A Study of the Performance of the Indian IT Sector

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Chapter 1: Introduction

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There is a tide in the affairs of men,

Which, taken at the flood, leads on to fortune; - Julius Caesar Act Four, Scene III, line 217 – William Shakespeare

1.1 Preamble

The Electronics industry in India is poised at a stage "which taken at the flood" could "lead on to fortune." For this the growth of the sector has to be sustainable – which means that the resource capital (natural resources, human, and finance) required has to be nurtured and maintained.

The Electronics Industry has emerged as the fastest growing segment of Indian industry both in terms of production and exports. During the Eighth $Plan^{\dagger}$ (1992-97), the electronics industry achieved a cumulative annual growth of 20% in production and over 40% in exports. The targeted growth in production and exports at the end of the Ninth Plan (1997-2002) is 37% and 52%¹ respectively.

The overall production base of the Indian electronics industry is widely distributed across various segments. There are more than 3500 units engaged in electronics production which include about 600 large / medium units in the organized private sector and about 2900 units in the small-scale sector. The total direct manpower employed in the Indian electronics industry is about 5,00,000.

Traditionally considered and categorized as a clean, non-polluting sector, it is increasingly becoming clear that this rapidly expanding sector is polluting and has significant environment, health and safety issues.

The electronics industry is very vast and diverse and comprises (I) the supply side i.e, hardware such as consumer electronics, industrial electronics, computers, communication and broadcast equipment, strategic (defense) electronics, components; (II) the demand

[†] The Government of India's planning exercise is carried out through development and implementation of a Plan every five years called the Five-Year Plan. Since the origin of this planning exercise nine plans have been developed. The country is presently in the Ninth Five Year Plan (also called Ninth Plan) developed in 1997 for the period 1997-2002. A National Level Planning Commission at the Centre carries out the planning exercise.

side i.e, informatics applications in all economic sectors, information service industries, electronic publishing, broadcasting, and management information systems.

The Consumer Electronics sector has been a leading catalyst for Indian electronics industry, contributing about 37% of the total electronics hardware production. India also has a well - developed electronic components industry catering to the requirements of consumer electronics, telecom, defense and information technology. The production of Electronic Components in the year 1998-99 represented a growth of 14% over 1997-98.

In the last decade the "visible" part of the electronics industry has been the Information Technology (IT) industry. The IT industry is constituted by the hardware "backbone" from the electronics industry and a very meteorically rising segment - the software industry. In the last 5-6 years the sector has seen a tremendous growth and is increasingly occupying a niche position in the global IT marketplace.

Some interesting insights into the IT industry² indicate the significant impact the industry has and is likely to have on the economic and social structure of the country.

- The IT industry clocked a turnover of US \$ 9.6 Billion in 1999-2000 a growth of over 30% over 1998-99.
- The sales of personal computers in 1999-2000 were 1.5 Million Units and the market is growing at 50% per annum.
- The Indian computer industry has been recording an impressive annual growth rate of over 30% during the past few years. This trend is expected to continue for the next three to five years.

The IT industry has the potential to become an engine of growth for all sectors of the economy. In order to ensure that this economic growth is consistent, its sustainability must be ensured. The present report proposes to examine the various issues – environmental, health, safety, labor and community related – that need to be considered to ensure this sustainability.

The IT industry is very diverse in its operations and the associated environmental and social issues are heterogeneous. To lend focus to the present study, the central theme selected for this report is the computer industry, given the phenomenal and far-reaching economic and social impact that it has had and is likely to continue to have in India. For the purpose of this report therefore the generic term "IT industry" will be used while discussing the computer industry. Where it is felt necessary, for the sake of completeness, relevant sub-sectors of the IT industry will be included in the discussion.

1.2 Basis of the Report

This report has been prepared based on information collected using a multi-pronged approach.

Review of trade literature, and web-based resources was supplemented by a field visit to Bangalore. Telephonic, email and personal interviews were carried out with representatives of multinational IT companies, the large domestic players, government (State and Central) officials, industry associations and academics.

Bangalore was selected for the field visit due to its premier position in the Indian IT industry – often referred as the Silicon Valley equivalent in India. Moreover all the large market players, MNCs and domestic have a strong presence here.

Information on the IT industry in other states was obtained from trade magazines, web sites of the respective State governments and discussions with industry and government representatives.

The entire study (field-work and preparation of this report) was carried out over a period of two months.

1.3 Structure and Content of the Report

The report begins with a Preamble on the status of the electronics industry in India in terms of its contribution to the Indian economy. The Preamble goes on to explain the focus of the present report, which is the IT industry, a very rapidly expanding sector of the electronics industry.

This sets the stage for the rest of the report which is structured to enable an understanding of the environmental, health, safety and social issues associated with the IT industry in India, including the relevant existing and emerging policies and regulatory framework. Based on this understanding, recommendations are derived for policy and governance to ensure accountability and environmental and social responsibility of the sector thus enabling sustainable growth of this industry.

Chapter 2.0 presents a background of the IT industry in terms of its evolution, structure, growth and significance to the Indian economy.

Given the spectacular growth of the industry Chapter 3.0 presents a situation analysis of the environmental, health, and labor issues associated with the industry and how they are managed today. This chapter also briefly discusses the social impact of the IT industry in India.

Chapter 4.0 discusses the existing and emerging environmental and labor regulatory framework in the country.

The report concludes with Chapter 5.0 where, based on the findings of the present study, policy and governance related recommendations are provided to ensure accountability and environmental and social responsibility of the sector.

Annexed to this report (as Annex 1) are gists of the interviews (email and personal interviews) that were carried out as part of the present study.

Endnotes

¹ Source of this data is the Ministry of Information Technology, Government of India's website at <u>http://itfriend.mit.gov.in/advantage.htm</u>

² This data was obtained from the web site of the Manufacturers' Association for Information Technology (MAIT) <u>http://www.mait.com</u> and from an email interview with Mr. Vinnie Mehta, Director, MAIT.

Chapter 2: The Indian IT Industry – Structure and Development

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2.1 Evolution of the IT industry

The global perception of the IT industry in India has typically been "software." Interestingly, a review of the industry statistics show that in 1990-91, hardware accounted for nearly 50% of total IT revenues while software's share was 22%. The scenario changed by 1994-95, with hardware share falling to 38% and software's share rising to 41%. This shift in the IT industry began with liberalization, and the opening up of Indian markets together with which there was a change in India's import policies vis-à-vis hardware leading to substitution of domestically produced hardware by imports.

Since the early 1990s, the software industry has been growing at a compound annual growth rate of over 46%. Taking cognizance of the growth of the IT industry (with a presence of over 1,000 Indian and Multinational players)¹ and the increasing dependency on imports for supportive hardware, the Government of India has set forth policy initiatives to provide an impetus to the growth of the hardware sector (both domestic and export), in its recent Annual Budget (2000-2001).

2.1.1 From Nehru to the 1980s

To understand the evolution of the IT industry it would be interesting to trace its development from Nehruvian times. In the post independence era, India was geared towards a program of self-reliance and internalization of production. Leaders like Nehru envisaged a move from labor intensive industrialization to more capital- intensive and mechanized systems of production. Associated with this was the development of the public sector as the predominant provider of utilities and basic infrastructure. Industrial research in hardware and software R&D did not receive government support. Rather, fundamental research was almost exclusively restricted to state run laboratories and defense establishments, with limited diffusion of results into the market.

The electronics industry, till the mid-60s was monopolized by select multinational companies such as IBM and ICL and until the mid-1970s they were the largest providers of hardware in India. The strategic importance of indigenous electronics development

was only understood in the aftermath of the two wars with Pakistan. The Department of Electronics, implemented policies to foster the hardware industry. High import duties, qotas and licensing requirements were used to protect it from foreign competition. Greater restrictions were imposed on the hardware industry in the late 1970s and early 1980s to protect the domestic hardware industry further from sale of second hand hardware bought for training professionals in India. This did not strengthen the industry. It however led to significant benefits for the public sector organization Electronics Corporation of India Limited (ECIL), which was the first electronics manufacturing and R&D establishment in India. The objective of establishing ECIL was for it to be the sole supplier of indigenously manufactured mini computers, a monopoly strengthened by Government policies that resisted the entry of private or transnational entry into this market.

The result was a poor market, with low supply and highly priced products (with a cost differential of at least five times vis-à-vis contemporary imported products!). A "panel on minicomputers" instituted in 1972 asserted that minicomputer manufacture could indeed be achieved without foreign collaboration. This seems to have resulted in "..curtailing the ability of Indian firms to join technology or marketing ventures with foreign collaborators in order to disperse high R&D costs or high investments in overseas marketing².."

Technology development remained stunted, to the extent that, by the mid 70s, "...India's technology gap was estimated at atleast eight years", though this was subsequently narrowed by renewed thrust toward technology development.

Till 1977, legislation "..*proved inadequate to establish technological capabilities in entrant firms*.."², while a restrictive industrial policy curbed access to technology, slowed market penetration and virtually eliminated competition. Indian products managed to achieve compatibility with global component standardization in the 1980s. In fact until the mid-1980s, India's development strategy was characterized by import substitution policies aimed at nurturing the domestic industry, including computer hardware and software. These included ..."quantitative restrictions and high tariffs on imports, elaborate import licensing procedures, export subsidies, controls on foreign direct investment and an overvalued exchange rate...³" In fact in 1984 there were only a few strong domestic computer companies including HCL and Wipro. It was also during the mid to late 1980s that computer firms shifted focus from mainframe computers (the mainstay of multinational corporations) to personal computers.

In the 1990s, the market thrived through import and local assembly, of components manufactured offshore. The old anthem of self-reliance through internalization of production has now been replaced by a focus on the "..*technological development of strategic industry*..³" The much criticized industrial policies are today credited with the development of the human resources necessary for the growth of the IT sector. An interesting point to note here is that the protectionist policies towards the domestic hardware industry forced computer firms to shift focus from mainframes towards producing and using personal computers (PCs), as discussed above. This led to a

generation of software engineers who gained experience in programming for PCs. The high skill levels however have focussed primarily on the software sector of the IT industry.

2.1.2 Locational preferences of the IT industry

Although Bangalore is today considered India's "Silicon City" the industry originated in Mumbai as described in a study by Heeks⁴. The business district of Nariman Point Mumbai was the site of origin of the Indian software industry in the late 1970s. Rise in prices and commute times led to the industry moving to the Santa Cruz Electronics Export Processing Zone (SEEPZ) in the city's western suburbs. Till the mid-1980s Mumbai continued to be the centre of the software industry. The Indian software industry, that started in Mumbai, is thus more than twenty years old, but it was only in the mid-1980s that India's presence in the global software services market became visible.

During this period, the industry migrated to Bangalore due to a decline in availability of technically skilled labor (the vital element in this sector). This was triggered by high prices, poor quality of life and the overseas brain drain from Mumbai.

Bangalore provided the industry (both local firms and foreign investors) abundant technically skilled labor drawn from its research laboratories and technical educational institutions such as Indian Institute of Science, Indian Institute of Management and the various engineering colleges. Electronics industry (particularly defense electronics) has had, since Nehruvian times, a strong presence in Bangalore for strategic reasons. Public sector firms such as Bharat Electricals Limited became key sources of both IT industry employees and entrepreneurs.

The superior quality of life in terms of weather, dust free environment, better infrastructure in the mid 1980s (water and power) the social fabric, combined with a comparative absence of communal and labor relations strife (that troubled Mumbai) led to movement of IT companies and workers to Bangalore.

Probably the turning point in the history of the IT industry's locational decision in India was the establishment of the US company Texas Instruments' (TI) design centre in Bangalore. TI established its subsidiary in Bangalore in 1986 and was the first offshore software facility using high-speed satellite links for communication. This event led to what Heeks⁴ describes as a "snowball effect" and Bangalore became an IT software hub with Indian and International companies clustering in and around Bangalore. Today, most of the top international computer and software companies (HP, Digital, Compaq, IBM, Intel etc.) have wholly owned subsidiaries or joint ventures with Indian companies based in Bangalore. The large Indian companies such as Infosys, Wipro, etc. are also headquartered in Bangalore.

Figure 2.1 presents a map of India showing the locations of Mumbai (where the IT industry began) and Bangalore (considered the Silicon city of India). An emerging IT centre and a strong contender to Bangalore's premier position is the city of Hyderabad, which is also indicated on the map.



Figure 2.1: Map of India showing Mumbai (where the IT industry began), Bangalore (which is the IT Centre today) and Hyderabad (a strong contender for the premier position in the Indian IT industry)

2.1.3 Indian IT industry in the 1990s

The IT industry with a turnover of US \$ 9.6 Billion [Hardware Domestic: US \$ 4 Billion; Software Exports: US \$ 3.9 Billion (Over 10% of Total Indian Exports) and Software Domestic: US \$ 1.7 Billion]¹ has had a tremendous impact on every facet of India's development - the Indian economy, commerce, the education system, and the direction of growth of technical skills. India crossed the one million mark in computer installations with a new computer being installed every two minutes in 1998. At this growth rate, India, which had only 100 computers before 1970 (many of them being mainframe computers), was predicted to have five million computers (a large number of them likely to be personal computers) before 2000⁵.

A more recent survey by the National Association of Software and Service Companies (NASSCOM)⁶ estimates that the installed base of personal computers in India would

zoom from 4.3 million as on March 31st 2000 to 20 million by 2008⁷ while the number of Internet users would expand to 100 million by 2008 from the current base of 4 million.

The turnover of the Indian software industry rose from US\$ 10 million in 1985, to approximately \$835 million in 1995, according to estimates made by NASSCOM. Although these figures are low by global standards, the industry's average annual rate of growth between 1992 and 1997 has been 46 %, with exports growing much faster than domestic sales.

In 1998-99, the software industry in India was worth US\$ 3.9 billion, and if the value of in-house development that takes place at many large commercial / corporate end-users is added in, then the total software industry is close to US \$ 4.6 billion. Ten years ago, the software industry in India was not more than US \$ 150 million⁸.

In 1998-99, more than 203 out of the Fortune 1000, that's nearly one in five, outsourced their software requirements to India. US customers bought almost 61% of the software that Indian companies exported to 91 countries around the world.

A recent World Bank Survey ranked India as number one in the preference list of US vendors for offshore software development. The Government has identified this as a thrust sector, both for export as well as for the domestic market, with such proactive measures as The Amendment of Indian Copyright Act, reduction of import duty on hardware in subsequent budgets, incentive schemes like software parks, etc.

Despite these high growth rates, India's share in the world software product market is still very low, but India still enjoys an advantage over many other nations in software development, services and exports. This is due to the fact that India possesses the world's second largest pool of scientific manpower which is also English speaking. Coupled with the fact that the quality of Indian software is extremely good with relatively low cost, it provides India a very good opportunity in the world market.

The Indian computer hardware industry grew from USD 1370 million in 1995-96 to an estimated USD 1912 million during 1996-97 reflecting an annual growth of 40%. This industry is targeted to reach USD 7,830 million by 2001.

This meteoric rise and growth of the IT industry has spawned "Silicon" metros such as Bangalore, Hyderabad, Mumbai, Pune, Chennai, and Thiruvananthapuram. This has had significant socio-economic impacts. In addition, smaller cities like Bhubaneshwar in the East, Pondicherry in the South and Girgaun and Perwanoo in the North are slowly finding their place on the IT map.

Government of India has identified the IT industry (specifically software) as its thrust area; has created a new ministry at the Centre – the Ministry of Information and Technology with a Cabinet Minister and, has released the IT Policy which provides tremendous incentives to develop the industry. IT policies are also being drafted at the State level by Andhra Pradesh, Karnataka, Goa, Orissa, Maharashtra, Gujarat, Tamil Nadu, West Bengal, Kerala, Uttar Pradesh, Punjab, Delhi, Rajasthan and Himachal Pradesh. Some States viz., Karnataka and Andhra Pradesh in Southern India, Maharashtra and Rajasthan in Western India have also established independent Department of Information Technology.

Having discussed the evolution of the IT industry to its present form, the next section will focus on understanding the structure and focus of this established IT industry.

2.2 Structure, Focus and Growth of the IT industry

An overview of the Indian IT Industry by Manufacturers' Association of Information Technology (MAIT) presented the following structure:

Hardware: Computers (PCs and notebooks), servers, motherboards, power supplies, monitors, keyboards, printers, networking products and add-on cards.

Software: Offshore development, products and technical support.

Training: Training material, multimedia computer based tools (CBTs).

Service: Maintenance, IT enabled Services

A schematic presentation of the structure of the IT industry is shown in Figure 2.2. For the purpose of this report, the Indian IT industry is broadly categorized into software and hardware, as shown in Figure 2.2. While software encompasses products for a whole host of applications, hardware as described above cannot be compartmentalized to include only computing hardware. Related sectors such as telecom hardware, manufacture of Printed Circuit Boards, Semi-conductors, and other electronic components are also encompassed in structure of the IT hardware industry.

In this report while greater focus is on the computer hardware and software sectors of the IT industry, it is proposed to briefly touch upon, where relevant, related sectors such as the manufacture of printed circuit boards, and accessories such as power systems, and power cords, given the environmental, health and safety issues associated with their manufacturing operations.

The focus areas of the Indian IT industry as described by the Manufacturers' Association for Information Technology (MAIT)⁹ include: (I) software - exports and domestic (II) hardware - domestic and (III) maintenance services of hardware and software and other associated services.



