business which cover following objectives:

- Expand high speed datacom facilities
  - Bandwidth availability on demand
  - No last mile problem
- Dispersal through seamless connectivity
- Development of Secondary cities
- Promote Small & Medium Scale Entrepreneurs
- SoftMOF: Market, Opportunity & Technology Forecasting

**Role of STPI**
The role of STPI was very important for the furtherance of the growing business of software segment. These included following types of activities:

- Promotional Role/Regulatory Role
- Facilitator/Catalyst
- Incubating Infrastructure Provider
- Dedicated Datacom Services
- To establish and provide Data Communication facilities, Computer Facilities and Infrastructure facilities like Office Space and General Amenities.
- Provides best interface between industry and Government
• Vital Role in attracting MNCs
• Front-end on behalf of MIT/Govt. of India
• To act as front-end to the Software Industry for the Govt. policies and approvals
• Effective projection of India through Road shows in USA, Europe & Japan
• To promote development and export of software & the services through technology assessments, market analysis, marketing segmentation, marketing support & related areas.
• To train professionals and to encourage design and development in the field of Software Technology and Software Engineering.  

Around the year 1991, winds of liberalization were blowing in India; this coincided with the setting up of STPs. The general policy changes such as the devaluation of the rupee and a liberal view towards foreign direct investment helped to a certain extent to Software producers in India. Exemption of profits earned from exports of software and other services and, most importantly, the 1992 removal of import licensing on equipment and industrial imports was quite an encouraging move. This facilitated import of those computers by Indian companies which its clients produced and used.  

In between the developments taking place in India and on global level concerning the Indian IT industry, a 1992 World Bank sponsored survey found that U.S. and European vendors ranked India as the top choice for on-site and off-shore software development, ahead of Israel, Ireland, Mexico, Singapore, China, Hungary and the Philippines. This was quite encouraging but with a few policy changes; it seems quite a less degree of attention was paid to materialize these findings.  

One of the major setbacks to the industry was piracy. Computer software already had a cover from the Indian Copyright Act of 1957 but it required amendment and the amended act was passed in 1994, which prohibited sale or
hire of computer programme without proper authorization of the Copyright holder. NASSCOM took lead in curbing piracy by setting up a hotline to receive complaints against software piracy.\textsuperscript{38}

In May 1998, the Prime Minister of India formed a National Taskforce on Information Technology and Software Development to formulate a long term National IT policy for the country so as to remove impediments for the growth of the infotech industry. The main objective of this was to help India emerge as an IT software superpower. The Taskforce submitted three key reports to the government - suggesting various measures to build India's infotech industry and proliferate use of IT in the country. The three reports were namely:

1. IT Action Plan – I : Software
2. Action Plan – II : Hardware

The IT Task Force committees which were formed to study the problems and potentials and to make recommendations for the development of IT industry comprised of politicians, bureaucrats and entrepreneurs. During this time a separate ministry i.e. the Ministry of Information Technology; was formed\textsuperscript{39}

**RESPONSE OF INDIAN FIRMS**

From the 1950s, IBM had implicit monopoly over computers in India. Its 360 series, released in the 1960s, became the workhorse of large organisations; they maintained batteries of programmers to write software for the machines and software was made available only alongwith the machine. Technology transfer issues marred seventies with the US following the nuclear test by India in Rajasthan, restricted sales of mainframes. To meet out the requirements of the industry, advancements in technology, the Electronics Corporation of India was established; whose mandate was indigenous research and production of mainframe systems.\textsuperscript{40} In 1978, George Fernandes, then
minister of industries, asked IBM to take local shareholders into its subsidiary. It refused, and wound up operations in India. Its ex-employees set up Computer Maintenance Corporation (CMC), with the primary object of maintaining computers which were looked after by IBM. IBM on the one hand charged heavily for its support services and had always shown disinterest in transfer of technology to India. This was the other reason behind setting up of CMC, followed by the creation of DoE. During the seventies and early eighties, revenue from system shipments dominated as the largest component of the domestic IT industry.  

By mid eighties business organizations and few government departments started using computers. Most of the software packages were used for accounting and financial management. This was the time when Peutronics, now Tally Solutions, launched Tally – the country’s first software package. This increasing trend of computerization gave birth to companies like Wipro Systems (1981), Infosys Technologies (1981), Rolta India (1982), Mastek (1982), Unicorp (1986), JTS (1986), Godrej Pacific (1986), TVS Electronics (1986), Sonata Software (1986), Satyam (1987), etc.