Figure 2.2 Structure of the Indian IT Industry

The IT industry's contribution to the Indian economy has been phenomenal in the last few years. Exports of the IT industry grew at the rate of 36% (in rupee terms) in 1999-2000. The sector thus contributed 15% to the country's export earnings during the last (1999-2000) fiscal year vis-à-vis 12.4% in 1998-99. 100% growth was seen in computer hardware exports in 1999-2000. India exported software and services worth INR 173.00 billion thereby registering a growth of over 38% in rupee terms. The software industry also constitutes around 35% of the Indian exports and 7.5% of the GDP.^{10, 15}

Figure 2.3 traces the growth of the Indian IT industry over the last five years.

As seen from Figure 2.3, the IT industry has grown by over 300% in the last five years. The production of the software industry is above US\$ 5.6 Billion and that of the hardware industry and related services industry is approx. US\$ 3.5 Billion in 1999-2000. Major portion of the software production (US\$ 3.5 Billion) was exported in 1999-2000. Hardware exports are not significant¹⁵.

In India, IT spending as a percentage to GDP is currently less than 1% compared to the USA, where the figure is more than 3.5%. However, with Government of India's resolve to increase IT spending - it is predicted that by 2003, India's IT spending could be 2.5% of its GDP¹⁵. Government has conventionally been recognized a key driver of domestic IT demand in India and even around the world. For example, in USA, about 23% of total domestic IT spending is derived from government and public sector units. However, in

the year1998-99, in India, Government spending constituted more than 28% of total IT spending.



Figure 2.3 Growth of the Indian IT industry from 1994-95 to 1999-2000 (projected)¹⁵

Source: Data has been obtained from - The Indian IT industry, NASSCOM

The fiscal year 1998-99 was characterised by the Indian economy going through its worst phase (% growth of GDP was 5.8% in 1998-99 vis-à-vis 7.8% in 1996-97); industrial growth reached a low (index of industrial production was 4% in 1998-99 dropping from 6.6% in 1997-98); exports growth declined considerably over the previous year registering -1.1% in 1998-99 from 1.6% in 1997-98. The IT industry however showed only a marginal fall in the annual growth rate from 18% in 1997-98 to 17.8% in 1998-99 indicating the sustaining power of the industry¹¹.

2.2.1 Software industry in India

Software can be in the form of operating systems (basic software controls of the operations of the computer), application tools (software tools that supports specific applications) and application solutions (software instructions that enable a computer to perform specific tasks of interest to the end user).¹² This software is either available in a packaged form or customized.

Structure of the Indian software industry

Drawing from the model proposed by Heeks¹³ showing the five strategic positions that could be taken by developing country software enterprises, India's software industry can be categorized predominantly in position A i.e., export services (see Figure 2.4). The B and C position are still very prominently occupied by the international players particularly the United States.

Till almost 1995, the bulk of Indian software exports have been in the form of professional services with majority of software exports being classified as "projects" or "professional services". Studies showed that in 1997-98, 95% of the exports from India were in the form of software services⁵. Even today the Indian software industry is very much a provider of professional software services, where custom services are the primary function.

India's competitive advantage in the software business has been its cost-effectiveness, world-class quality, high reliability, and rapid delivery. Of the top 300 software companies 145 have ISO 9001 and 70 are in the pipeline; 41 companies are SEI-CMM certified and of the 21 companies world-wide with Level 5, thirteen are in India.¹



Figure 2.4 Strategic Positioning for Developing Country Software Enterprises

(Source: Heeks, R. 1999. Software Strategies in Developing Countries. Development Informatics Working Paper Series. Institute for Development Policy and Management, University of Manchester, UK. <u>http://www.man.ac.uk/idpm/idpm_dp.htm#devinf_wp</u>)

Trends in the Indian software industry

This competitive advantage was responsible for India being one of the earliest players in the global software market. The software outsourcing arrangements in the early 70's required import of programmers to work on the client site in the US on a regularly billed basis since the American firms did not want to risk outsourcing higher in the value chain activities like design³. This was also triggered by the severe shortage in the supply of programmers and software developers in the American software industry. This practice called "body shopping" though still prevalent, is slowing down (the reasons for this are discussed in greater detail in Chapter 3).

In 1988, the percentage of on-site software development was almost as high as 90%. Body-shopping or on-site services have declined significantly but they still account for over 60% of industry revenues.

Around the late 1980s global markets (primarily the US) began to recognize that there were possibilities available for offshore¹⁴ software development in India. Leading multinational IT companies like Texas Instruments set up offshore software development centers and R&D laboratories. Over the last few years HP, IBM, Intel, Apple, SUN, Oracle, Microsoft and many other US companies have set up offshore software development centers where software teams in India and their US counterparts work in close conjunction on various aspects of software development. Not only cost but also productivity, quality and technology governed these decisions.

Recently however, the shift towards off shore project development has been more marked. This has also begun to include offshore package development. The offshore component is expected to increase further with the improvement in infrastructure, communications services, liberalization in economic policy and because of visa restrictions in the United States and Europe. During 1999-2000, the offshore component was expected to increase to about 45% of total software exports.

An examination of the type of activities in the software industry shows a distinct difference between the domestic and export market. Figure 2.5 presents a segment-wise break-up of the activities in the domestic and export market for the year 1998-99¹⁵.



Figure 2.5 Segment-wise breakup of the software market for the year 1998-99¹⁵

The figure shows that close to 45% of software exports are in the category professional services and 35% in the area of projects (consultancy). Products and packages form a very small segment of the export market. As the PC revolution spreads there would be a greater demand for packages and products that can be bought off the shelf. It is therefore important for the sustainability of the Indian software industry to focus on products and

packages for the export market as well i.e., according to Heeks's model (see Figure 2.4) a move from position A to B / C.

One of the main issues associated with products and packages is that of "copyright piracy" (see Box 2.1 for some facts on piracy).

Box 2.1 Some facts on software piracy

A survey of the software industry in 1997-98, by NASSCOM, indicated that in general the developed nations have lower rates of piracy vis-à-vis the developing nations. However, in absolute terms the level of piracy in software in the developed countries will be higher because of the larger size of the computer market.

In the Asia-Pacific region revenue losses from software piracy were estimated at US\$ 3.7 billion in 1996 out of which Japan's contributions was US\$1.2 billion. Vietnam and Indonesia had the highest piracy rate at 99% and 97% respectively followed by China at 96% and Korea at 70%. India was in a better position with a piracy rate at 60%. *Piracy rate is defined as the amount of software pirated as a percentage of total software installed in each country*. The piracy estimate is arrived at by taking the difference between software application installed (demand) and software applications legally shipped (supply).

In India NASSCOM is working to combat computer software piracy. Besides, promoting the concept and advantages of using legalized software, NASSCOM is actively involved in educating the end users, as well as law enforcing authorities. Where necessary NASSCOM also assists the local police force in conducting raids on premises of illegal software sellers.

The grey market which has a large market share in selling computer hardware is a very major source of promotion of pirated software. On demand, the grey market vendors provide the necessary software on CD-ROM with Multimedia Kit virtually at throwaway price. Such vendors can be seen at prominent business centres in the big cities. In Delhi, NASSCOM made visits to specific grey market vendors. The price quoted for the software being provided with hardware was lower than about one-tenth of the price of the original packaged product. Estimates by NASSCOM indicated that the total value of illegal application software accounted for about 44 % of the total domestic software market in 1996-97.

The main reason of software piracy appears to be the large difference in price of the original software visa-vis the pirated software. With technological development, copying the packaged software into a CD-ROM has been an easy and inexpensive proposition. The counterfeiting of software in India is virtually negligible as compared to other developing countries of Asia.

Apart from the problems of software piracy, marketing of packaged software is extremely resource intensive. Indian companies would find the market tough to penetrate given the lead that many of the well established international companies such as Microsoft and Oracle already have in the market. For the domestic market however, close to 50% of software revenues are generated from products and packages, about 28% from turnkey projects and less than 5% from professional services. Thus there is a distinct difference in the focus of revenue generation in the exports and domestic market. While products and packages dominate the domestic market, professional services are the main revenue generators in the export market. Projects however contribute to revenue on both fronts.

According to a recent analysis¹⁵ of the sector by the management consulting company McKinsey & Co., India is best positioned to offer competitive cross-border IT services and enterprise IT solutions scoring high on multiple parameters of vendor sophistication as well as people sophistication.

A potentially high growth area for the Indian IT industry is IT enabled services.¹⁶ ITenabled services do not include remote production or manufacturing units; the local branches of global businesses; or businesses on the Internet.

Companies, such as Bechtel, GE Capital, British Airways and many others are already benefiting from IT-enabled services provided from India. Bechtel has set up its own engineering design subsidiary in New Delhi. Over 500 employees in this subsidiary provide engineering design services to Bechtel customers over telecom and data networks. The benefits for Bechtel are twofold: (I) the company's transaction and salary costs are greatly reduced; and (II) it can now cover customers in different time zones.

Other organizations obtaining IT-enabled services are US Hospitals, which obtain medical transcriptions services from Bangalore, the software technology park in Thiruvananthapuram etc.

According to McKinsey & Co., IT-enabled services are expected to grow 15-fold by 2008, providing vast opportunities for Indian players. India offers many advantages to serving as an IT Enabled Services destination for major global companies These include¹¹:

- A virtual 12-hour time zone difference with USA and other major markets for IT Enabled Services;
- A huge pool of English speaking and computer literate graduate manpower who can continue to cater to the growing demand for professionals for IT Enabled Services. These professionals are skilled as well as quality conscious;
- Cost of qualified personnel is amongst the lowest in the world;
- Stable legislative and economic framework;
- Support of Government of India for all IT led industries.

The proliferation of IT Enabled Services and its continuing demand-led growth may well emerge to be a strong opportunity for India, both in terms of generating employment and export.

As per a survey done by NASSCOM, IT Enabled Services can generate the following amount of revenue and employment for India in the next ten years¹⁵.

Year 1999		Year 2008 (Projections)	
Employed	INR (billion)	Can be employed	INR (billion)
41,000	2,0.30 (~US\$ 0.45 billion) [*]	11,00,000	810 (~US \$ 18 billion)

Government of India is providing extensive support to facilitate supportive infrastructure for proliferation of IT Enabled Services throughout the country. In fact, stress is being laid on developing suitable infrastructure in 'non-software' cities. Industry observers have noted that hi-tech industries flourish essentially in the rural hinterland adjacent to the cities with modern telecom and communication infrastructure and top class hi-tech educational/research institute. The state of Andhra Pradesh was one of the first States to announce a special policy for IT Enabled Services industries. Among other incentives, the State Government has provided land at concessional rates. The States of Karnataka, Tamilnadu, Maharashtra, Rajasthan, Goa, Gujarat and Orissa also have announced special fiscal and policy incentives to promote IT enabled services.

Market for the Indian software industry

Export of Indian software, until the mid-1970s was mainly to Eastern Europe. In the early 1980s the scenario changed with the United States taking over as the main export market with 75% of the Indian exports geared to that market. This was because of (i) the sheer size of the United States market for software, which is much larger than any other market, as well as (ii) the long history of Indian engineers and computer personnel working in the United States. Some of them came back to India to set up their own companies but maintained their contacts in the United States and were able to use these to penetrate the market. Indians who worked for large American IT multinationals also played a role in attracting attention to the software development work that was being done in India and to the level of skill and expertise. Furthermore, India enjoys an advantage in English, the main language used in the development of software.

The break down of markets for India's software exports in 1994-95 and in 1998-99 is shown in Figure 2.6 A and B respectively.^{9,13}

^{* 1}US\$ = INR 45





As seen from figure 2.6, the United States continues to be the main export market with 60% total software exports from India. Market opportunities in Japan, South Africa, Canada, France and Middle East were discovered. Efforts were made in 1996-97 to penetrate the Japanese and European market. This was through (i) formation of a consortium of software companies to Japan and (ii) a Software Services Support & Education Centre (3SE), in Bangalore by the European Commission and the Indian Government to promote software ventures and projects between European and Indian companies.

NASSCOM states that the six OECD countries (U.S.A, Japan, U.K., Germany, France and Italy) together have almost 71% of the market share of the worldwide software market and India's exports to these countries is also almost 79% of its total software exports.

Growth of the software industry

The growth rate of the Indian software sector is substantially higher than the global software industry growth rates, which are between 15-18%. In fact India was the only country to register software industry growth rates in the order of magnitude of between 40-50% between 1990 and 1995. The domestic market has been growing at a Compounded Annual Growth Rate (CAGR) of 38% since 1990-91, but achieved significantly higher growth rates of 42% in 1993-94 and 55% in 1994-95. In the period 1994-1999, the Indian IT Industry has recorded a CAGR of more than 40.5% which is almost double the growth rate of the IT Industry in many of the developed countries¹⁵.

Software continues to contribute a major portion of Indian IT Industry's revenues. During the year 1998-99, the Indian software industry's revenues constituted almost 65% of Indian IT industry's revenues.

The future of the Indian software Industry

As on 31 March 1999, the software industry in India employed more than 250,000 people and continues to be amongst the fastest growing sectors in the Indian economy. NASSCOM's study, of the software industry does not indicate any slowdown in the industry. The industry was estimated to grow by more than 50% during 1999-2000. The study indicates that due to increased government spending towards IT in the domestic market, as well as increase in sale of PCs, the domestic software market will fetch revenue in 2000-2001 which, would be almost a record 50% increase in the domestic market.

Predictions and projections for the future of the software industry are very optimistic. It is projected that during the year 2001-02, software industry in India would be close to Rs 55,500 crore. At current level of dollar-rupee parity, this would translate to almost US\$ 13 billion industry in that year.

On the other hand, it is predicted that exports will continue to grow in 2000-2001 with focus on E-Commerce, IT Enabled Service, Euro and ERP. Exports during 2000-2001 are expected to continue to grow by almost 50%.

Commenting on the future of the Software industry in India, Prof. Ashok Jhunjhunwala, the Head of the Department of Electrical Engineering, Indian Institute of Technology (IIT) Madras, India and a renowned personality in cutting edge technology in the telecom sector, states¹⁷ "However, having achieved considerable success, most front-running software companies are dissatisfied with their performance. They recognize that they have come up with very few products that they own. Although they may have made significant contributions to many products on the shelves, hardly any carry their brand

names. They are eager to make and own products, but they have little experience in marketing products worldwide. The home market is still too small to allow these products a trial site as well as a little protection, before they could handle fierce competition. **Product ownership is imperative if the Indian software industry is to take a major leap forward**".

2.2.2 Hardware industry in India

The IT hardware industry includes in its ambit computer hardware, telecom hardware, and manufacture of specific electronic components. Given the diversity of operations and the associated environmental and social implications of these sectors for the purpose of this report the focus will be maintained on computer hardware and the associated electronic component manufacture.

Computer hardware comprises: data processing equipment (computers), peripherals and networking products. The computer systems being manufactured in India comprise desktop personal computers, workstations and servers. It must be noted here that *"manufacture,"* in the context of the Indian computer hardware industry, refers to assembly of primarily imported components. Today in India, the hardware sector primarily assembles computers and peripherals with imported components using an indigenous skilled, technical labor force. The locally manufactured computers cater to low-end applications while imported computers continue to facilitate CAD, CAM, multimedia, and other high-end applications.

Computer manufacture in India

The International Data Corporation (IDC) estimates that of the 844,550 PCs sold in India in 1998-99, more than 50% were assembled locally with imported components and the rest were fully imported. Not one machine was fully made locally. MNCs such as Compaq and HP who have manufacturing facilities at Bangalore and Pondicherry source their components from specific international vendors selected based on the corporate vendor sourcing policy. Outsourcing of all components, including the shell, is also done by domestic manufacturers like Wipro (manufacturing at Pondicherry) and Zenith (manufacturing at Goa), usually from Taiwan. At the manufacturing facilities in India these companies, carry out quality checks, assemble the components and package the machines. Power cords and packaging material is very often sourced from the domestic market (*see Interview with Compaq – Annex 1*).

The PC segment in India is supplied by four kinds of manufacturers:

- Multinational brands like Hewlett Packard and Compaq
- Indian brands like Wipro, Zenith and HCL
- Branded assemblers and
- Unbranded assemblers (very often referred to as "grey market"¹⁸)

The distribution of the PC market among the various manufacturers, is shown in Figure 2.7.



Figure 2.7 The distribution of the PC market in India among the various producers in September 1999. Source: IT Industry Performance Mid-Year Review¹⁹ 1999-2000, MAIT, New Delhi January 21, 2000.

The statistics in Figure 2.7 show that the unbranded assemblers have the majority share in the PC market. The market share of assembled PCs - including smaller lesser known regional brands and unbranded has increased since September 1998. As a result, the market share of Indian brands and MNC brands reduced from 23% and 29% in 1998 to 21% and 22% in 1999, respectively.

The growth of the assembled PC market has been spurred by restrictive import duties on complete systems, and not on components which has led to import of components being cheaper than complete systems. The assemblers are therefore able to provide the PCs at a lower price to the consumer. Growth of the organized sector is being determined therefore purely on the basis of cost.

Given the intent of the Government of India to increase PC penetration in the country, the demand for PCs would escalate. A market review by the International Data Corporation reported that for the first time in 1999, India had more than a million personal computers (PCs) of shipment. With this, India has emerged as the fourth largest market for PCs in the Asia-Pacific region²⁰. The domestic demand for PCs is expected to increase to 2.1 million units by the year 2000-01²¹.

Increasingly, the home PC market is rising, not only among the more affluent sections of society but also among the not-so- upmarket market homes. The MAIT Mid-Year review for 1999-2000 (April-September)¹⁸ revealed that PCs sold to the business segment grew by 42% while in households it grew by 58% as compared to the same period last year (1998-1999). Within businesses, the smaller sized establishments, i.e. those with under 10 employees at the premise, the PC consumption grew by 57% over the same period last year - a significant improvement in the PC penetration in the smaller sector. The socio-economic class 'B' (the not so up-market households) have increased their share in total purchases to 38% compared with 28%, implying that PCs are finding their way into lesser affluent and not-so-up- market homes as well.

In terms of the configuration, PC shipments in the first half of 1999-2000 are largely Pentium II and III which together account for 64% of sales, thus reflecting the ease of availability of latest technology and also the technology consciousness of the Indian market.

An IDC report in February 2000^{22} based on a study of 23 cities (based on population) plus Bhubaneshwar and Chandigarh observes a geographical bias to growth of the PC enduser in India. Home/ home offices in the northern cities of India and small and medium establishments in the southern cities are the hottest segments and they are poised to witness the maximum growth in 2000, at 105% and 65% respectively.

Moving away from PCs, computer systems have increased in sophistication and variety in the country. Production bases for PCs, minis, super-minis, servers, workstations, mainframes and parallel processing machines are fully established in India.

The Peripherals market

A very integral part of the computer market is the **peripherals** segment. Peripherals being manufactured in India are keyboards, monitors (both colour and monochrome), dot matrix printers, line printers, disk drives, plotters, digitizers, etc. and networking products such as add-on cards, modems, etc.

In printers there appears to be a clear shift from Dot matrix Printers to Ink-jet printers because of its low cost and better printing quality of the latter. A mid-year review of the IT industry's performance for 1999-2000 by MAIT indicated that while the Dot Matrix Printer which accounted for 55% of all printer sales in 1996-97 has dropped to a share of 40%, the sale of inkjet printers has risen from 35% in 1997-98, to estimated sales of 50% for 1999-2000. The superior quality of non-impact printing coupled with the reducing costs especially of Inkjet printers has been responsible for this shift.

The sale of laser printers grew by 47% (although their market share is lower than that of inkjet and dot matrix) and Inkjet by 20% in April-Sept 1999 vis-à-vis April-Sept. 1998.

Associated with the printer market is that of consumables such as printer cartridges (for Inkjet) and toners (for laser printers). Typically they are supplied by the printer

manufacturers. In the last year however there is a slow emergence of toner sand cartridge remanufacturers. High quality, guaranteed, remanufactured cartridges compatible with a number of printers are being produced in the organized sector by very few emerging players. Some players in the unorganized sector - largely the "grey market" – are also producing compatible consumables.

Considering the increased need for connectivity and the related emerging market for products, MAIT's mid-year review for 1999-2000 introduced a new segment on the networking market. The market for NIC (Network Interface Cards), is growing at 10% while that for Hubs and Modems at 10% and at 50% respectively. The household segment accounted for over 30% of the modem sales in the first half of 1999. The high rate of growth in the modems sectors can be attributed to the fast growing internet penetration in the country.

Other peripherals such as Key Boards, Monitors and UPS have grown by 39%, 36% and 20% respectively in April-Sept. 1999 over April-Sept. 1998 according to MAIT's midyear review for 1999-2000.

Overall, while the computer industry's performance has been consistent and positive, it must be noted that the typical volumes in the PC segment are from the unorganized market - a significant proportion of which is "Grey".

At this point in the discussion on the hardware industry it seems timely to obtain a better understanding of the grey market given its omnipresence in the computer industry.

The Grey Market

A large segment of the computer hardware market in India is that of assembled nonbranded PCs (built very often from components sourced through illegal, routes). In tandem with the hardware is the market of unlicensed or smuggled software. All assemblers of PCs cannot be categorized under the term "grey market". Strictly, the term is applicable to only those who do not use components sourced through formal channels. The low end of the grey market is occupied by vendors who use smuggled components, under invoice, or take cash payments from customers and pass on the benefits of excise tax evasion to the customer in the form of lower prices. There is little customer support offered. Legitimate dealers and assemblers would have proof of tax paid, which would be included in the cost of the machine thereby being passed on to the end user. Such firms are differentiated by the level of customer support they provide²³.

Components used by the responsible assemblers are imported as direct imports; the importer typically sells to selected dealers, and does not interact with individual end users as a retailer.

The grey market was reported to be operating largely in cities like Bombay, Bangalore and Calcutta, and increasingly involving components smuggled via Nepal²⁴ from manufacturing facilities in Singapore. In cities like Mumbai, components are sometimes

also sourced at a very low cost from hardware "junk" markets (Bhendi Bazaar in Mumbai has a weekly hardware street market on Friday). The components sold here typically include motherboards, hard disks, and floppy drives. They are recovered from discarded PCs, bought in bulk by weight and sold in the street market. Traders in these markets are usually not very educated and have no idea of what these components cost or whether they are useful or not.

In India, the grey market is estimated to account for anything between 25% and 50% of the total domestic hardware market. According to the MAIT, the grey market operations, as a proportion of the total PC market in India, may soon be one of the highest in the world. The grey market not only affects the viability of PC and PC peripheral manufacturers, but also leads to considerable loss of revenues on account of customs duty, excise duty, sales tax, and octroi for the government. MAIT estimates this loss to be around Rs 1,230 crore in 2000 (~ US\$ 273 million). The grey market share in the Indian PC market was a as high as 76% in 1999.

One study²⁵ of the grey market reports that the goods are typically sold extremely cheaply, often at little more than 10% profit on the ex-factory price (e.g., a brand-new Seagate 540 megabyte hard disk costs little more than US\$200). Intense competition ensures fluctuating prices. The traders primarily make their money on volumes. The estimated turnover, nationwide, of the grey market is believed to be somewhere between US\$200 million and US\$400 million.

A 1996 report in Dataquest²⁶ on the grey market, states that a typical grey market operator will have low overheads, cheap labor, less manpower (3-10 man force), a relatively small domain of operation, select customer base (mostly first time users), and a limited scope of repurchase. The above three points put together establish the economics of operation for the operator.

A large part of the income for the grey market comes from component and peripheral pushing. Electronic components, storage devices, motors, and consumables are easy to bring into the country through unauthorized routes. As the import duty is high, smuggling increases the margins for the operator. Smuggling of higher end units are given better preference as there are volumes to be sold and a price to quote. To smuggle a CPU is highly risky and the numbers do not justify the revenue. With Intel continuously slashing prices by 35-45%, dealing in chips is not feasible either. Low-end Hard Disk Drives and CD drives are non-lucrative due to changing industry standards.

The grey market has virtually no existence in printers due to the price slashing of the industry by the leaders of the non impact category (ink jet / deskjet) of printers. The price parity is so low in that segment that it is not viable.

In the case of software, application software (CD ROMs included), being the driver for the growth of the packaged software market, is the hottest segment for piracy. All the pirates need for duplication is one legal copy at the most. NASSCOM believes that piracy will subsist only in lower-end software, whereas at the higher end, it will cease to exist because of insufficient support facilities.

The main reason of software piracy is the large difference in price of the original software vis-a-vis the pirated software. With technological development copying the packaged software into a CD-ROM has been an easy and inexpensive proposition. The counterfeiting of software in India is virtually negligible as compared to other developing countries of Asia. In India, software is typically copied from one legal copy and installed in different machines. With falling import duties reducing the margin of profits, it is essential for grey market vendors to look at volumes to justify costs. To augment the margins, better value addition needs to be considered through pirated software. Thus it is clear that the traders, assemblers, and small-time operators dominate the grey area.

If the growth of the PC sector is to be sustainable then the organized sector needs to be promoted and the grey market phased out.

The grey market pervades all sectors of the IT industry. Apart from hardware and software even consumables such as printer cartridges and toners are traded in the grey market.

Cartridges and toners are available either as (I) refilled cartridges (II) remanufactured (III) or as spurious replicas of branded consumables²⁷. Refilling is done by an unorganized but not illegal market. The ink is bought from bulk importers who source it from abroad. Quality of ink is not guaranteed and there is no warranty on effect of using this refilled cartridges on printers. The remanufactured / compatible cartridges and toners are produced using the recovered and refurbished bodies of disposed toners / cartridges. There is a formal, organized market that is emerging for remanufacture in India (*see Interview with Lipi Datasystems Ltd. - Annex*). A very informal, illegal market also exists where the body of the cartridges and toners are used, ink/toner refilled and sent back into the market as products of the original companies. This is the real threat to both customers (who would receive poor quality, fake consumables) and producers (whose market share and image suffer).

Why has the grey market grown?

Analysts put the growth of the grey market down to the rise in the spending power of the middle class, coupled with a certain conservative attitude to spending that makes the slashed rates of assembled unbranded machines more attractive. At an average of 20% lower costs for PCs, for instance, the small budget buyer who is merely looking at a one-time purchase for the home or for business purposes, will this option very attractive.

What initiatives are being taken to curb the grey market and promote the organized segment?

<u>Cost restructuring by branded producers:</u> Branded producers are reducing component prices translating this into better cost structures for the end user. In India however, there were little or no embedded production facilities to engender quality production systems. The only way a user could get good solutions was to rely on either expensive trade-offs or opt for the grey products. This happened in part because the market was not mature enough to encourage domestic manufacturing. This scenario is now changing. With the phenomenal growth of the IT sector and the need for reliable, affordable hardware in large volumes, local manufacturing is essential. The advent of affordable technology, reduced cost of manufacturing, a sizeable market to cater to, and a burgeoning vendor demand for domestically manufactured systems, will lead to the growth of the hardware manufacturing in India.

<u>Reduced Duty Structures:</u> Hardware import duties which were at 107% in 1993-94 came down to almost half in 1995-96. At 61% computer system's import duties were well within the competitive pricing structures that the industry would like to have for itself. Further drastic reduction in import duties on components in the 1999-2000 budget and the proactive export-import (EXIM) policy is likely to significantly reduce the grey market.

<u>Vendor Strategies</u>: With the advent of liberalization and the entry of MNCs, differential between Indian and international prices have been minimized. The vendor's distribution strategy of increasing geographical coverage and vendor accessibility across the country is contributing to decline in the grey market. Strategies such as Intel's Genuine Intel Dealer program (*see Interview with Intel – Annex 1*) ensuring aggressive penetration of Intel products into the Indian market, overriding the previously unchallenged monopoly that the unbranded assembled machines segment held. Intel is also continuously slashing prices on chips by 35-45% thus making the grey market non-viable.

<u>Increased End-user Awareness:</u> Just like any other consumer product, the PC was also known more by its brand/model, than its configuration. The reliable service and support combined with the fact that, there was no major price difference between the branded and the unbranded, made it ideal for the corporate user to go for the branded. This trend needs to penetrate into the home and individual PC market as well, which is the largest customer for the grey market!

Computer hardware manufacturing locations

Manufacturing of computer hardware in India is in pockets. It is governed to a large extent by two factors, (i) the tax structure and incentives and (ii) the availability of skilled labor force. Discussion with multinational companies like Compaq (*see Interview with Compaq - Annex 1*) however indicated that for the manufacture of computers, the availability of skilled labor was more important. Hence they opted to carry out their manufacturing activities in Bangalore.

The areas in the country where hardware manufacturing and integration happens are NOIDA (New Okhla Industrial Development Area) and Gurgaon industrial areas (periphery of Delhi), Bangalore and Chennai in the South and Mumbai in Western India.

In the last year or two however a number of multinational and domestic companies such as IBM and Acer, and HCL and Wipro respectively have invested in IT manufacturing facilities in Pondicherry due to the more favourable tax structure and incentives provided by the Government. Incentives are being provided to promote development in industrially backward areas by the Government of India.

Factors responsible for hardware manufacturing largely being "assembly"

As mentioned earlier computer hardware manufacture in India has been restricted to assembling of imported components. While growing volumes of PCs will make manufacturing an attractive proposition for India, the problems encountered are many.

Logistics and the tax structure seem to be the main barriers. Transport strikes, port closures, ships not getting berth to dock, sales tax changes, and import tariff structure. Since importing is cheaper why make things here! For instance in the case of PCs, - the three main components: the motherboard, the processor and the hard disk are not made in India. All these need to be imported.

At this point it may be useful to briefly look at what constitutes electronic component manufacture in India given that there is a large presence of this sector in India. Box 2.2 presents some salient features of the component industry.

Box 2.2 Manufacture of electronic components in India²⁸

The overall production base of the Indian Electronics industry is widely distributed. There are more than 3500 units engaged in electronics production which include 13 central public sector units with 30 manufacturing establishments, over 58 units in state public sector, about 625 units in organized private sector and more than 2800 units in the small scale sector.

Electronic components are the building blocks of the electronics and IT industry. India has a well developed electronic components industry primarily catering to the requirements of consumer electronics, telecom, defense and information technology – but presently not to the computer hardware industry.

The electronic component sector is represented by ELCINA (Electronic Component Industries Association) which is the oldest and largest electronics association in the country established in 1967.

There are about a thousand units manufacturing different types of active and electromechanical components. These range from large and medium units to small scale industries (SSI). There are numerous SSIs (about 80 in the organized sector) in electronics component manufacture. Restructuring within the industry however has led to consolidation and expansion resulting in large units dominating the market share. Capital intensive operations such as manufacture of semi-conductors, are dominated by large units and given the current dynamic market, role of large units is becoming significant in terms of production and export.

Units are distributed fairly evenly across the country barring the north-eastern and eastern regions. Well developed clusters are found in and around Delhi (Okhla, NOIDA, Ghaziabad, Faridabad, Gurgaon and stretching upto Chandigarh and Jaipur), Bangalore, Hyderabad, Pune, and Mumbai. Smaller clusters are in Chennai and Ahmedabad.

The components in production in India today include TV picture tubes (Black and White and Colour), monitor tubes, diodes and transistors, power devices, Integrated Circuits (ICs), hybrid microcircuits, resistors, capacitors (plastic film, electrolytic, tantalum, ceramic), connectors, switches, relays, magnetic heads, DC micro motors and tape deck mechanism, Printed Circuit Boards (PCBs), crystals, loudspeakers and hard and soft ferrites. A number of component units have got ISO 9000 certification.

Components like color picture tubes, monitor tubes, hard ferrites, B&W picture tubes, electrolytic capacitors, PCBs, floppy diskettes, audio and video tapes, among others, are being exported. Over 20% of the components manufactured in India are exported.

India's electronics production is less than 1% of the global production. Estimates by the Electronic Component Industries Association (ELCINA) in India indicate that in 1998-99 when the (i) global electronics / IT production was US\$ 1180 billion Indian production was US\$ 5.65 billion; and (ii) global component production was US\$ 335 billion Indian figures were US\$ 1.21 billion.

The production of electronic components in the year 1998-99 grew by over 14% compared to 1997-98 figures. The export of electronic components during 1998-99 is estimated to be about 15% of the production.

The electronics hardware sector recorded an impressive 27% growth in 1999-2000 after 2 successive years of negative growth. Hardware exports include consumer electronics, electronic components, computer hardware, telecom equipment and office and medical equipment. Electronic components contributed the maximum to total hardware exports during this period growing at 33% over the previous fiscal year.²⁹

Economics of electronic component manufacturing strongly demands export operations since the domestic market is too small. Inverted customs duty structure, poor infrastructure and trade procedural delays are seen as areas where competitors such as China and other South East Asian countries have an edge. While quality, standards and prices are acceptable internationally, operational problems in this highly capital and technology intensive industry remain the major barriers. Government policies for the IT and electronics hardware industry are not favourable. MNCs exploring India as a manufacturing base have also therefore expressed reservations. An IT Action Plan Report (Part II focussing on dynamic policies for hardware industry) has been developed by a task force set up by the Indian Prime Minister in 1998. However no action has been taken yet.

PCBs form a very critical component of the IT industry being the backbone of hardware manufacture for the IT industry. There are about 160 units manufacturing PCBs in the country today of which 76% are SSIs. 15% are large and 9% medium sized units. Majority of the units (38%) are located in the western region with the highest percentage of large units located in the South. 90% of the SSIs are located in the north.

India is an obscure player in the international PCB market producing only US\$ 80 million worth PCBs in a world market of US\$ 25 billion. In the domestic market the Indian PCB industry caters to consumer, industrial, telecom and defense electronics. It serves to a very limited extent the IT and computer sectors, apart from being engaged in manufacturing of boards of about 20-25% for export. **Taiwan currently produces 60% of the motherboard quantum for India.**

With increasing demand for IT hardware it is critical that the Indian PCB industry be promoted. Some of the main barriers to its growth are: lack of infrastructure; extremely high cost of capital serving as a deterrent for domestic industry to modernize; composition of industry owners with poor financial resources. Infrastructure needs to be updated since the capacity of even the largest unit in India is only one-third of the capacity of even the lowest capacity manufacturer in competing countries.

The overriding questions being addressed at the hardware industry in India is: Why are the large multinational IT companies opting to set up manufacturing facilities (from chip fabrication plants to hard disk drive assembly lines) in China? Why do countries like Taiwan and Malaysia have a strong domestic manufacturing base for IT and Why not India?

To put these questions in perspective, a brief look at the scenario in China, Malaysia and other South East Asian countries. Box 2.3 presents some observations on the performance of the hardware industry in these countries.