The announcement of the famous National Computer Policy by the then Prime Minister Rajiv Gandhi in the year 1984 accelerated the growth of Indian IT industry and sincerely speaking gave birth to the peripherals industry. Encouraged by this policy several PC vendors started manufacturing PCs in the country. And thus, the need for peripherals like, SMPS, keyboards, mouse, tape drives, LAN cards, VGA cards, printers and so on was felt. Companies like HCL, Wipro, Vintron, Essen, VXL Instruments, TVS Electronics, Microtek, Lipi Data Systems, Moser Baer, were major producers of peripherals. The increasing demand for peripherals also gave boost to import the same from Hong Kong, Singapore, Taiwan and South Korea.

From then till the opening up of the early 1990s, the only mainframes being imported into India were Russian. When Rajiv Gandhi became prime minister
and visited the US in 1985, he asked to be allowed to import Cray computers, then the most powerful computers available. After much pleading, a license was issued for one for the Indian meteorological office. It did not arrive. But in the meanwhile, the government’s Center for Development of Advanced Computing (CDAC) connected together a string of less powerful computers to create the first powerful parallel computer in 1991.

In the meanwhile, computers were finding commercial applications in India as in western countries – in materials planning, airline scheduling, CAD/CAM etc. Programmers got training in working out these applications on aging and heterogeneous computers. In this way, a stock of technological capability was built up. In the 1980s, three types of organizations employed programmers. First, there was Computer Maintenance Corporation, which employed software engineers who worked for IBM before it closed shop in India in 1978. Second were the producers and third were suppliers of computers. The 1970s and 1980s saw the downsizing of computers into mini-computers and PCs, and the number of their producers grew in the US, Europe and Japan. India’s import substitution policies reserved the domestic market to whoever could “produce” a product in the country. The definition of production was vague: it could consist of assembly of imported components, with a few being produced within the country or bought from another domestic supplier – who could get his own import licenses. Thus a large number of licensees came up who, for instance, imported the chassis of the PC and put it into a box welded by them.

Finally, since mini-computers did not come loaded with user-friendly programmes such as Windows today, users also employed programmers. Amongst the users were consultants, large firms and government institutions. Thus amongst India’s software producers today, TCS started as a consultancy in 1968, whilst Tata Infotech, Patni Computer Systems and Wipro began as computer manufacturers. Programmers were also scattered amongst large companies and government laboratories. These were the warehouses of
programmers; they began to lose programmers as the US demand for programmers spilt over to India in the late 1980s.

INDIAN SOFTWARE AND THE GLOBAL MARKET

The Indian software industry emerged in late 70’s and its revenue touched Rs. 50 million mark in the eighties. This segment of IT industry has proved to be the most productive in terms of revenue and the most flourishing business in the past decade. But the other side of the coin is quite disturbing i.e. the slow pace of growth of domestic market for software. This has kept the Indian domestic software industry relatively at low profile than that of the hardware industry. This is contrary to the worldwide trend, where software is bigger than hardware and is growing at a faster rate too.44

In 1989-90 software exports started with a very meager contribution of 9.3% by contributing gross revenue of Rs. 156 crores to the industry turnover of Rs. 1,675 crores. This was just the beginning, which continued to grow by leaps and bounds. In this section the researcher intends to explore the software sector alone by comparing the domestic market and the international market, which earned India global reputation with a distinction of being an IT superpower.

At the end of 1990-91, total revenue from software sector was registered as Rs. 536 crores of which Rs. 452.20 crores came in from exports. In the next year overall growth of IT sector gained momentum and the share of exports moved up with a contribution of 49.53%. The upward growth trend of software exports dominated the domestic market during the past decade (See Table 2.4)
Table 2.4
Total Software Revenue (Domestic & Exports) of Indian IT Industry From 1990-91 to 1999-2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic (Rs.Cr.)</th>
<th>Exports (Rs.Cr.)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>83.80</td>
<td>452.20</td>
<td>536.00</td>
</tr>
<tr>
<td>1991-92</td>
<td>125.20</td>
<td>676.20</td>
<td>801.40</td>
</tr>
<tr>
<td>1992-93</td>
<td>170.60</td>
<td>930.50</td>
<td>1101.10</td>
</tr>
<tr>
<td>1993-94</td>
<td>222.80</td>
<td>1405.00</td>
<td>1627.80</td>
</tr>
<tr>
<td>1994-95</td>
<td>377.40</td>
<td>1881.50</td>
<td>2258.90</td>
</tr>
<tr>
<td>1995-96</td>
<td>777.90</td>
<td>2680.90</td>
<td>3458.80</td>
</tr>
<tr>
<td>1996-97</td>
<td>1647.00</td>
<td>3582.73</td>
<td>5229.73</td>
</tr>
<tr>
<td>1997-98</td>
<td>3459.04</td>
<td>6273.34</td>
<td>9732.38</td>
</tr>
<tr>
<td>1998-99</td>
<td>4470.49</td>
<td>10342.93</td>
<td>14813.42</td>
</tr>
<tr>
<td>1999-00</td>
<td>4567.00</td>
<td>15387.00</td>
<td>19954.00</td>
</tr>
</tbody>
</table>


The above figures as presented graphically in below given Bar Graph (2.1)

Bar Graph 2.1

Over the years, Indian software companies have helped companies worldwide grow and compete using software developed by Indians. This paints a colorful picture of software exports but this would have been more impressive
provided the government had taken proper care. The blossoming software industry literally moved against the current. It lacked an ideal environment, posed numerous problems, which consumed substantial time and energy of the software entrepreneurs. Lack of proper telecommunication facility, which was an absolute necessity for the software business, was the major hindrance. Access to Internet was difficult and if the connection matured speed was the next problem faced. Cost of these facilities was the other worry. Nowadays telecom links of various types, such as ISDN, frame relay, etc, are available to Indian software exporters. But a couple of years back installation and connection of these facilities took long time for proper functioning.

Poor modes of transportation were the other factor barring full swing growth of software exports. Our international airports of those days comparatively had pathetic conditions. Poor upkeep of facilities and procedural delays would hold the prospective clients for long hours. And clients – keen about quality of infrastructure; would have a negative image of India at the first hand. The poor quality of approach roads to STPs and EPZs (Export Processing Zone) were the second step to scare away the clients.

The so-called attention given to the software industry had a major setback with regards to supply of electricity. The Silicon Valley of India i.e. Bangalore too was not spared out of this. To fight out this grave problem software companies had to install large UPS (Uninterrupted Power Supply) and generators, which increased the cost.45

Despite, the above constraints software exports maintained its major share of contribution over the domestic revenue during the decade under study.

One of the major reasons behind this was the comparative cost of labour. IBM’s departure from the country hurled a challenge before zealous Indians, who were not having ample computing facilities in those days. And in 1980s computer manufacturers had no option other than Unix (the first portable,
machine-independent, multi-user operating system). Thus Indian programmers learned to work on a variety of platforms. According to a NASSCOM report Indian educational institutions were producing 67000 computer science professionals and other private institutes contributed to the tune of 2,00,000 computer professionals annually in 1990s. Though in 1990s alternatives to Unix were made available but it still dominated the programming world and by that time India had battery of Unix programmers, which was scarce elsewhere in the world. In addition to this India had a large number of English-speaking workforces who were ready to work at salaries that were quite low than what the US and other European countries were required to pay to their US counterparts (See Table 2.5). Geography too played its role in the growth of software exports. The 12 1/2 hour difference between Indian Standard Time and Pacific Standard Time allowed Indian firms to perform maintenance and reengineering tasks for U.S. customers by accessing their computers without disturbing the regular work of users. This poured in more projects. Thus, the US and other European companies exploited this opportunity and the export-driven Software segment saw major long-term projects coming to India and Indian companies bagging larger and larger share of the global outsourced business.46

### Table 2.5
**International Wage Rates for Employees Working in Software Industry as on 1994**

<table>
<thead>
<tr>
<th>Country</th>
<th>Programmer U.S. $</th>
<th>Systems Analyst U.S. $</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>54,075</td>
<td>65,107</td>
</tr>
<tr>
<td>Japan</td>
<td>51,731</td>
<td>64,519</td>
</tr>
<tr>
<td>U.S.</td>
<td>46,600</td>
<td>61,200</td>
</tr>
<tr>
<td>France</td>
<td>45,431</td>
<td>71,163</td>
</tr>
<tr>
<td>Britain</td>
<td>31,247</td>
<td>51,488</td>
</tr>
<tr>
<td>India</td>
<td>4,002</td>
<td>5,444</td>
</tr>
</tbody>
</table>


Policy reforms initiated by Nasscom and other bodies also had its own impact on the growth of software exports. Where exemption from Income Tax of profits on software was the major attraction on the other hand removal of licenses on imports facilitated Indian companies to import the computers that
its clients used and produce or modify software for them directly. The establishment of STPs was the second reason behind it.