Box 2.3 Scenario of the hardware industry performance in China and some South East Asian countries²⁰

India's export figures for 1997 and 1998 shows that the exports declined from US\$ 3.25 million (Rs 1.3 billion) in 1997 to US\$ 2.6 million (Rs 1.1 billion) in 1998—less than even 1% of the total exports from India.

In comparison electronic manufacturing exports from Singapore exceeded 52% of the total US\$ 186 billion exports in 1997. Guangdong in China alone contributed US\$ 36 billion worth of electronic exports in the first half of 1998, while in Malaysia electronic hardware exports grew 14% to US\$ 44 billion in 1997.

In terms of investment in the manufacturing sector, foreign investors have shown a preference for other countries particularly China. In 1997, of the ten most significant investments in China, five were in IT totaling up to over US\$ 6 billion; whereas, since liberalization (1991-92) till date (1999-2000) only US\$ 3 million (approximately Rs 1.2 billion) has been invested in Indian IT manufacturing. China's pro-investment policies and encouragement by the government for consumption of locally manufactured IT products has been responsible for the attraction of sizeable investments in IT manufacturing.

Dennis Philbin, Vice President and Managing Director of IDC Asia Pacific in his 1998 study¹⁹ compared the Indian and Chinese markets and arrived at some subtle but significant findings:

- Between 1996 and 2002, IBM would have invested US\$ 2 billion in the Chinese hardware sector, of which US\$ 70 million would have gone in a hard disk drive manufacturing facility. The other investments are in engineering technology and research and development. However, IBM, in a joint venture with the Tatas in India was hesitant to set up a manufacturing base in India.
- Intel is setting up a flash memory manufacturing unit in Shanghai. It will involve an investment of US\$ 198 million and a research centre costing US\$ 50 million.
- NEC is setting up a US\$ 2 billion semiconductor plant in China. Hewlett-Packard is investing US\$ 200 million and Motorola US\$ 1.2 million in China, all in hardware ventures.

The principle reason for these heavy investments, the Philbin study claims, could be the Chinese law that multinationals can sell their computers in the country only if they have a manufacturing base there. Consequently several centres of computer manufacture have sprung up across China and multinational companies have begun huge investments in localizing software. Microsoft is leading the localization endeavor with its Chinese versions of the Windows operating systems.

In Malaysia, according to investment policies a multinational manufacturing company has to partner with a local company.

The insistence on setting up manufacturing base in the country has paid rich dividends to the local Chinese

companies too. Legend, a Chinese hardware company, has become the number one IT company in the country. In the first quarter of 1998 it shipped 420,000 PCs. That figure has put it ahead of IBM, HP and even Compaq.

In India the domestic PC business is slow. The high-end of the market goes to multinational brands. The huge low-end goes to the 'grey market operators' (see Figure 2.8) that comprises people who assemble unbranded PCs from imported parts and sell them at rock bottom prices. As a result, the domestic Indian brand (e.g., Zenith, Wipro etc.) is sandwiched in a narrow space between the foreign brands and the grey market.

In addition the government, which is the single largest buyer of PCs, has been insisting on buying foreign brands. The MAIT had to petition the authorities against mentioning foreign brands in tender notices for purchase of computer hardware.

On the other hand, in China, the government completely supports the local brand. The Philbin study quotes the 34-year-old chief of Legend's PC division, Yang Yuanquing, as saying, "If the quality and price are the same, they (the Chinese government) will buy a domestic brand first."

As seen from Box 2.3, the local hardware industry's strong position has been due to the insistence of the Chinese government on MNCs to set up a manufacturing base in the country and also complete support of the government for the local brand.

Discussions with MAIT³⁰ revealed that hardware manufacturing is not competitive in India due to"numerous bureaucratic and procedural hassles especially those associated with exports and imports. The average turn-around time in the industry is much higher compared to its counterparts in Taiwan, Malaysia, Philippines etc".

Observers³¹ in the hardware industry attribute the skewed tax structure to be largely responsible for this exclusion of India from the manufacturing activity. The taxation policy has consistently moved in a direction that makes trading cheaper than manufacturing! The excise duty on manufacturing is so high that it is significantly cheaper to simply import. That also appears to be the prime mover behind the flourishing grey market. Even large brands like Intel have their most significant partners in the grey market assemblers in India, who, by definition, are 100% importers.

There is very little exports focus in the hardware industry. NASSCOM¹⁴ reports that in 1990-91, hardware accounted for nearly 50% of total IT revenues while software's share was 22%. By 1994-95, hardware share had fallen to 38% while software's share had risen to 41%. This may reflect the changed import policy vis-à-vis hardware imports, which may have led to a substitution of imports for domestically produced hardware. Hardware is, in any case, produced in India for the domestic market, with less than 20% of revenues during the 1990s coming from exports.

MNCs in India have however started investing in assembly of low-end systems. These include IBM, HP, Compaq and Acer. Further, very recently Compaq and HP have announced assembly of high-end server as well. The IT distribution channels in India are well evolved and robust and an estimated over 60% of IT sales happen through this.

Demand for appropriate hardware is increasing given the growth of computerization in various sectors in the country, especially in the financial sector, trade and commerce, health, governance, public services and utilities, etc. More and more on line transaction processing systems are being introduced in the country. New applications like Electronic Data Interchange (EDI), CAD, multimedia, distributed and networked environment, Internet and high performance computing have attracted wider attention. This is thus a sector with high growth potential given the growing demand for hardware.

The focus of the Indian IT industry and the policy makers has always been on the software sector. Growth of the hardware sector has not been accorded the same priority. 45% of the Indian market's component needs are still met through imports! Policy measures such as customs duty of 5-20% on imported components makes it more cost effective to import entire PCs rather than manufacture them locally.

Unstable policies, rigid taxation structures and lack of investment have till date relegated manufacture and development in electronics to the background, overshadowed by India's presence as a strong player in the software industry. A gradual recognition has developed of the need to promote indigenous manufacture, if India is to achieve a stronger position in an IT market still monopolized by MNCs. This has led to the structuring of a comprehensive IT policy, that focuses individually on the software and hardware sectors.

The Prime Minister's Task Force for Information Technology and Software Development set up in 1998 developed an IT Policy and IT Action Plan (Parts I, II, III). The IT Action Plan, consisted of 108 recommendations which suggests *"revisions and additions to the existing policy and procedures for removing bottlenecks and achieving a pre-eminent status for India"*. Another report, referred to as a *Basic Background Report on IT Hardware Development, Production and Export* calls for:

- a paradigm shift in the IT hardware industry so that it "can survive the future shock of fast changing prices, technological obsolescence and an ever-expanding horizon of highly innovative industry";
- creation of a proper investment climate, and
- streamlining of procedures for minimizing uncertainty, grey market, avoidable licensing and purposeless inspection.

To provide impetus to the hardware sector, the task force had set up a 'hardware panel'. That panel has now listed over 700 ancillary units that could take up small volume manufacturing. Industry sources believe that the figure could easily be 7,000 units as a five-fold jump in demand for computer hardware is expected.

Growth of the Indian hardware industry

The Indian computer hardware industry grew from USD 1370 million in 1995-96 to an estimated USD 1912 million during 1996-97 reflecting an annual growth of 40%. This industry is targeted to reach USD 7,830 million by 2001. An average annual growth of 35-40% is forecasted for this industry segment³. More recent estimates (mid-term review

for 2000) by the MAIT indicate that in 1999-2000 the turnover of the domestic hardware industry was US\$ 4 Billion. Hardware and IT design is expected to grow to US\$ 5 Billion by 2005 and US\$ 10 Billion by 2008³².

Way forward for the hardware industry

Based on its mid-year review the MAIT's observations on the way forward for the IT hardware industry are as follows:

- India can be the ideal base for outsourcing both hardware, software and services
- Hardware and IT design is expected to grow to US \$ 5 Billion by 2005 and US \$ 10 Billion by 2008
- PC Penetration is expected to grow from current 4.5/1000 to 10/1000 by 2005
- The potential products for manufacture include: Motherboards and Populated PCBs; Add-on cards; Terminals and Monitors; Telecom equipment and components; Power Supplies: SMPS and UPS; Head Stacks and components of Drives; Line and Dot-Matrix Printers and other Finished Products
- There is a strong focus on Quality. Of the top 300 Software Companies 145 have ISO 9001 and 70 are in pipeline. 41 companies are SEI-CMM certified and of the 21 companies world-wide with SEI-CMM level 5, 13 are in India.
- Indian IT firms attracted approx. US \$ 320 Million of Venture Capital (VC) funding in 1999; The VC funding is expected to exceed US \$ 3 Billion by 2001.

The Review also revealed that:

- the areas of fast growth in the Domestic Market include: PCs and PC servers; Non-impact printers; Internet and Networking products and Domestic Software: ERP, CRM, CAD/CAM, Small Office Home Office (SOHO) applications;
- opportunities for out-sourcing include: Hardware and Hardware Designs; Firmware; Turnkey Software Solutions; E-commerce solutions; IT enabled Services: Call Centers, Medical Transcription, Web designing, back office IT operations.

While looking at the way forward it is critical to note here that increasingly worldwide, the traditional demarcation of companies into hardware and software is blurring. System integration viz., a customized integration of software and hardware sourced from certain vendors, to suit specific client requirements, today contributes a far larger segment of the IT sector's revenue than software development or hardware manufacturing. The continuous fall in the price of computer hardware requires that a company provide unique services to retain its competitive edge. This is enabling companies to take on system integration or as IBM states "....*the progressive assembling of system components into the whole information system...*" . This trend is very strongly being observed in India as well whether it is IBM, HP, Digital, Wipro or HCL, all of who are very strongly projecting themselves as total solutions provider in their products and services.

Discussions with some industry observers³³ however indicated that hardware manufacture for the IT industry in the true sense of the word i.e., chip sets, boards etc. may not really be feasible in India. This is primarily attributed to the infrastructure requirements (continuous, stable power, water) and the extremely capital intensive nature of the manufacturing facilities. Discussions with Texas Instrument in Bangalore revealed that the cost of setting up a semi-conductor facility is typically US\$ 1.5 billion. In addition, in India there is a lack of a cluster of similar units in India which, is also a deterrent since presence of clusters means that phase wise upgrading of units can be done. This happens in other countries like the USA or Taiwan thus making the establishment of fabrication facilities viable.

The Industries Commissioner in Karnataka however observed, that in the long run it will probably be more cost-effective for MNCs to source components from India (thereby enabling manufacturing to happen in India). The Commissioner also added that in terms of manufacturing technology India is lower in the learning curve and hence creating new facilities here when it can easily be imported from well-established facilities in South East Asia may not be optimal³⁴.

To provide greater impetus to the growth of the hardware industry a number of policy initiatives have been taken by the GOI. This together with the policy initiatives for the IT industry as a whole are presented in the following section.

2.3 Policy initiatives for the growth of the IT industry

As discussed in Section 1.1, policy has played a very important role in the development of the IT industry. The early protectionist policies gave way to liberalization policies, which opened markets and led to growth, both domestic and international, of the Indian IT industry. A turning point in the policy framework has now emerged with India signing the WTO IT agreement (ITA). According to India's commitment on the ITA, by 2003 no duty will be charged on imports i.e., a zero duty regime. Given this scenario, some of the significant policy initiatives made by the Government of India, to achieve this commitment and to ensure sustainability of the Indian IT industry, are discussed below[#].

Creation of a Ministry of Information Technology: The newly formed Ministry of Information Technology, Government of India will provide direction to the growth of the IT industry as it is responsible for the national development of Electronics and Information Technology (IT) industry and promoting applications of Electronics and Information Technology in the country. Its mandate is to develop the Indian Electronics and Information Technology Industry as a major global player and to bring the benefits of Electronics and Information Technology to every walk of life.

[#] The discussion in this section will focus on all policy initiatives – fiscal, EXIM, labor etc. Specific and more detailed discussions on environmental and labor policies and regulatory framework will be covered in Chapter 4.0 of this report.

Constitution of a National Task Force on Information Technology and Software Development: To ensure a strategic approach to promotion and growth of the IT industry, the Indian Prime Minister appointed this task force. Recommendations made by the Task Force in the form of the IT Action Plan have been accepted by the Government of India (GOI) and the implementation is being planned.

Recommendations cover a wide spectrum of issues relating to telecommunications, finance, banking, revenue, commerce, electronics, HRD, defense and rural development. They address critical national needs in the areas of information infrastructure, Internet access, software development and exports, hardware manufacture, electronic commerce, R&D in IT, manpower training and education.

Targets for both hardware and software: Targets have been set for software exports of around US\$ 50 billion by the year 2008 and IT for all by 2008. The IT Action Plan has recognized the need for a robust hardware industry if these targets are to be realized. The Task Force constituted a Panel to prepare an Action Plan for the IT Hardware Industry along with policy instruments to make India a major IT power with an export target of USD 10 billion for development, manufacture and exports by the year 2008.

Industry observers believe that once implemented, the IT Action Plan II (aimed at the hardware industry) will not only stabilize the IT manufacturing environment in the country which is currently in a state of flux, but will also fuel PC penetration to 30 per 1,000 from the current 3 per 1,000. This will be accompanied by substantial reduction in PC prices. In addition, the grey market will be curtailed and there will be many incentives for MNCs to manufacture in India.

Research and Development: R&D is a very critical part of the growth of any hi-tech sector. The IT Task Force had a working group that provided recommendations to give impetus to R&D in the IT sector. Discussions with Prof. Dhamdhere a member of the Working Group on IT Research, Design and Development Composition of the National Task Force revealed that there has not been much of a thrust on indigenous R&D (*see Interview with Prof. Dhamdhere – Annex 1*). The working group therefore recommended a number of steps to boost R&D. He believes that ... "much more needs to be done and R&D should be a vital component of our strategy for the future"...

Initiatives underway by Ministry of Information Technology (MIT): Aside from the IT Action Plan which is yet to be implemented, some policy initiatives made by the Ministry of Information Technology (MIT) are already underway to promote growth of the IT industry²¹. These include:

<u>Industrial licensing and clearance procedures:</u> Industrial licensing has been virtually abolished in the electronics sector except for manufacturing electronic aerospace and defense equipment. There is no reservation for public sector enterprises in the electronics industry and private sector investment is welcome in every area.

Electronics industry can be set up anywhere in the country, subject to clearance from the authorities responsible for control of environmental pollution and local zoning and land use regulations.

Policies to promote Foreign Direct Investment (FDI) are being laid in place. Procedures for FDI are being simplified.

At individual State levels land incentives are plenty. Land is being subsidized for IT and land use changes are being encouraged by allowing only software companies to set up operations in residential areas to enable proximity facilitating flexi hours.

<u>Simplification of export-import (EXIM) procedures:</u> The revised EXIM Policy and Procedures, 1997-2002 have been effective from April 1, 1999.

The simplified policy facilitates import of components, consumables, spare parts etc. thus promoting business transaction and bringing down the turnaround time, which allows India to be competitive in the global market. By reducing the differential in import duty between input components and finished goods the domestic manufacturing industry has received an impetus.³²

Some of the salient features of the EXIM Policy are:

- The need for quality in products has been recognized by the EXIM policy. This is emphasized in the IT Action Plan III as: "The high quality of Indian Software Services and Software products exported, will be sustained by compulsory insistence of ISO-9000/SEI level-5 Standards or equivalent, certified by one or more competent certification agencies in India."
- Electronics Hardware Technology Park (EHTP) Scheme, Software Technology Parks (STPs) and Export Oriented Units (EOUs) can be set up anywhere in India.
- STP scheme is an export-oriented scheme for the development and export of computer software using data communication links or in the form of physical media, including export of professional services. STPs were established at Pune, Bangalore, Bhubaneswar, Thiruvananthapuram, Hyderabad, Noida, Gandhinagar, Mohali, Jaipur, Navi Mumbai, Chennai and Calcutta. Software exports from STP units have been Rs. 47.22 billion during 1998-99.
- The Government has established Export Processing Zones (EPZs) which will provide internationally competitive infrastructural facilities including standard designed factories at concessional rate, a duty free and low cost environment for export promotion.
- 100% Export Oriented Units can be established outside the zones, anywhere in India and all the incentives available to units in EPZs are also applicable to EOUs. Foreign Equity upto 100% is permitted in 100% EOUs and units in EPZs.
<u>Flexibility of manufacturing:</u> Setting up of S-BITs-the Soft Bonded IT units to allow the IT manufacturing industry to service the domestic and export markets from the same facility is the most significant and critical change sought. Industry experts strongly feel that this will help the local manufacturing of IT and telecom products to thrive. This is yet to be implemented.

<u>Fiscal Policy initiatives</u>: Fiscal measures that have been taken to promote the growth of this sector include:

- The depreciation on computers has been increased to 60%
- Information Technology Software has been exempted from customs duty
- Computer systems have been made freely importable
- The donation of computers, imported duty free by EOU/EPZ/STP/EHTP units to recognized noncommercial educational institutions, registered charitable hospitals, public libraries, public funded research and development establishments, etc., two years after their use by the above-specified units has been permitted
- The second-hand computers and computer peripherals donated by an outside donor to Government schools have been exempted from customs duties.

A number of amendments have been made to the Income Tax Act in the Budget 1999-2000 for the Electronics and IT Sector, to induce more investment for R&D activities by industry into universities, research institutions, and scientific and research associations.