In the second half of the decade i.e. from 1995-96 to 1999-2000 TCS, HCL, Wipro, Pentafour, Infosys and Satyam were the leaders in software exports (See Table 2.6)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TCS</td>
<td>420.52</td>
<td>TCS</td>
<td>606.88</td>
<td>HCL</td>
<td>989.34</td>
<td>TCS</td>
<td>1519</td>
<td>TCS</td>
<td>1820</td>
</tr>
<tr>
<td>HCL</td>
<td>270.51</td>
<td>Wipro</td>
<td>252.56</td>
<td>TCS</td>
<td>949.14</td>
<td>Wipro</td>
<td>648</td>
<td>Wipro</td>
<td>1042</td>
</tr>
<tr>
<td>Wipro</td>
<td>163.90</td>
<td>Pentafour</td>
<td>159.43</td>
<td>Wipro</td>
<td>388.94</td>
<td>HCL</td>
<td>579</td>
<td>Infosys</td>
<td>870</td>
</tr>
<tr>
<td>Pentafour</td>
<td>100.27</td>
<td>Infosys</td>
<td>125.28</td>
<td>Pentafour</td>
<td>271.75</td>
<td>Infosys</td>
<td>500</td>
<td>HCL</td>
<td>733</td>
</tr>
<tr>
<td>TUL</td>
<td>93.50</td>
<td>Satyam</td>
<td>85.22</td>
<td>Infosys</td>
<td>247.21</td>
<td>Satyam</td>
<td>377</td>
<td>Satyam</td>
<td>663</td>
</tr>
</tbody>
</table>


PROBLEMS FACED BY INDIAN IT INDUSTRY DURING EARLY 1990s

In 1990, the IT industry received some good news like exemption of tax on profits from software exports, and reaffirmation of Export Processing Zone (EPZ) to STPs under the DoE.

But at the same time devaluation of rupee and stringent import policies like software import duty was raised to 112 percent. Policies of those days made customs clearance more difficult. This altogether was hampering the overall growth of IT industry. The entire nation was going through economic instability when Dr. Manmohan Singh, the then Finance Minister came to its rescue. Perhaps his western education and experience of working with the World Bank were instrumental behind his liberal views. He initiated a new phase of development by liberalizing the entire industrial policy. During his tenure many foreign trade barriers were lowered, lists of imported goods subject to licensing were shortened; foreign investment policies were liberalized especially with respect to Institutionalized investors and non-resident Indians, and Private capital was allowed access to most industries.
(except six strategically important ones). The overall efforts on the part of the government and the industry were fruitful and the IT industry’s total revenue in 1989-90 was Rs. 1,675 crores that moved up by 32% earning a total revenue of Rs. 2,213.60 crores in the year 1990-91.

1991-92 had a background of political uncertainty, which affected the growth of IT industry resulting into a mere 22.75% of overall growth by generating only Rs. 2,717.20 crores. But the wheels of growth and diversification kept on moving. IBM returned to India in a 50-50 joint venture with Tata Information Systems Ltd. and Siemens-Nixdorf Information System AG of Germany tied up for a joint venture for software with Siemens Ltd. of India. Lately but finally – Internet attracts attention and VSNL announces to provide 64 Kbps leased lines for internet connectivity which was an opening to access the globe. Hughes Software Systems sets up a division in India. Another STP is set up at Noida. NIC established its network ‘NICnet’ that provided access to private sector.  

After a small downfall IT industry once again showed progress and comparatively the 27.11% growth at the end of 1992-93 was pleasing. The overall revenue generated was Rs. 3,454.10 crores. Software exports gave an extra push to the industry with a contribution of Rs. 930.50 crores. The success in software sector can be attributed to the NASSCOM’s nationwide campaign against software piracy alongwith an extra boost to the IT industry by reducing duties on all computer equipment including peripherals, software and hardware. During this year TCS became the first Indian software company to cross the Rs. 200 crore mark.  

1993-94 also proved an upwards-moving year for the IT industry with the inauguration of India’s first national information highway, installation of PARAM at the IISc. (Indian Institute of Science), computerization of Delhi’s customs office and CDAC setting up a company to manufacture and market its systems like PARAM. MNCs like Dun & Bradstreet, the world’s largest
marketer of information, Tandem Computers and Computer Vision entered India. Wipro established an R&D center and Infosys Technologies started its subsidiary in the U.S. The industry grew nearly by 38% by generating revenue of Rs. 4,757.50 crores.\textsuperscript{49}

1994-95, came with more impressive results than ever before by registering a growth of nearly 44% with revenue of Rs. 6,840.90 crores.

**Table 2.7**  
Indicators of IT use in India’s Industrial sector (1997)

<table>
<thead>
<tr>
<th>Industries (2 digit level)</th>
<th>Per cent of factories with</th>
<th>Total no. of Computers in Factories</th>
<th>Office</th>
<th>Network</th>
<th>Internet</th>
<th>Robots or Computer in Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food products</td>
<td></td>
<td>14,695</td>
<td>13.01</td>
<td>0.84</td>
<td>1.39</td>
<td>0.29</td>
</tr>
<tr>
<td>Other food products</td>
<td></td>
<td>8,109</td>
<td>24.17</td>
<td>1.38</td>
<td>2.01</td>
<td>1.64</td>
</tr>
<tr>
<td>Beverages tobacco, etc.</td>
<td></td>
<td>8,669</td>
<td>47.81</td>
<td>0.36</td>
<td>0.28</td>
<td>0.14</td>
</tr>
<tr>
<td>Cotton textiles</td>
<td></td>
<td>9,227</td>
<td>22.28</td>
<td>0.54</td>
<td>1.87</td>
<td>1.37</td>
</tr>
<tr>
<td>Wool/silk Mfg. of Textiles</td>
<td></td>
<td>3,989</td>
<td>49.76</td>
<td>1.25</td>
<td>2.28</td>
<td>0.25</td>
</tr>
<tr>
<td>Jute &amp; other Veg. fiber textiles</td>
<td></td>
<td>503</td>
<td>16.70</td>
<td>0.40</td>
<td>3.78</td>
<td>0.60</td>
</tr>
<tr>
<td>Textiles Prod. Incl. Apparel</td>
<td></td>
<td>5,409</td>
<td>51.32</td>
<td>3.18</td>
<td>11.31</td>
<td>2.09</td>
</tr>
<tr>
<td>Wood and wood products</td>
<td></td>
<td>3,787</td>
<td>8.98</td>
<td>0.40</td>
<td>0.95</td>
<td>0.24</td>
</tr>
<tr>
<td>Paper and paper products</td>
<td></td>
<td>6,304</td>
<td>38.50</td>
<td>1.84</td>
<td>3.73</td>
<td>4.71</td>
</tr>
<tr>
<td>Leather products</td>
<td></td>
<td>1,742</td>
<td>37.60</td>
<td>1.89</td>
<td>7.18</td>
<td>0.29</td>
</tr>
<tr>
<td>Basic chem. &amp; related products</td>
<td></td>
<td>9,357</td>
<td>50.69</td>
<td>2.91</td>
<td>5.58</td>
<td>2.56</td>
</tr>
<tr>
<td>Rubber plastic and coal</td>
<td></td>
<td>7,597</td>
<td>42.57</td>
<td>2.80</td>
<td>4.01</td>
<td>1.59</td>
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<tr>
<td>Non-met. Mineral products</td>
<td></td>
<td>11,376</td>
<td>13.37</td>
<td>0.41</td>
<td>0.95</td>
<td>1.09</td>
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<tr>
<td>Basic metal and alloys</td>
<td></td>
<td>6,915</td>
<td>41.94</td>
<td>0.93</td>
<td>3.69</td>
<td>1.72</td>
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<tr>
<td>Metal products</td>
<td></td>
<td>8,243</td>
<td>31.68</td>
<td>0.92</td>
<td>2.86</td>
<td>1.01</td>
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<tr>
<td>Machinery and equipment</td>
<td></td>
<td>8,203</td>
<td>44.46</td>
<td>2.12</td>
<td>5.63</td>
<td>2.66</td>
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<tr>
<td>Electric Machinery &amp; Equip.</td>
<td></td>
<td>5,743</td>
<td>55.77</td>
<td>3.53</td>
<td>10.92</td>
<td>4.89</td>
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<tr>
<td>Transport equipment</td>
<td></td>
<td>3,999</td>
<td>46.96</td>
<td>1.63</td>
<td>7.15</td>
<td>2.58</td>
</tr>
<tr>
<td>Scientific equipment</td>
<td></td>
<td>2,243</td>
<td>48.02</td>
<td>4.01</td>
<td>14.00</td>
<td>3.97</td>
</tr>
<tr>
<td>Repair of capital goods</td>
<td></td>
<td>2,240</td>
<td>25.89</td>
<td>0.80</td>
<td>1.96</td>
<td>0.36</td>
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<td>Electricity</td>
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<td>3,644</td>
<td>64.71</td>
<td>0.93</td>
<td>3.10</td>
<td>3.24</td>
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<td>Gas and steam</td>
<td></td>
<td>80</td>
<td>75.00</td>
<td>2.50</td>
<td>3.75</td>
<td>5.00</td>
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<td>Water works and supply</td>
<td></td>
<td>293</td>
<td>10.58</td>
<td>0.68</td>
<td>1.02</td>
<td>0.68</td>
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<tr>
<td>Non conventional energy</td>
<td></td>
<td>4</td>
<td>25.00</td>
<td>25.00</td>
<td>25.00</td>
<td>0.00</td>
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<td>Storage and warehousing</td>
<td></td>
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<td>0.37</td>
<td>0.37</td>
<td>0.09</td>
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<td>Sanitation</td>
<td></td>
<td>102</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Motion pictures, etc</td>
<td></td>
<td>51</td>
<td>7.84</td>
<td>7.84</td>
<td>27.45</td>
<td>0.00</td>
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<tr>
<td>Laundry and others</td>
<td></td>
<td>94</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Repair services</td>
<td></td>
<td>1,966</td>
<td>2.59</td>
<td>2.59</td>
<td>1.12</td>
<td>0.00</td>
</tr>
<tr>
<td><strong>All industries</strong></td>
<td></td>
<td><strong>135,679</strong></td>
<td><strong>34.70</strong></td>
<td><strong>1.50</strong></td>
<td><strong>3.72</strong></td>
<td><strong>1.77</strong></td>
</tr>
</tbody>
</table>