Recognizing the importance of Venture Capital Funding, the Government of India has approved setting up of an IT Venture Capital Fund of Rs. 1000 million with contributions from financing institutions, Government of India and the software industry. The aim of the Fund is to provide Venture Capital to start up software professionals and IT units in the small scale sector.

<u>Human resources:</u> India's intellectual capital has been responsible for the meteoric rise in the IT sector. India has the second largest English speaking scientific and technical manpower in the world. Policies are being put in place to ensure continued creation of this manpower on a sustainable basis.

To ensure this, initiatives aimed at upgradation of quality of education in existing institutions; identification of gap areas and developing specialized programs; and introduction of new educational technologies are being put in place.

"Operation Knowledge", a national campaign to increase computer literacy and IT education is proposed by the MIT. Schemes such as lowering the cost of PCs, easy-installment bank loans, computer donations by IT companies and other business houses, bulk donations of computers by NRI organizations, large-volume bargain price imports, multi-lateral funding, etc are proposed to be initiated by the Government of India.

Employment Generation Training Scheme in repair and maintenance is being implemented to improve the employability of youth in backward regions.

<u>IT infrastructure improvement:</u> The convergence of different technologies namely Computers, Communications, Consumer Electronics and Contents/Multimedia (4Cs) has led to launching of National Information Infrastructure (NII) in several countries worldwide. An Action Plan has been developed to set up an NII in India aimed at boosting socio-economic development. The primary aim is to stimulate investment in infrastructure - especially in telecom sector, network backbone, internet etc.

High priority is also being accorded to development of the telecom sector with the basic thrust on improving accessibility, reliability and provision of traditional basic services like telephones, telex and telegraph to cater to urban and rural areas alike.

At individual State levels also considerable stress is being laid on infrastructure improvement. For e.g., Electronic City in Bangalore and Information Technology Park Limited (a collaborative effort between Government of Karnataka, Singapore consortium and the Tata Group) in Bangalore which provide state-of-art office facilities, communication, uninterrupted power supply, recreational facilities and a very conducive ambience comparable with any international facility (*see Plate 1 in Annex II*).

The Andhra Pradesh State government is developing the Hi-Tech City outside Hyderabad, through private sector initiative complete with high-speed broad band networks and state-of-art technical, commercial and residential facilities.

Many state governments have already set up venture capital funds for the IT sector in partnership with local state financial institutions and the Small Industries Development Bank of India. These include Andhra Pradesh, Karnataka, Delhi, Kerala and Tamil Nadu.

<u>Institutional arrangements:</u> At the State level independent IT departments have been created in Karnataka, Andhra Pradesh, Maharashtra and Rajasthan. Karnataka was the first State to lay down an IT Policy in 1997. Other states in the country are also developing their IT policies to ride the IT wave. While it works at promoting the IT industry the IT department at the State level does not lay any policy guidelines regarding labor, environment and infrastructure. The guidelines in this regard are laid down by the concerned departments. The Department of IT works at simplification of these guidelines and procedures for the IT industry through the respective departments.

Comprehensive Legislation for Information, Communication and Entertainment: Above all these policy initiatives more recently, a comprehensive legislation called the Information, Communication and Entertainment (ICE) Act of India 2000 is being prepared to integrate the information, communication and entertainment sectors. "*This is being done to promote, and encourage investment and growth of both the broadcasting and communication sectors based on the development and use of technologies which maximize user control over carriage of information.*"³⁵ This has extensive implications for literacy, medical and health care, science and technology, research, governance due to

greater public awareness and on the IT industry in terms of requirement of infrastructure, extensive hardware and software.

Taken together, the policy initiatives and associated legislation are aimed at significantly broadening and deepening the process of economic reforms by encouraging competition, entrepreneurship and innovation – essential drivers for India to be a lead player in the global IT market.

Having laid down the structure, growth and policy initiatives for the IT sector in India the setting has been created to examine the environmental, health and safety and labor issues associated with the IT industry. This is the focus of the next chapter.

Endnotes

¹ India: The IT Opportunity. Presentation by MAIT. Received from Director, MAIT during an email interview conducted for the present study.

² Rajan, R. Autonomous IT Firm Concentrations in Bangalore City – Location Rationale. Dissertation for the Post Graduate Diploma in Planning. School of Planning. Centre for Environmental Planning and Technology. Ahmedabad. January 2000.

³ Lateef, A. Linking up with the global economy: A case study of the Bangalore software industry, New Industrial Organization Program DP/96/1997 ISBN 92-9014-599-4. International Institute for Labor Studies. 1997

⁴ Heeks, R. 1998. The Uneven Profile of Indian Software Exports. Development Informatics Working Paper Series, Institute for Development Policy and Management, University of Manchester, UK. <u>http://www.man.ac.uk/idpm/idpm_dp.htm#devinf_wp</u>.

⁵ India: Leading Sectors for U.S. Exports & Investments 1998. Country commercial guides. Document id: 19. Chapter V: Leading sectors for US exports and investment. http://www.tradeport.org/ts/countries/india/sectors.html

⁶ Nasscom is India's National Association of Software and Service Companies, the apex body and umbrella organization of I.T. Software and Services industry in India. The member companies of Nasscom are in the business of Software, IT Services, Internet, E-commerce and IT Enabled Services. Nasscom is both a Chamber of Commerce, and a single point-reference on any information on I.T. and Services and Industry in India. Nasscom's primary objective is to act as a catalyst for the growth of the software; I.T. services and dotcom industry In India. It was specifically set up to facilitate business and trade in software and services and to encourage advancement of research in software technology. It is a not-for-profit organization.

⁷ Business India, June 26-July 9, 2000. p. 27

⁸ Mehta, D. India's software industry: A time for consolidation. <u>http://www.cw.com.hk/</u> <u>Features/f980805001.htm</u>. August 5, 1998.

⁹ MAIT was set up in 1982 for scientific, educational and IT industry promotion. It represents domestic hardware, domestic software, IT Training, IT maintenance and services sector of the Indian IT industry and does not distinguish between large and small scale operators. MAIT's charter is to develop a global, competitive Indian IT industry, promote the usage of IT in India, strengthen the role of IT in national

economic development and promote business through international alliances. MAIT's special focus is on export promotion and attracting foreign investment in the Indian IT industry. <u>http://www.mait.com</u>

¹⁰ IT software services, electronics exports up. Times of India, July 14th, 2000.

¹¹ I.T. Industry in India. <u>http://www.iiitb.ac.in/New_Folder5/it/it.htm</u>

¹² Chawla, S. 1999. Viability of Offshore Software Development: A Case study of International Division of Labor between Indian and US organizations (Initial Findings). http://www.intech.unu.edu/calendar/events/workshop/seema.htm

¹³ Heeks, R. 1999. Software Strategies in Developing Countries. Development Informatics Working Paper Series. Institute for Development Policy and Management, University of Manchester, UK. <u>http://www.man.ac.uk/idpm/idpm_dp.htm#devinf_wp</u>)

¹⁴ Offshore means, software developed on Indian land.

¹⁵ Data for Figure 2.4 and Figure 2.6 was obtained from NASSCOM's web site at: <u>http://www.nasscom.org/</u>

¹⁶ Cross-border IT-enabled services are functions and services that are provided from a country different from the one where end-products are delivered; are delivered over telecommunication or data networks (wireline and wireless); are either externally contracted (outsourced) or provided by a remote subsidiary of the same company (outlocated).

¹⁷ Jhunjhunwala, A. Can Information Technology Help Transform India? <u>http://www.tenet.res.in/Papers/IT-Trans/ittrans.html</u>

¹⁸ Grey market is an unorganized unit of local assemblers and market operators who use smuggled or reused parts and accessories. The evolution of this market can be attributed to government policies such as high import duties. It has a fairly large share in the home PC market in India.

¹⁹ MAIT conducts an Industry Performance Review, bi-annually which aims to address the hardware sector's efforts to manage the business environment, gauge the market potential and consumer trends. The first mid-year report evaluates the industry's performance between April-September and the second, the period of October-March. A presentation on the review for 1999-2000 was made available for the present study, by Mr. Vinnie Mehta, Director, MAIT, during an email interview. June 2000. (See interview with MAIT – Annex 1)

²⁰ Industry Watch: Computer Hardware. The FPJ – Business Journal, April 24, 2000. ²⁰ Industry Watch: Computer Hardware. April 24, 2000. <u>http://www.dhan.com/moneyline/y2k0424-hardware.html</u>

²¹ <u>http://itfriend.mit.gov.in/advantage.htm</u>. This is the official website of the Ministry of Information Technology, Government of India.

²² <u>http://www.idcindia.com/</u>

²³ Based on an interview with Mr. Amal Anand D'Silva, Director, Summation Enterprises Limited. They are system integrators and resellers for HP, Compaq and IBM, July 2000.

²⁴ Nepal has a free-trade agreement with India on components, though this does not cover goods brought into Nepal for resale. Poor law enforcement does little to stem the heavy flow of component traffic across boundaries.

²⁵ Ghosh, R.A. A Paler Shade of Grey. Indian Techonomist. 1995. <u>http://dxm.org/techonomist/</u>.

²⁶ Dataquest, August 15, 1996. GREY MARKET Strains Of Grey.

²⁷ Based on personal interview with Lipi Datasystems Ltd. manufacturers of compatible, remanufactured cartridges and toners in India. (See Interview with Lipi Datasystems Ltd. – Annex 1).

²⁸ Based on email interviews with Mr. Somnath Chaterjee, Secretary General, ELCINA and Mr. R. Chellappa, Secretary General Indian Printed Circuit Manufacturer's Association (IPCA) (See Interview with ELCINA and Interview with IPCA – Annex 1).

²⁹ IT software services, electronics exports up. Times of India, July 14th, 2000.

³⁰ Based on an email interview with Mr. Vinnie Mehta, Director, MAIT, India, June 20, 2000 (see Interview with MAIT – Annex 1).

³¹ Penn, Z. October 1998. Infotech: Chinaware to hardware. Rediff on the Net. <u>http://www.rediff.com</u>

³² MAIT, April 2000 www.mait.com

³³ Based on interviews with Prof. Dhamdhere, Member Working Group on IT Research, Design and Development of the IT Task Force; Mr. Jaidev Raja, Manager Corporate Communications and Mr. Mahesh, EH&S Officer at TI, Bangalore and Mr. Shalabh Jain, Compaq India (see Interviews with Prof. Dhamdhere, TI and Compaq – Annex 1).

³⁴ Based on a personal interview with Mr. V.P. Baligar, Industries Commissioner, Government of Karnataka. July 2000.

³⁵ Business India, June 26-July 9, 2000. p.44-46.

Chapter 3: Environmental, Health and Labor issues in the IT sector

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The environmental, health and labor issues associated with the IT industry in India will be discussed in this Chapter under three main sections: (I) Environmental issues (II) Labor (including health and safety) issues and (III) Impact of the Indian IT industry on the community.

Any discussion on environmental, health and safety issues in industry is usually in the context of manufacturing operations and production. In the case of the IT industry however, manufacturing and production would include both hardware and software. As discussed in Chapter 2, computer hardware manufacturing in the Indian IT industry is largely through assembly of imported components. Chips and PCBs for the computer industry are not manufactured in India. Albeit, electronic component manufacture (including PCB manufacture for other applications) does take place in India with both a domestic and export presence, in a global context, the activity is small.

Many of the environmental issues that are significant for the industry in other countries such as China, Taiwan, USA and parts of Europe where fabrication and manufacturing is done are therefore not presently in focus for India. There is however an emerging trend and commitment by the GOI to increase manufacturing activity in India and these issues could emerge then.

Therefore while discussing issues associated with the IT industry, the scope of the discussion in this Chapter will go beyond the manufacturing stage of the life-cycle of IT products - primarily computers and peripherals (the focus of this report) - and consider the environmental, health and safety issues associated with the management and disposal of used computers and peripherals. This end-of-life disposal is emerging as a significant

issue for India given the meteoric growth of the IT industry and the likely expansion of IT usage in India.

Software industry, considered innocuous in terms of environmental impacts will also be discussed in this chapter with a focus on the health and safety issues.

3.1 Environmental issues in the Indian IT industry

Worldwide, the perception of the electronics industry has been that of a relatively "clean" industry compared to other polluting sectors like for e.g., the chemical industry or textile or tannery. In the United States quantitative data (in the form of the Toxic Resource Inventory emissions – considered a fairly good environmental indicator) shows that the electronics industry apparently only emits 1.6% of the total US TRI¹ emissions annually. However, the toxic and hazardous nature of the emissions have significant impacts.

In China in 1998 when Foreign Direct Investment (FDI) was being invited for "Eco-Investments" in Environmentally Sound Technologies, investments in the electronics / hitech sector were considered to be inherently environmentally sound. The Chinese government had identified the electronics sector as non-polluting and a thrust area for FDI.

The "clean" perception of the electronics industry in India led to it being classified as a "non-polluting" industry by the Ministry of Environment and Forests, Government of India. Associated with this categorization are the relaxation of environmental clearances, siting of these facilities and the environmental regulatory controls over this industry.

Increasingly however, the long-term, irreversible environmental impact of this industry is being realized. The complex nature and the very wide variety of chemicals and materials used in this industry is making management of waste and emissions from the processes very difficult. Not just the manufacturing wastes but the final disposal of electronic products are also raising a number of critical environmental, health and safety issues.

3.1.1 Inputs and outputs from the IT industry

How clean is the IT industry in India? In India as in other countries, electronics manufacturing requires water, power and a variety of chemicals, which are hazardous in nature. The volumes of production of electronics - the building blocks of the IT industry – have been significantly lower in India but given the thrust that the industry (manufacturing and usage) is poised to receive the situation could change significantly. As the industry is expanding in India what was considered clean and non-polluting is increasingly being observed to cause severe environmental damage. This has now led the manufacture of PCBs and semi-conductors to be considered among the list of polluting industries.

Some of the characteristic chemicals used include toxic and hazardous gases such as arsene and phosphene, cyanides, acids such as hydrofluoric acid, silanes etc. Very often

the chemicals are in the form of formulations and limited information is available about their constituents.

Manufacture of printed circuit boards and their assembly involve electroplating and soldering activities. Acids (hydrochloric, sulfuric etc.), alkalis, and solvents (halogenated e.g., Trichloroethylene, Carbon Tetrachloride and non-halogenated), are used which produce a variety of effluents such as spent copper plating solution, photoresist developing solutions, spent etchants containing ammonia, chromium, copper, and large volumes of wastewater. Ozone depleting substances (ODS) such as Chlorofluorocarbons (CFCs) typically CFC 113, hydrochlorofluorocarbon (HCFC) are used as solvents.

Electron tube manufacture produces effluents rich in chromium while the manufacture of glass suitable for use in the CRT involves use of lead.

The impact of the manufacturing activity in these industries is not only on environmental components such as air, water and land but also on the workers who are exposed to the chemicals in the workplace.

Information on the exact nature of the inputs, outputs and operations pertaining to these industries is limited in India. Recognizing the need for such information as a vital prerequisite to developing any system to minimize the impact of this industry, the MIT, GOI together with UNDP (United Nations Development Program) have embarked on a three year program on environmental management in the PCB and semi-conductor industry. The MIT and the Ministry of Environment and Forests, Government of India have been collaborating to develop a phase out program for ODS solvents since 1995-96.

A large part of the electronics industry in India (including components manufacture) however, caters to non-IT applications. At this point to understand the environmental issues associated with the IT hardware industry it is necessary to look at what part of the supply chain of the global IT industry resides in India. Figure 3.1 presents the supply chain.

As seen in Figure 3.1, computer hardware manufacture in India is restricted to assembling of components sourced from international markets. This is largely a physical, automated process with minimal / no usage of chemicals and water. Power, labor and packaging are the main resources used, which would have environmental implications. Some assemblers in the unorganized, informal sector / grey market however even today carry out soldering and cleaning operations wherein there is use of solvents primarily ODS. This would be phased out given the changes in PCB technology. Today most of the components are surface mounted (SMT) on the boards so both the requirement and the feasibility for such operations during assembling becomes negligible.



Figure 3.1 Supply chain dynamics in the Indian IT hardware industry

Peripherals are another area where again it is largely assembly of components. The consumables for peripherals are imported presently. Hence manufacture per se is limited. There is however an emerging market for remanufacture of printer consumables such as cartridges and toners, which would have environmental implications.

Since India is, presently at least, predominantly a software player in the global market, the industry is perceived as non-polluting. The environmental issues associated with the software are typically due to land requirement for establishment of large software parks, need for uninterrupted clean power, utilities such as water, roads etc. Issues of health and safety are of course significant in the software industry. These range from ergonomical issues to exposure to radiation from monitors.

Finally the most important and significant aspect of the IT industry is the disposal of the products at the end of their useful life – computers, servers, printers and other peripherals, consumables such as floppy disks, CDs, printer cartridges and toners. The environmental implications of this stage in the life-cycle of the IT industry are enormous particularly since the IT industry in India is aimed at pervading all sections of society.

With this brief setting of the inputs and outputs to the Indian IT industry the next section examines the various environmental, health and safety issues facing the industry.

3.1.2 The main issues

Drawing from the above section it appears that the main environmental issues facing the Indian IT industry are:

- Solid and hazardous waste
- Ozone depleting substances
- Issues related to power demands
- Supply chain pressures

Solid and hazardous waste

Presently, generation of solid and hazardous waste in India is during electronic components manufacture and at the disposal / user end of the supply chain.