INDIA’S SOFTWARE SPECIALIZATION

At the end of financial year 1982-83 the IT industry’s gross revenue touched Rs. 100 crores mark and by the year 1991 this figure has reached to the tune of Rs. 2,214 crores. The Software segment’s contribution was Rs. 536 crores. If it was not very impressive it wasn’t very low too. This was the beginning of a golden era. The shortage of skilled labour in the U.S. and other European countries compelled them to knock the doors of India and thus India was flooded with hundreds of U.S. and other European IT companies. Indian IT companies started working out projects at home and at the client’s site. The overall growth of IT sector gained momentum and in the year 1991-92 the industry grew to a total size of Rs. 2717 crores, while the Software segment’s contribution was Rs. 801 crores.

Table 2.8
Share of Software Revenue in Total Revenue of Indian IT Industry From 1990-91 to 1999-2000

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue from Software (Rs. Crore)</th>
<th>Total Ind. Revenue (Rs. Crore)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990-91</td>
<td>536.00</td>
<td>2213.60</td>
</tr>
<tr>
<td>1991-92</td>
<td>801.40</td>
<td>2717.20</td>
</tr>
<tr>
<td>1992-93</td>
<td>1101.10</td>
<td>3454.10</td>
</tr>
<tr>
<td>1993-94</td>
<td>1627.80</td>
<td>4757.50</td>
</tr>
<tr>
<td>1994-95</td>
<td>2258.90</td>
<td>6840.90</td>
</tr>
<tr>
<td>1995-96</td>
<td>3458.80</td>
<td>9712.90</td>
</tr>
<tr>
<td>1996-97</td>
<td>5229.73</td>
<td>13434.10</td>
</tr>
<tr>
<td>1997-98</td>
<td>9732.38</td>
<td>18015.70</td>
</tr>
<tr>
<td>1998-99</td>
<td>14813.42</td>
<td>23955.80</td>
</tr>
<tr>
<td>1999-00</td>
<td>19954.00</td>
<td>33052.00</td>
</tr>
</tbody>
</table>