Manufacturing waste

Hazardous manufacturing waste from component manufacture is characterized primarily by acidic, alkaline and metal containing wastewater and sludge, and used solvents (halogenated and non-halogenated). Today, apart from landfill facilities at Narora and Ankleshwar in the Western Indian State of Gujarat and an upcoming facility in Hyderabad there are no locations where the solid / hazardous waste can be disposed by the industry.

The PCB manufacturing units in the organized sector are regulated by law and they are required to set up waste treatment plants to meet the disposal standards. The SSI manufacturing components have both technical and financial barriers in complying with the standards. Disposal of incompletely treated wastewater / hazardous waste generated in these processes can lead to extensive contamination of land and surface and groundwater. Emissions of volatile organic compounds (VOCs) characteristic of these processes are today not regulated today as there are no standards yet for VOCs.

Recognizing the potential for this industry to cause long term environmental degradation of air, land and water standards are being made more stringent. In fact with the amended Hazardous Waste Management and Handling Rules, 1989 (amended 2000) most of the operations in electronics manufacture and assembly will be regulated by this rule.

However, as in the case of other industries as well enforcement is a critical issue. Institutional challenges for the regulatory bodies at the State and Centre are high in terms of number and technical capacity of staff, monitoring facilities and lack of familiarity with the sector to ensure strict enforcement. Currently no manuals or guidelines have been developed by the GOI for waste management in this sector.

As discussed in Chapter 2, given the initiatives to promote growth of the hardware manufacturing industry both domestically and for export, Indian manufacturers will have to meet very stringent international environmental standards to be part of the global market.

Taking cognizance of all the above issues, the lack of information on the nature of operations of this sector in India and the potential environmental impact of the hazardous processes and products, the Ministry of Information Technology, GOI in collaboration with UNDP has initiated a program towards cleaner production in the industry. The program is to be implemented with cooperation from R&D institutions and other government departments. The aim is to minimize waste generation, improve production efficiency and substitute hazardous raw materials and solvents with less harmful ones. Box 3.1 presents the salient features of this project.

Box 3.1 The GOI-UNDP Program on Environmental Management in the Electronics Industry²

A National Program on Environmental Management in Semiconductor and Printed Circuit Board Industry (EMS-Electronics) has been developed by the MIT in collaboration with UNDP to adopt cleaner production technologies and optimal use of raw materials / natural resources by improving the process efficiency and reuse and recycling in the selected electronics industry. This is the first such program being taken up for the Indian Electronics Industry.

Development of suitable treatment and disposal methods for the waste emanating from these process industries would be a part of this program. The areas intended to be covered include Semiconductors, Printed circuit boards, CRT, resistors/ capacitors, and electro- galvanisation of component parts. On the basis of the study conducted, in each identified thrust areas, a demonstration unit would be set up in order to demonstrate the technical feasibility and economic viability of the operation. The environmentally sound technology demonstration units set up in this program would be replicated in other industries.

The project is proposed to be implemented in two phases. The first phase of the project is currently under implementation. During this phase the following activities are proposed:

- Survey of various manufacturing units (small, medium and large) in semiconductors, printed circuit boards including board level assembly, cathode ray tube & electron tube, capacitors, resistors and electro-galvanisation of electronic component parts. The survey will cover qualitative and quantitative assessment of various pollutants emanating from these industries and identification of the hazards inherent in technology/ manufacturing processes used.
- Analysis and categorization of data in terms of various toxicity level and quantity.
- Collection of information on internationally prevalent manufacturing process / technology and control standards used in respective industries.
- Assessment of the water management practices being followed at the electronics units and suggest key areas where attention needs to be paid to minimize wastage.

- Recommendations on the standards that could be adopted for Indian industries in the light of the study conducted for Indian industries vis-à-vis the internationally prevalent practices.
- Create awareness on environmental management through a National Seminar.
- Suggest action plan for achieving the environmentally safe and cleaner technologies in the second phase of the program including sub-projects and demonstration projects in the area of recovery/regeneration of useful items, recycling of streams with suitable treatments, water recycling, effluent treatment and disposal of complex wastes.
- Development of a strong knowledge base in the selected areas of electronics sector on Environment Management System.
- Development of a suitable framework for Institutional arrangement for Environment Management System and its implementation methodology for Indian electronics industry.
- As a first step to implement demonstration project, recovery of Copper from spent etchants or in similar area would be taken-up at one of the PCB industry.

During the first phase, R&D institutions would be involved for characterization and other technical activities.

The program is to be carried out over a period of three years. This sub-program will be implemented by the Department of Electronics, Government of India. In order to advise, guide and decide on various technical, policy and other matters which may come up during the implementation of the sub-program, a National Advisory Board has been set up comprising of experts from Ministry of Environment and Forests,

Central Pollution Control Board, PCB industry, Semiconductor Industry, National Environmental Engineering Research Institute, Administrative Staff College of India, Confederation of Indian Industries and Electronics Industry Associations such as (Indian Printed Circuit Association and Electronic Component Industries Association).

The Board would help in formulating the key implementation strategy of the sub-program. This would be achieved by conducting periodical discussions and meetings. A panel of technical experts would be drawn from the above mentioned institutions and their services would be utilized for this sub-program in the form of national consultants. The technological and other inputs required from advanced countries would be provided by the international consultants from UNIDO.

Besides the hazardous waste generation, discussed above, there is the issue of solid waste as well. In PCB operations, solid wastes may include scrap board materials, plating and hydroxide sludges, inks, solder dross, scrap boards, components, organic solvents, and metals.

Solid waste in the form of scrap plastic / metal and packaging would typically be generated from computer and peripheral manufacturing facilities in India given that manufacture of components of the computer industry is not carried out indigenously.

Both MNCs (like HP, Compaq) and domestic PC manufacturers (like Wipro, Zenith etc.) import components including the shell (box) from South East Asia or USA and assemble it locally in their manufacturing plants. Packaging, power cords and UPS is sourced typically from the domestic market. The waste here would include various forms of

paper, plastic, anti-static packaging material etc. Packaging is a major source of solid waste from this industry both at the manufacturing and consumer end.

Several companies worldwide are radically rethinking packaging strategies rather than merely switching from bleached, white product boxes to natural brown ones, or eliminating foam packing. For example, last year IBM issued a 105-page set of environmental packaging guidelines that detail everything from the amount of recycled content in packaging to the heavy metals used in the inks on some packages to the reuse of wooden shipping pallets to keep them out of landfills. The multinational companies in India would require to follow the Corporate Codes of Conduct (as confirmed by Compaq, which stated that corporate packaging guidelines are to be followed locally as well).

The domestic manufacturers however do not appear to have any specific codes of conduct or guidelines incorporating environmental considerations in packaging.

The magnitude of the waste management issue from the IT industry could rise significantly given the increasing volumes and the increasing number of manufacturing facilities being set up in the country. Quantification of the solid / hazardous waste due to this industry has yet to be carried out in India. Given the multiple sources of components primarily from outside the country it becomes extremely difficult to track down the resource usage by this industry.

<u>End-of-life waste</u>

At the consumer end of the supply chain is the issue of disposal of waste or used product. This entails disposal of packaging, computers, peripherals and consumables.

In India computers and peripherals are recycled / reused much more than they are in developed countries. Figures for the US indicate that computer systems are replaced on average every three years. In the case of developing countries like India till the last 1-2 years affordability of computers was limited to only a socio-economically advantaged section of the population. Therefore, resale and reuse of computers was (and continues to be) high as does dependency on assembled machines. No reliable figures are available as yet to quantify this statement. Increasingly as computers are becoming more affordable (even the branded machines), and there is greater access to technology (note the increase in sales of Pentium II and III which together account for 64% of sales in 1999-2000 – Chapter 2, Section 2.2.2), the turnover of machines could definitely be higher.

Apart from the consumer end, another source of more obsolete computers in the market is from the large software industry where use of cutting edge technology, greater computing speed and efficiency necessarily increase the rate of obsolescence. For e.g., at Infosys, one of the largest Indian software companies in Bangalore and at the R&D Centre of Texas Instruments obsolete machines are being stored on at their warehouse and on-site respectively while the companies are trying to work out a feasible method for disposal.

The end-of-life options for computers in India are presented schematically in Figure 3.2.



Figure 3.2 Computer hardware market and the end-of-life options for computers, peripherals and consumables

As seen in Figure 3.2, these options include:

- Sale as secondhand computers
- Donation to non-profits specializing in distributing donated computers to community groups and educational institutions
- Direct donation to educational institutions
- Electronic scrap businesses (primarily in the informal/ unorganized sector)
- Disposed in municipal waste bins

Computers can thus be Reused, Resold, Recycled, Demanufactured and Disposed³. In this section the discussion will focus on final disposal. The other options are being considered during a discussion on industry / society's response to disposal in Sections 3.1.3 and 3.1.4.

In India the route to the final disposal of computers is very long. There are no welldefined waste management systems in place for computers and their components. They are usually disposed off in the municipal bins after the recoverable components are removed. Scavengers collect these broken machines / discarded components, take them to a scrapyard where further attempts at recovery of components such as metal parts, motherboards, etc are made and the residual waste is junked in the municipal solid waste bins. Some idea of the complexity of the disposal issue in India may be gleaned from a report on Mumbai's computer recycling market in Box 3.2.

Box 3.2 Computer recycling in Mumbai, India⁴

Bhendi Bazaar in the southern part of Mumbai, has a strong metal, and electronics scrap market. Every Friday there is a street market here where defunct electrical and electronic equipment such as household appliances, pumps, motors, metal components such as ball bearings, bolts, nuts etc. are sold at bargain prices. Together with this the market also sells, components from PCs like mother boards, floppy drives, components from the mother boards (some desoldered in scrap yards and sent here) printers, monitors etc.

These components are bought in bulk from scavengers. The scavengers collect them from the municipal bins or from offices (typically public sector) when the machines are junked. These machines are then taken to crushing areas in the slums of Dharavi and Mahim in Western Mumbai, Mankhurd in Navi Mumbai and Masjid Bunder in Southern Mumbai. The mother boards and floppy drives are removed from the machines and sold by weight / as individual pieces to scrap dealers in Bhendi Bazaar. Sometimes they are junked even by scavengers but picked up by scrap dealers and sold at Bhendi Bazaar. None of these scrap dealers have the ability to identify the condition of these components. They are then typically sold at Rs.50-100 (between US\$ 1-2) per motherboard but the price can be bargained much lower. Floppy drives are sold at Rs. 150 (About US\$ 3) per piece. During the field visit to Bhendi Bazaar it was observed that one of the street shops was selling an Epson Stylus Printer as well for Rs. 3500 (US \$ 75 - which could be bargained to a lower price).

In addition to these temporary footpath based Friday markets there are a few regular shops which deal with computers, and peripherals. One such shopkeeper was interviewed. The gist of the interview is as follows:

Computers (typically low end e.g., 286, 386) are bought from companies when the used machines are tendered / bid out for disposal. The computers are checked by a hardware engineer associated with the shop and then sold typically at Rs.1000-1500 / machine (US 20-30). Such shops also buy motherboards by weight and sell them sometimes as individual pieces (Rs. 50-100 a piece – US 1-2) or by weight to customers who assemble machines. Monitors are sometimes dismantled and the picture tubes sold. No desoldering activity takes place here. The shopowner indicated that the older machines had aluminum and other metal parts which could be recycled in the scrap market but the newer machines are largely plastic and so no recovery of useful material was possible from these machines.

These motherboards and components are bought by people who repair electronic equipment. Some of the components are in very good condition and with some minor maintenance they are in working condition made possible at very low costs.

It is believed that gold recovery which is possible from the contacts on the motherboards, is not practiced in the market in India because the volumes of machines / motherboards disposed is too low to make the recovery process viable. Recovery is done by some units in the USA and some European countries.

India has not yet experienced the problem facing the United States where it is estimated that up to 150 million use computers will be dumped in US landfills by the year 2005,

with disposal costs exceeding 1 billion US dollars. However, with the IT revolution and increased PC penetration the problem of eventual disposal will be a major issue.

Recent fiscal incentives such as 60% depreciation of computers as well as fall in PC prices will make it cheaper to buy a new machine than to upgrade old ones, thus increasing the disposal frequency.

The municipal dump areas in India are not secured landfills. Dumping of computer scrap in these areas could result in metals and chemical leaching into the groundwater over a period of time due to changes in the chemical conditions of the soil. Reportedly more than 700 different compounds including plastics, metals, glass, ceramics, composites, solvents, and gases contribute to making a PC. Typically computer and related scrap contains toxic heavy metals such as lead and cadmium in computers, and computer batteries, mercury switches, lead oxide in cathode ray tubes, and metal stabilizers in plastic computer casings⁵.

Indiscriminate burning by scavengers takes place in these dumps for metal (Cu, Cd etc.) recovery from municipal waste. Particular hazards arise under such conditions when the recycling of this waste is not managed properly. Plastics or polymer based parts of computers could release toxic chemical vapors. Brominated flame retardants used on PCBs, cables and plastic casing and the PVC coating on these surfaces could lead to toxic emissions of dioxins and furans when burnt indiscriminately under uncontrolled conditions. Therefore even where people are not working directly with the waste itself, their health can be seriously affected.

Disposal of peripherals and associated consumables is another major issue since very often the disposed cartridges find their way back into the illegal market.

Refilling of cartridges, generate ink waste and rejected refilled pieces. There is also an emerging market of *compatible* manufacturers who manufacture cartridges and toners for Inkjet and laser printers by refurbishing old bodies of cartridges and toners. Those bodies, which are damaged beyond repair and remanufacture constitute solid waste. Eventually all this solid waste primarily plastic and metal is disposed with municipal waste in open dumps. Given the growth of the Inkjet and laser printers in India (see Chapter 2, Section 2.2.2) with Inkjet accounting for almost 50% of the market share the consumption of cartridges and toners will grow as well leading to a proportionate increase in solid, non-degradable waste.

Ozone depleting substances

Ozone-depleting chlorofluorocarbons (CFCs), are used in solder coating and during assembly and soldering of PCBs. It is used to remove the flux residue (flux is used to clean the board surface prior to soldering). In the world market however, use of ODS substances in the computer industry has almost been phased out. Digital Equipment Corporation (DEC) and Nortel/Northern Telecom were the first companies to donate patented technology to the public domain in order to hasten ozone layer protection.

AT&T, Nortel, and the U.S. EPA founded, the Industry Cooperative for Ozone Layer Protection (ICOLP) to encourage competing companies to cooperate on the development and implementation of environmentally protective industrial technologies.

In India however, ODS solvents are still in use, in the Electronics Sector, where Small and Medium Enterprises (SMEs) consume large volumes of ODS solvents and in a very informal and unorganized manner⁶. ODS solvents are used for cleaning functions by PC assemblers in India. Lack of technical know-how and lack of awareness of the environmental implications of the use of ODS has been the main cause of its continued usage in the industry.

The ODS solvents typically used are CFC 113 and methyl chloroform. Hydrochlorofluorocarbons (HCFCs) have been developed as a substitute for CFCs, but they are also ODSs.

For the assembly process in PCB manufacture, non-ozone- depleting alternatives are available for cleaning the assemblies. These alternatives include other organic solvents, hydrocarbon/ surfactant blends, alcohols, and organic solvent blends, as well as aqueous and semi-aqueous processes. More importantly, it has also been demonstrated by the industry that assemblies can be made without cleaning by using low-residue fluxes that leave very little in the way of contamination on the boards.

India is signatory to the Montreal Protocol and needs to meet its phase out target for ODS. The MIT, Government of India has recognized the impact that the rapidly expanding electronics industry could have on ODS phaseout. In collaboration with the Ministry of Environment and Forests, MIT has during the last 4-5 years formulated the Country Program for phasing out of ODS, especially in the solvent sector where usage by the electronics industry was predominant. As a follow up of this program, MIT has also actively assisted the industry in formulating the first few projects on ODS phase out and for seeking assistance from the Multilateral Fund. More recently, draft regulations to control ODS production and consumption in the country were released called the Ozone Depleting Substances (Regulation) Rules, 2000 - Draft Notification. As of August 2000 however the draft rules have been formalized and the Ozone Depleting Substances (Regulation) Rules, 2000 passed as a regulation.

Of significance here for the IT industry are the phase-out dates. CFCs cannot be used in manufacture beyond January 2003 except for medical purposes for which affordable replacements are not readily available. Hydrochlorofluorocarbons however may be used till 2040.

Issues related to power demands

The computer industry has made great strides in reducing PC energy use largely due to the EPA's Energy Star Computers program, which encourages companies to design PCs, monitors, and printers that slip into a low-energy "sleep" mode when idle. In Energy Star certified computers and printers, the maximum power consumption cannot exceed 30

watts in low power mode for PCs and monitors, and 30 to 45 watts for printers. But as micro-processors get faster and more powerful - and manufacturers add increasingly more features – reducing energy consumption is becoming more challenging.

With greater access to technology in India today such developments in energy aspects get translated to the Indian market as well.

The energy issue facing the Indian IT industry however is the need for reliable, clean, uninterrupted, power supply. This demand is going to increase with the predicted growth in the industry and increased penetration of PC and the Internet.

The industrial sector is one of the largest consumers of power in India accounting for around 50% of total energy consumption in the country. It is increasingly facing severe problems due to the increasing cost, as well as the unreliable supply of power. The power sector is going through extensive restructuring and reforms in recognition of these issues.

Discussions with industry observers indicated that the Indian IT industry's manufacturing activities and overall absolute power requirements are not as high as some of the energy – intensive sectors such as cement, iron and steel, fertilizer etc. However, non - availability of adequate power supply, and poor quality and reliability of supply can be a major deterrent to its growth and this has also been one of the reasons for the absence of a strong hardware industry. Quantitative information for the IT industry's demands for power were not available.

A number of industries are now increasingly relying on their own generation (captive and cogeneration) rather than on grid supply. Notably, about 30% of the electricity requirement of the Indian industry is met from in-house power plants.

A large number of IT companies have also set up captive power sources in the form of generators usually DG sets.

Very few of the "Silicon" states in India are power rich. Karnataka (home to Bangalore, the Silicon City) for e.g., is deficient by over 20%. To promote the IT industry state policies are promoting captive power sources. Studies by the Tata Energy Research Institute indicated that 23% of the total power requirement of the State was being generated through captive power in 1998⁷ (this is the highest in the country). The new Millenium IT Policy of Karnataka provides total exemption to captive power generation sets installed by the IT industry from payment (I) of electricity tax without any time limit and (II) of sales tax on fuel used for captive power generation without any time limit.

Discussions on this issue with the Industries Commissioner (now having moved on to the Department of Power) in Karnataka indicated that this reliance on DG sets and captive power was a transition phase till the State became self-sufficient in power. Privatization of the power sector both generation and distribution is being considered. However in the last few years due to environmental impacts of large power projects and their location in ecologically sensitive areas in the State three major projects have not been cleared. To

ensure more efficient power availability, the billing system has been privatized in some parts of Bangalore City.

Adverse environmental impacts due to promotion of captive power can arise depending on the type of fuels used and from higher emissions per unit of production, as compared to large power plants. This needs to be considered when considering the fuels used for generating captive power and promoting greater generation of power through captive sources.

A report by the Tata Energy Research Institute on the issue of captive power in the country indicated that of the overall captive power generated by various industry sectors in the country, the electronics industry contributes only 0.5% and the services industry (of which software is typically a part) 0.6%. The net environmental impact may therefore not be as significant as it is from other more energy intensive sectors like engineering (which accounts for 20.1% of total captive power generated) etc.

Apart from power generation, demand side activities such as more efficient power consumption are also issues facing the power sector. In Andhra Pradesh, 25% concession in power tariff is being provided as an incentive for new IT units. Electricity duty is to be waived for IT industry in Maharashtra State.

Gujarat State is also providing power incentives in its IT policy. IT companies set up in designated Information Technology Sector will be considered eligible for exemption from power cuts. These measures would in a collective manner impact the power structure in the country given the overall power scarcity.

Promotion of utilization of non-conventional energy sources and co-generation are increasingly being promoted as more sustainable alternatives by the State of Karnataka and a number of other states in the country. The feasibility and viability of these schemes on a long-term basis is to be considered. In its encouragement for modernization of industry, the Government of Karnataka is also extending incentives such as grants in aid for units reducing energy consumption by 10% over earlier consumption (based on average consumption norms of previous three years), to the IT industry⁸.

If impetus is to be provided to the Indian hardware industry, energy becomes a very critical issue. Electronics and component manufacture would require uninterrupted, continuous power supply. Energy demands would therefore definitely escalate and one of the critical infrastructure ingredients required for the growth of the IT industry is power.

Supply Chain Pressures

Supply chain management is critical in the IT industry given that the quality and cost of the products depend on suppliers from all over the world. Strict vendor sourcing policies and supply chain audits are typically operational in large computer manufacturing companies both in multinational and domestic companies (*see interviews with Compaq and Wipro – Annex 1*).

With the increasing concerns on environmental impacts of this sector and its potential to be a high business risk, many companies internationally are taking responsibility for the full life-cycle of a product through product stewardship programs such as "take back" schemes and "extended producer responsibility." (mainly in Europe). Environmental concerns are also being incorporated into supply chain management and vendor sourcing policies leading to supply chain environmental management (SCEM). A recent study by the United States Asia Environment Partnership (USAEP)¹ on SCEM in the electronics industry defines SCEM as "…merging of a firm's environmental management policies and goals with its supply chain programs."

Internationally, SCEM practices are adopted by HP, Intel, IBM among others. In the case of Indian IT industry, both MNCs and domestic manufacturers (in hardware and software) are dependent on a number of suppliers and vendors. The MNCs in India, being 100% subsidiaries, adopt the supply chain requirements as laid out in the Corporate Codes of Conduct whether it is for manufacture (Compaq, IBM, HP and Intel have environmental requirements factored into the supplier / vendor sourcing policy) or sourcing hardware for R&D and software production (e.g., Texas Instruments). They source all their components from the world market (from pre-screened vendors). If the Indian hardware industry aims to provide components for manufacturing, SCEM will be a critical issue.

The domestic computers and peripherals manufacturers such as Wipro and Zenith do not have environmental aspects factored into the vendor sourcing policies. A very stringent supply chain management including supply chain audits exists for quality in Wipro, however, there is no environmental aspect factored in.

SCEM practices sometimes differ between the operations of MNCs in other countries and in India. A case in point is that of HP's policy for recycling consumables. While recycling of printer cartridges and toners is practiced through a recycle program in the United States, Hong Kong and Taiwan, HP does not have such a recycling program for India. Use of remanufactured cartridges / toners which has been practiced worldwide for the last 4-5 years is aggressively discouraged by HP in India through promotion programs and customer education pamphlets (*see Annex III*).

SCEM is still in its infancy and is growing but its emergence as a major tool in the world market must be taken note of by the Indian hardware market if it means to be a global player. Some recognition of this is evident in the domestic PCB industry, electronic components industry and peripherals (UPS) manufacturers. A number of companies in these sectors are working towards or have already received ISO 14001 EMS certification to enhance their position in the export market and global supply chain.

3.1.3 Industry's response

In order to understand the Indian IT industry's response to environmental issues and their current environmental management practices some of the leading players (MNCs and Indian) were interviewed through field visits, telephonically and through email. Based on

the information collected, using the above approach, the response of the industry to environmental issues can be categorized as:

- Adoption of Corporate Environmental, Health and Safety (EHS) policy;
- Presence of a distinct EHS Division in India;
- Absence of an environmental management division;
- Compliance with local environmental legislation;
- Efforts at Voluntary Environmental Management Initiatives;
- Role in End-of-life disposal practices;
- Stakeholder communication.

It must be noted at this point that this is by no means an exhaustive list of the IT companies in the country but a sample to understand the trend of environmental management in the industry.

Adoption of Corporate Environmental, Health and Safety (EHS) policy: All the MNC manufacturers covered during this study viz., HP, Compaq, and IBM^{*} stated that the corporate EHS policy and codes of conduct both for EHS and the supply chain were followed, to the extent applicable to the various operations being performed in India. These operations are largely manufacture of computers, servers and peripherals by assembling components sourced from outside India.

Adoption of EHS policy and standards by these companies in India ranges from the vendor sourcing policy to packaging. For e.g., Compaq in India sources its components from Compaq certified vendors in Taiwan, Malaysia, USA, and Mexico. HP DeskJet printers sold in India (mainly imported from Singapore) are cushioned using molded paper pulp made from recycled newspaper instead of expanded polystyrene.

The implementation of the various EHS requirements are verified through periodic audits by EHS auditors from the Principals. For e.g., at the Bangalore facility of Compaq, a six monthly EHS audit is carried out. This does not include an audit of the staff who typically undergo a one time exposure to the EHS codes during an induction program at the entry level. In the case of HP, the manufacturing facility at Bangalore had its first corporate EHS audit in 1999.

R&D Centres such as that of Texas Instruments^{\dagger} and the design centre of Infineon Techno^{\ddagger} at Bangalore adopt the EHS codes of conduct of their parent companies. These

[‡] It used to be Siemens Semiconductors till 1999. Now Infineon Techno is registered as an independent company with Siemens holding 75% equity. A design centre has been set up in Bangalore at the

^{*} Compaq and HP have well established manufacturing facilities which are undergoing expansion in Bangalore and IBM has recently (November 1999) started manufacturing operations in Pondicherry.

[†] The TI Asia Centre at Bangalore is a design centre where primarily chip design is done and there is 100% export of all activities. The design is sent through high speed links to TI Inc., USA. This Centre services only TI Inc. This is one of TI's four worldwide R&D centres. The others being in Dallas (US), Japan and France. Prototyping is not done. All the work is software and design oriented.

centres almost function as departments of the parent company and their activities and products are 100% export oriented servicing their principals.

At TI's R&D Centre the EHS policy and codes of conduct provided by TI Inc., USA are to be strictly followed (including building design, layout, ergonomics and safety). An annual report is sent to the US in response to specific performance indicators laid down by TI Inc. The company encourages the various facilities worldwide to go beyond compliance to EHS codes. An incentive is provided in the form of awards to the facility with the best environmental performance. This has developed a healthy competition between the various facilities of TI to improve environmental performance.

In fact TI's EHS policy mandated phasing out of halon based extinguishers in 1995-96 at the R&D Centre in Bangalore and CFC's in the airconditioning plant in Singapore.

In the case of Infineon Techno, corporate codes of conduct are more in the form of ergonomics, health and safety and the policy is mandated by Infineon Techno in Munich. This is applicable across all facilities. An annual corporate security audit is conducted by a team from Munich. The focus of this is to codify practices to ensure security of information. As part of this audit, office cleanliness, housekeeping as well as health and safety practices are also audited.

Similarly for software operations and sales and marketing activities at HP as well as Intel, the applicable elements of the EHS policy and codes of conduct relating to ergonomics and workplace health and safety are adopted.

Distinct presence of an EHS division in India: Presence of an independent EHS division is a rarity in the computer industry in India. Even among the various MNCs where the Corporate EHS Codes of Conduct are mandated, only HP and Agilent Technologies (which only markets and sells medical and measurement equipment in India)[§] have an independent EHS division with a country head responsible for local EHS practices.

Discussions with IBM, Compaq and Intel did not indicate the presence of an independent EHS division. In fact in terms of employee awareness across all levels and even at the level of Corporate Communications, there was no awareness about the existence of such a division. The responsibilities for EHS were typically part of the responsibilities of

International Tech Park. Focus of this centre used to be hardware design but now it is embedded software which is useful in wireless, automotive remote access, in industrial networking etc. This is a 100% FDI and services only Infineon Techno, Munich.

[§] Agilent's EHS will not be discussed in this report as Agilent Technologies (part of HP till November 1999) has a presence in India to market and sell products viz., measurement equipment, high-end medical equipment, chemical analysis equipment (very small segment of the market). No manufacturing takes place here. Agilent, like HP, has an EHS division in India - a proactive initiative given that presently it is not a very strong requirement. A separate EHS head has also been appointed recently under the title of Work Place Manager.

Human Resources or the manufacturing division. At IBM, a consultant was being used to promote awareness on environmental, health and safety issues through defined training programs.

Absence of an environmental management division: There was a complete absence of a distinct environmental management function in the organizational structure at the large Indian domestic players viz., Wipro, Zenith and HCL Insys Ltd. Discussions with representatives at Zenith and Wipro indicated that since the manufacturing function involved only assembling of components there were really no environmental issues of consequence.

Wipro has a PC manufacturing plant at Pondicherry that was set up in 1999 and a peripherals plant manufacturing Dot Matrix Printers at Mysore. Manufacturing here as in the case of other companies involves importing all components including the case from Taiwan, Malaysia etc. While quality checks are carried out at the plant and vendor selection policy is strong with a robust supply chain management in place, there is no environmental policy nor is there an evidence of integration of environmental aspects in the vendor selection, and supply chain audit. Wipro is a diversified company and its other operations such as manufacture of oils, consumer care products, and lighting equipment have environmental management as a function. The computers and peripherals operations however do not have an environmental management function in place⁹.

Zenith Computers Ltd., with 8% of the computer market share in India has its manufacturing plant in Goa. The company does not have an EHS policy or environmental management function presently¹⁰.

Compliance with local environmental legislation: In India, the electronics industry has been exempted from obtaining environmental clearance from the Ministry of Environment and Forests at the Centre or from the State Department of Environment since it belongs to the "non-polluting" category. However when a facility (particularly manufacturing) is to be established a Consent to Establish and a Consent to Operate have to be obtained from the State Pollution Control Board (SPCB). This consent requires information on the inputs into the operations at the facility and outputs likely to be generated from the facility.

Most of the companies covered during this study (both MNCs and domestic players) indicated that the consents from the SPCB had been obtained and periodic renewal of consents was being obtained based on inspections by the SPCB officials. The primary issue in all these facilities for inspection was the presence of captive power sources usually in the form of DG sets. These DG sets are regulateable by law via specific emission standards.

Environmental compliance in related sectors such as PCB and other electronic components manufacturers as well as UPS manufacturers is much more complicated due to the complex nature of the wastes generated. There are no specific environmental clearances or licensing processes for setting up of these units today. However they are

required to set up wastewater treatment plants in accordance with the requirements prescribed in the Consent to Operate issued by the SPCBs.

These units are also regulated by the Hazardous Waste (Management and Handling) Rules, 1989 (amended 2000) by virtue of the wastes generated. Compliance with the Rules is becoming more complicated with the amendment that makes the control on hazardous wastes generated from these operations more stringent. Almost 76% of the PCB manufacturing units in the country are SSIs who have both technological and financial constraints in establishing control systems to comply with legislation given the complexity of the wastes generated. Industry associations are increasingly working with the government and the various member industries to assist in environmental compliance.

Efforts at Voluntary Environmental Management Initiatives: Worldwide, voluntary initiatives in environmental management such as ISO 14001, and product stewardship are being increasingly discussed and implemented by the IT industry.

ISO 14001: HP and IBM have a strong ISO 14001 program for manufacturing facilities worldwide. In fact the websites have a separate section devoted to ISO 14001. In India however, HP's facility is not yet ISO 14001 certified.

None of the other computer manufacturing MNCs have as yet considered ISO 14001 to be a significant requirement. Discussions with Compaq India revealed that ISO 14001 is not critical for them since they have their Corporate EHS system in place. Both Zenith and Wipro also did not consider that ISO 14001 certification was critical for their market performance.

Quality related ISO certification however is considered critical in the IT sector in India. Compaq India's entire supply chain is ISO 9002 certified and Wipro is a certified ISO 9001 and 9002 company and also follows the quality management Six Sigma principle.

ISO 14001 certification is however increasingly becoming a strong requirement for the electronic components sector. A number of PCB and other electronic components manufacturers are working towards ISO 14001 certification. Assistance is being provided in the form of training programs, and consultancy promoted by Indian Printed Circuit Board Manufacturers' Association, ELCINA, MIT and UNDP. Monetary incentives are also being provided by the Government of India and State Governments like the Government of Karnataka for industries that have acquired the certification. The major driving forces are the increasing stringency of local legislation and the pressures of the export market particularly since India has set targets to significantly increase hardware exports in the next few years.

Product Stewardship: Initiatives aimed at product stewardship are reflected in the corporate EHS policies of all the MNCs viz., HP, Compaq, IBM, Intel etc. This ranges from product safety instructions, through recycling of products and consumables at the end - of - life stage, "take back" schemes to demanufacture and remanufacture initiatives.

While some of these initiatives are practiced worldwide a large number of them are country / location and culture specific in their application for e.g., "take back" schemes are operational strongly in Europe.

Product safety instructions like power connection and battery disposal accompany the products manufactured by Compaq worldwide. Products manufactured and sold in India also carry these instructions. No information however is provided regarding end-of-life disposal of machines nor is there a "take back" scheme for old / obsolete machines with Compaq in India. The very significant issue of obsolescence regarding computers emerged during discussions with Compaq. Obsolescence of computers in India is 2% per week so in 50 weeks the value of a computer is effectively zero (*see Interview with Compaq – Annex 1*). It would then have to be taken off the market and disposed suitably. To control this, an efficient inventory control has to be ensured. Compaq has a very tight inventory control therefore the piling up of machines at the warehouses is avoided.

Product safety instructions accompany the PC and peripherals for HP products in India. In the case of printers, particularly the laserjet, a leaflet encouraging the customer to join the toner - recycling program, *HP Planet Partners*, is provided. However, this recycle program is valid only in Hong Kong, Taiwan, USA, Canada etc. It is not operational in India. Such instructions are therefore not relevant to the Indian customer. Discussions with HP revealed however that "buy back" schemes for consumables like cartridges and toners exist in some metro cities in India. In Bangalore HP has a channel partner called Tech Pacific for buying back cartridges and toners. However, this is not very well networked and structured and it has not been extensively communicated to customers. As a result most customers of HP printers use the consumables (toners / cartridges) only once and then it is disposed with the general garbage reaching the municipal solid waste system. Obsolete PCs from HP facilities in India however are remanufactured at HP while at Compaq obsolete machines are very often donated to educational institutions.

As part of its Product End-of-Life Management (PELM) activities, IBM began offering product "take back" programs in 1989 in Europe and continues to expand this scheme. Reportedly there are 14 such programs in the U.S., Europe, South Africa and Asia with nine major Materials Recovery Centers around the world, and additional locations supporting parts return and regional collection¹¹. Neither through discussions with IBM in Bangalore nor with local dealers of IBM machines was any information available on the availability of this scheme in India.

Manufacturers such as Wipro, Zenith and HCL do not currently have any product stewardship initiatives such as end-of-life disposal schemes or "take back" for remanufacture.