Source: Dataquest Vol. XVIII No. 13 July 15, 2000 P 85

The above figures are presented graphically in below given Bar Graph (2.2)
IT AND THE ECONOMY

The age of IT industry of India is quite less in comparison to other industries that have a very long standing. IT industry during early 90s can be called as in its infancy stage. Still it came into limelight; not only at domestic level but globally also only because of its speedy growth and development in the last decade.

India’s talent bank and its initiatives showing quest for implementation of Information Technology on large scale attracted the World Bank in the 80’s who, actively participated by funding various software development projects. The World Bank also positively supported government reforms in the field of Finance, Education and Marketing. It also defined guidelines for governments encouraging growth by developing infrastructure leading to improved IT production.

In early 1991, the process of importing software was very cumbersome when Congress was the ruling party; headed by P.V. Narsimha Rao as the Prime Minister and Mr. Manmohan Singh as Finance Minister. The Finance
Minister had some western education and had worked for some time for the World Bank. His vision for IT as a tool for nation’s development and growth was quite clear. He initiated the liberalization process for industries’ and in particular for the IT industries. This was the time when Private Capital was allowed access to most industries (except six strategically important ones), simultaneously Foreign Trade barriers were lowered and the list of imported goods subject to licensing was reduced. In this course of liberalization the Institutional Investors and Non-Resident Indians (NRI) were taken due care of. Industries operating from STP’s were facing problems with regards to the percentage of stake by foreign investors which, now was increased to 51 percent and for exporters to 100 percent.

In this changed scenario it would be relevant to look at the achievements, indicators and growth prospects of the segment to gauge the dimensions of the IT industry in India. According to the NASSCOM, India’s quasi-governmental software industry promotion organization, the software industry in India was worth Rs. 243.5 billion or US$ 5.7 billion in 1999-2000, whereas ten years back its worth was not more than Rs. 3 billion or US$ 150 million.\(^5\) In the last five years (1995-2000), the Indian IT Industry has recorded a CAGR (Compounded Annual Growth Rate) of more than 42.4 percent, which is almost double the growth rate of IT industries in many of the developed countries.

The IT manufacturing sector is growing at an average rate of 30 to 35 percent annually over the past decade. And the industry has over 150 major hardware players supported by over 800 ancillary units and small time vendors engaged in sub-assemblies and equipment manufacturing.

Software continues to contribute a major portion of the Indian IT industry's revenues. In terms of Indian rupees, the CAGR for India’s software export revenues over the past five years has, according to NASSCOM’s statistics, been as high as 62.3 percent, compared to 46.8 percent of CAGR for its
domestic market revenue during the same period.\textsuperscript{51} During 1999-2000, the Software segment’s revenues constituted over 65 percent of the Indian IT industry's annual revenues. The software industry in India grew by an average growth rate of 50 during the decade under study. Its total revenue jumped to Rs. 19,954 crore at the end of fiscal year 1999-2000, from Rs. 14,813.42 crore at the end of fiscal year 1998-99.

**IT BOOM AND THE PRODUCT MARKET**

India is now being identified as the major powerhouse for large scale and rapid development of Information Technology. Inviting global attention India’s IT industry earned respectable position not because of the actual size of industry but because of its rapid growth.

Liberalization of the early ’90s has initiated computerization in India and with fast changing technology and its large scale varied application this new term ‘Information Technology’ was coined which, earlier was known only as computer. Simultaneously, swift amendments in policies, relaxations in licensing, import-export procedures and concessions in duty offered by the government boosted IT business in India and soon it was acknowledged as Industry.

Information Technology, as a product can be broadly categorized into Hardware and Software but its large spread activities and the volume of revenue these activities/products contribute has categorized the IT market into segments like; Hardware, Software, Peripherals, Training, Maintenance, Networking and Others.

The striking difference between computer software and hardware industry is that, Software is more of a service oriented industry mainly targeting exports whereas hardware is a goods oriented industry, targeting home market.
The Indian computer hardware and software industries differ a lot in terms of their levels of innovation, kinds of manufacturing and the markets catered to. The computer hardware industry in India has hardly anything to contribute in terms of innovation. Most of the computer hardware firms import machine parts and the intermediate goods (motherboards, processors, memory, hard-disk etc.) and they assemble and sell the finished product i.e. the computer systems under a brand name in the Indian local market. Price hike or decline directly impacts the product market and Indian market witnessed a continuous fall in prices of computer or IT equipments since the early 1990s. Government’s aggressive strategies and an intrusive approach to the field of IT resulting into high rate of cuts in customs and duties were quite helpful in reducing prices of computers. From 1990 to 1996 the acquisition price of IT equipment for investment fell 16.6% annually, while the price of computers for consumption fell even faster at 24.2% per year.52

Despite reduced prices of computers use of IT in India was quite low as compared to the world average. Around mid 90s the telephone density in India was quite less as compared to countries like; the USA, UK, France, Germany, Japan, Korea, Malaysia and Thailand. Similarly, the world average of computers was 25/1000, in India it was one. This was one of the reasons behind such slow growth of Hardware segment. The other reason was perhaps a very wrong and destructive decision of the government; when the Ministry of Finance imposed restrictions that badly affected the Electronic Hardware Technology Park Scheme. Wrong – because the entire industry was penalized for the mistake of one company from the Santa Cruz Export Processing Zone which breached condition. Destructive – because a very good scheme to promote Hardware segment on the pattern of Hong Kong and Singapore was derailed.53

On the other hand, the software firms are mainly dependent on exports for selling their products. The software industry has to continuously undergo innovation in the face of rapidly changing technology if it has to compete for
patent rights at an equal pace. The domestic market, though also flourishing due to rapid computerization, is catered to by the ready-made software manufacturers (usually large MNCs like Sun, Microsoft etc.). Application software, specifically designed, do not have substantial demand from Indian buyers.

**IT – BASE FOR THE CAPABILITIES OF THE INDIAN YOUTH**

It is widely believed that key to the success of the Indian software exports is the supply of trained, low cost software professionals. By the late 1980s, India was graduating a large number of English-speaking engineers and science graduates whose services were in lesser demand from rest of the sectors of Indian economy. This batch was lucky in the sense that around the same time Information Technology revolution was sparked in developed nations. These developed countries were facing shortage of skilled programmers and IT professionals. Texas Instruments, started its operations in India in 1985 and seeing the potential set up its own infrastructure in India. Its remarkable success in leading edge work motivated other companies to set up their units in India, particularly in Bangalore. Motorola was one of such companies whose Bangalore unit attained the highest possible quality rating for software processes of Capability Maturity Model (CMM) Level 5; in 1992, only one other centre in the world (IBM) achieved a similar rating. This success of Motorola opened floodgates for software work in India. This provided a good employment opportunity at home. Simultaneously, batches of Indians working abroad in the field of IT were earning in dollars which compared domestically was quite high. At the same time Indians with their low appetite in terms of salary were easily affordable by foreign firms as they had to pay much higher to locals what was being offered to Indians. These high returns attracted people to choose IT as career which ultimately was a good chance for the Education/Training segment to grow.
Finally, India’s comparative advantage in the software industry, generated from its relative abundance of qualified software engineers can only be termed as the beginning of growth of the Indian IT industry. This was just one aspect signaling the growth of this industry which also demanded strong support from the government in terms of framing policies enabling to build infrastructure. Telecommunications, one of the vital components of Information Technology also required special attention from the government. This sector’s need of the time was to build improved communications infrastructure; obviously backed by favourable policies from the government. Thus, setting up of improved infrastructure cannot be simply viewed as opening up of new avenues from employment but in the long-term this step would to play an important role in the growth and development of the Indian IT industry. The instant results of such a change would be to improve business from software exports.

In early 1990s the major share of revenues of Software segment came in from exports which itself was acknowledgment of the strong base of English-speaking software professionals in India. The unbeatable combination of quality software at low cost was one of the biggest reasons behind global demand for Indian software professionals. And to the satisfaction of the nation this strong battery of software professionals has carved out very fine reputation in the world market. At the same time adoption of international software quality standards helped India to gain dominant position at global level.
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