<u>Role in End-of-Life Disposal Practices:</u> As mentioned in Section 3.1.2, in India products are Reused, Resold, Recycled, Demanufactured and eventually Disposed.

Reused: In India computers are reused to a large extent through (a) informal and one-toone donations by consumers to educational institutions and community group (b) corporate donations to educational institutions (e.g., Compaq donates old computers to educational institutions) (c) old machines being made available to employees at depreciated value (e.g., Wipro) (d) donation to non-profit groups.

Discussions with Texas Instruments at Bangalore revealed that R&D Centres and some software companies are allowed to bring in computers duty free into the country. However when they become obsolete donation of these machines becomes difficult since the companies have to pay the duty to the Government before they donate the machines. Large number of obsolete machines are piled up at TI's R&D centre and at Infosys in Bangalore since it is more expensive to donate than retain on-site. Disposal of these machines is becoming a big issue.

There are very few organized non-profit groups in India that collect obsolete machines, refurbish them and donate them to educational institutions. Probably the only such organization in India is FORCE (Foundation for Computer Education) based in Mumbai¹². (Section 3.1.4 discusses the activities of FORCE in greater detail as Civil Society's response to environmental issues associated with the IT industry).

Recently GOI has introduced fiscal policy initiatives to promote donation of obsolete computers (see Chapter 2, Section 2.4). The donation of computers, imported duty free by EOU/EPZ/STP/EHTP units to recognized noncommercial educational institutions, registered charitable hospitals, public libraries, public funded research and development establishments, etc., two years after their use by the above-specified units has been permitted. Moreover, second-hand computers and computer peripherals donated by an outside donor to Government schools have been exempted from customs duties.

Resold: In India, resale of computers is carried out by a number of computer assemblers as well as scrap dealers in the informal sector. Both cater to individual consumers and small businesses. Many computer retail outlets and third party vendors also take trade-ins when customers buy new machines. They clean up and refurbish the old machine, and then sell the used equipment for a profit. A large market for this resale of computers is the private coaching classes / tutorial classes in metros like Mumbai where a large number of students are provided special coaching for specific competitive examinations. It is extremely cost-effective for these institutions to buy resale machines as their overheads and infrastructure costs are reduced significantly. These machines are finally junked once their useful life is over.

Recycling of computers: In India recycling of computers is done typically by the scrap dealers in the very unorganized market. Discussions with scrap dealers in Mumbai (see Box 3.2) revealed that today recoverable components from computers are limited⁴. Over the last several years, to reduce costs, the computer industry has cut its use of precious

metals by as much as 90%. In addition, computer recyclers and scrap dealers are becoming inundated with various plastics - particularly ABS plastics (acrylonitrilebutadiene-styrene) typically used to make CPU and keyboard housings in place of metal which was used earlier. This shift in available material is making it more difficult for computer scrap recyclers to operate effectively. The scrap dealers also feel that if they are to continue to make a profit, they will need greater volumes of material and more advanced processing technologies. (See Box 3.2 for a report on the recycling market in Mumbai, India).

Precious metal recovery from mother boards is not typically carried out in India due to lack of availability of technical know-how and the necessary infrastructure. This is also borne out by observations made by recycle market watchers that "....the amount of precious metal recovered in one ton of recycled computers would normally require 30% more time and raw material when utilizing traditional methods".

Reportedly, in general, a ton of circuit boards yields approximately 10 ounces of gold. The average computer contains 0.25 - 1.0 grams of gold¹³. Other metals recovered include platinum, silver, copper, steel, and aluminum. Some interesting asides shown in Box 3.3 on the recoverables from a desktop PC, provide evidence on what the real worth of an old computer is.

Box 3.3 The real worth of an old computer ¹³		
Component	Percent (%)	Value (US\$)
Plastics	23	11.73
Aluminum	6.3	9.11
Steel	20.5	4.18
Gold	0.001	6.27
Silver	0.02	1.03
Lead	6.3	1.93
Cadmium	0.01	0.01
Mercury	0.0022	0
TOTAL	56.13	34.26

The figures in Box 3.3 thus indicate that approximately 55% of a standard desktop PC is recoverable with a scrap value of US\$ 34.

Recycling of consumables: Recycling in consumables for peripherals such as printers is a big business in India. Used cartridges and toners from inkjet and laserjet printers are recycled in two ways (I) refilled using ink sourced from bulk importers (II) refilled, repackaged and sold as original branded consumables. While the former is a legal but informal sector route the latter is an illegal market. In both cases the customer does not receive any guarantees¹⁴. Therefore in India there are: genuine cartridge providers i.e., the dealers of branded printers, genuine refillers in the informal market, traders who have smuggled consumables from South East Asia and illegal market pirated cartridge dealers.

A printer dealer thus receives consumables from a combination of all these sources. Therefore the average price of a cartridge from many dealers fluctuates and is many times lower than the original price.

Demanufacturing and Remanufacturing: Often coupled with computer scrap recycling is the process of dismantling computers into their constituent components, removing and testing chips, hard drives, CD-ROM drives, circuit boards, etc. This is done in India largely by the unorganized, informal sector. Some assemblers also demanufacture recovering useful parts for use in other machines. Demanufacturing by the scrap market in India is not organized.

If done skillfully, this is a highly specialized niche field and it has vast potential as microprocessor-based technologies continue to advance. However the demanufacturing market is dependent on the stability of the components market. Revenue is typically generated only when there is a shortage of a component in the market. The fluctuating prices of chips and components and the lack of quality control of this market in India makes it unstable and unreliable.

Remanufacturing is done by HP and Compaq using the old in-house computers from their operations in India.

Over the last two years remanufacture of compatible cartridges and toners is emerging in India. One of the largest players is Lipi Data Systems Ltd., based in Mumbai with a manufacturing facility in Udaipur, Rajasthan. The plant in Udaipur has a capacity of 5000 cartridges / month (roughly in India a 1999 survey said that there are 125,000 printers which accounts for about 500,000 cartridges a year as the market size). The domestic market needs to be first established but export is a long-term vision of the company. Box 3.3 presents some more details about remanufacturing at Lipi Datasystems Ltd.

Box 3.3 Remanufacturing of printer toners and cartridges in India¹⁴

Used cartridges are collected all over the country through regional offices (47 branches in the country) and brought to Navi Mumbai where they are sorted and screened according to product category. The cartridges are sent to the manufacturing facility at Udaipur where recoverable parts like the plastic body, are recovered, assessed for quality, worn out, other parts replaced and fresh toner / ink introduced. They are quality tested, packaged and made available to customers at 30% lower costs than the original with a guarantee and warranty. Lipi has been manufacturing dot matrix and laser printers for the last 6-7 years. The remanufacturing of cartridges has commenced about 2 years ago with actual production being about a year old. Today Lipi has 70-80 corporate customers in Mumbai. The entire business house of the Tatas are customers of Lipi.

Raw materials are imported from PBTI UK which has manufacturing plants in Florida and Surrey, UK. PBTI has collaborations in Japan and India (here it is only technical collaboration). PBTI also manufactures compatibles for Xerox, and Canon. The main source of raw material for PBTI UK is Japan and Taiwan. From there it is sent to UK / US and then sent by PBTI to India. Lipi is looking at directly sourcing the raw material from SE Asia.

The remanufacture market in India is very small and consumer awareness low regarding remanufacture. In India there are about 6-7 small players carrying out remanufacture in the unorganized sector. Lipi is one of the largest players and is in the organized sector. Modi Xerox is likely to set up a remanufacturing / compatibles manufacturing facility in Hyderabad.

The remanufacturing industry does face market resistance due to (I) the lack of awareness about the environmental advantages of using remanufactured cartridges. Customers request for at least 50% lower costs on remanufactured consumables; (II) the GOI does not have supportive policies in place for remanufacture; (III) lack of incentives leads to costs of remanufacture precluding low costs for remanufactured cartridges; (IV) drives by MNC market players such as HP to discourage customers from buying remanufactured cartridges.

Internationally, 40% of the printer consumable market share is with recyclers.

Internationally the compatible industry is more than 5-6 years old and enjoys policy and government support in a number of States such as Texas and California in the United States. In India, Lipi has not received any incentive from the Government and is facing stiff opposition from the branded players like HP¹⁴. HP discourages its customers from buying remanufactured cartridges and toners in India based on the premise that remanufactured cartridges in India are typically refilled or are fraudulent (*see Annex III for sample promotional material*).

HP however has a strong laser jet toner recycling program operational in Taiwan, Hong Kong, Canada and the United States is not applicable in India. Industry observers state that this could be because HP does not have a consumables manufacturing facility in India and transport of the used toner cartridges from India to Taiwan / Hong Kong could lead to damage of the cartridges and inability to use them for possible remanufacture. They would then have to be disposed off locally. *A formal response / feedback from HP India on this practice is awaited.*

Stakeholder Communication: Both internal and external stakeholders need to be aware of the environmental management approach of a company. A distinct feature in all the MNCs covered during this study was that the awareness about environmental management as a function was not clear sometimes even to the senior staff in manufacturing and operations. Senior Corporate Communications personnel at for e.g., HP, IBM or Wipro were not very clear about the position of environmental management in the organizational structure. Environmental considerations in product development was not presented as a competitive advantage.

Discussions with Compaq, HP and Agilent indicated that during induction training of employees exposure and awareness was provided on the corporate EHS codes. Training on a regular basis in EHS however did not appear to be a feature. Corporate EHS audits of Compaq in India for e.g., did not involve staff audit.

Annual Reports, performance of operations worldwide are communicated by all the MNCs on their respective websites. However the country specific web page for e.g., for India does not provide any information on the environmental performance / environmental management practices.

Stakeholder communication with respect to the supply chain is also not very strong in the case of these companies in India. Education / training of retailers / dealers on environmental issues associated with the products (both use and disposal of computers) as well as the associated consumables (printer cartridges / toners) and how it should be communicated to customers, is apparently missing. Sometimes as in the case of HP printers and cartridges, dealers / retailers are trained to aggressively discourage the customer from buying non-HP, refilled / remanufactured cartridges. The latter is a form of miscommunication given that the formal and organized remanufactured cartridge market is emerging in India.

Some models of IBM personal computers are equipped with extra bays and expansion card slots to allow upgrades. Additionally, many components, such as microprocessors and hard disk drives are designed for replacement when new, higher performance components are available. This is a move aimed at preventing constant replacement of PCs by users and therefore decreasing the need to dispose machines more often. Communication of such information and creating awareness among consumers about the monetary and environmental benefits of such initiatives is absent in the Indian market.

Having looked at how industry responds to environmental issues in this sector, the next section focuses on how civil society responds to these issues.

3.1.4 Civil Society's response

Civil society has also responded to some of the critical environmental issues associated with the IT industry but it is sporadic. Of particular significance is the presence of a non-profit initiative called FORCE for recycling old computers thereby increasing the time between purchase of a computer and its final disposal.

FORCE, is a Mumbai based initiative of Mr. P.D. Jain who has worked in the IT industry for over twenty five years (with IBM for 16 years and then with CMC a large Indian public sector electronics company). This organization collects old and unused computers from business organizations, tests and repairs them, and then redistributes them to schools and colleges particularly disadvantaged urban and rural schools. FORCE accepts all models of computers, as well as peripherals and hard drives. About four years old (started in 1996), FORCE has found that the introduction of computers in schools has caused several positive changes. Attendance to school has increased, as has interest in learning about the computer. Such schools also invariably graduate to higher grades of computers on their own volition. The organization is dependent on donations from concerned NRIs. It has no other branches in India, nor does it invest in promotion. Currently, FORCE is seeking financial support from NRIs in the United States. FORCE is also involved in computer literacy¹².

FORCE is finding it extremely difficult to obtain donations of obsolete machines from corporates as they prefer to either directly donate to institutions / junk or sell old machines as scrap. Some corporates donate used machines to schools, thereby aiding the admission of its employees' wards into the same institutions!

One very important factor affecting the success of reuse groups like FORCE is the fact that they often receive as many non-functioning computers and peripherals as they do working ones. In such a case FORCE discards it into the municipal waste bin. It is important to begin to quantify the number of computers these organizations currently handle on a monthly basis, and the number that could be handled were the public more educated about this issue.

It was not possible to identify any NGOs working on environmental issues associated with the IT sector in India. Labor issues are occasionally studied by some NGOs but no significant / active studies / initiatives appear to have been reported.

Given the increasing growth of the IT industry and the various issues that need to be addressed, there is an increasing need to increase industry's accountability through development of a stronger civil society response. This would also influence government policy particularly with respect to responsible management of the products and wastes from the industry.

3.2 Labor issues in the IT sector

The principal strength of the country with respect to the IT sector has been and continues to be the abundant availability of skilled and technically qualified manpower. Labor issues are therefore a very integral part of this industry. The difference between this industry and other labor intensive industries in the country is the presence of a largely technically skilled workforce in the IT industry. The rapidly growing nature of the industry requires that the productivity of this workforce is high on a continuous, sustained basis.

The various relevant labor issues that will be discussed in this report are:

- Intellectual property and "brain drain"
- Working conditions (including health and safety)
- Working hours
- Wages
- Unionized representation
- Gender issues

3.2.1 Intellectual property and "brain drain"

Intellectual property in the form of technically skilled, highly qualified and competent manpower is India's competitive advantage in the IT industry. In 1999 the IT industry as a whole had 300,000 technical and managerial personnel¹⁵. Figures for the software industry alone in 1998 were about 200,000 people¹⁶ up from 140,000 in 1997 and between 2500 and 6800 in 1985¹⁷.

Type of workforce and status of skills

Studies on the software industry by Heeks¹⁸ in 1996 and Lateef¹⁷ in 1997 indicated that this sector per se is not a very large employer. By the mid-1990s, the software industry employed about 8% of the total electronics industry workforce and about 0.5% of total employment in the manufacturing sector in India. The studies also indicate that the export side of the Indian software industry is extremely skill intensive. The number of software professionals working for the export sector are approx. 20% of the total software industry workforce and generating an export revenue figures of about 58% of total revenues. Hence with the targets of increasing export revenues, the demand for highly skilled personnel will continue to increase.

This demand for technically skilled personnel will have to be drawn from the very large English speaking, skilled labor force in the country. It is interesting to note at this point that India has been emphasizing the development of a strong technical workforce both in its industrial policy as well as in the field of education since the post-Independence period. 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 labor intensity, and its foreign exchange earnings potential.

According to NASSCOM, with over 4 million people with technical backgrounds, 1,670 educational institutions and over 55,000 graduates in engineering and the sciences every year, there is a rather large "trainable" technical workforce. Management institutes produce 40,000 management graduates annually. All these are potential entrepreneurs.

India also has a vast pool of existing and on-going scientific and technical research carried out by a large number of research laboratories, including defence laboratories as well as universities and technical institutes.

These skills however need to be constantly upgraded since technologies change very fast. Further, to meet global needs, India needs to continuously add to its manpower pool. The global advancement and worldwide opportunities are so huge that India needs to train more skilled manpower in this field, so as to fulfill demand, not only in India, but across the globe.

In fact studies in 1997¹⁷ showed that demand far outstripped the supply of professionals. In the United States the demand for programmers had risen to 190,000 and world-wide there were over 900,000 programming jobs waiting to be filled. There are, therefore, a large number of projects that need to be completed or that have not been initiated because of the lack of manpower.

Both manufacturing (particularly assembling) and the software industry require a skilled, technical labor force. However the profile of the skilled Indian labor force has always

been discussed with respect to the software industry due to the significant impact that its growth has had on the Indian economy, education, employment situation, and the socioeconomic structure. Some skews or unevenness has been observed by many researchers in this area which, will be briefly discussed here in the context of labor.

Body shopping

In Chapter 2 while discussing the evolution of the IT industry it was observed that in the early days of the Indian software industry's foray into the global market, a large part (more than 75%) of the work was onsite. Indian professionals were contracted out to US companies to implement the tasks. This led to an *international <u>skill</u> division of labor¹⁹* whereby, the majority of software contracts resulted in Indian workers doing the programming work rather than the higher skilled systems analysis or design of the software. This combination of onsite and programming work has come to be known as **'body shopping'**.

Studies^{17,18} on the "body shopping" trend showed that in 1990 over 95% of Indian software companies were involved in body-shopping activities and of the 3,000 programmers who were working in the software export sector, the majority of them were on assignment abroad. During these studies discussions with some industry leaders indicated that body-shopping was a necessary first step for the Indian industry particularly at a time when it was difficult and expensive to import the latest hardware and software technologies. The opportunity to travel abroad was therefore the only way that many of the Indian programmers and engineers were able to use and understand these advancements.

Body-shopping, is not a sustainable activity given the constant risks of these firms in losing their workforce to clients abroad. Better working environments, higher wages, greater exposure to new technology and challenges made this a great risk.

Since the last 6-7 years however body shopping has reduced extensively. It is becoming logistically more difficult and financially non-viable. For example, the United States Government in 1989 and later in 1993 placed visa restrictions on Indian programmers. These restrictions made it harder for Indian programmers to obtain visas and stipulated that Indian programmers were to be paid according to the prevailing wages in the United States and were to be taxed on their United States income.

In addition to these barriers for exporting programmers, rapid advancements in telecommunications technology, and the growing reputation of Indian programmers and their ability to handle fairly sophisticated projects on time, has led to Indian firms being offered contract programming services offshore, in India. This process began in 1989 but it was not until 1993 that the Indian software industry began to reduce its involvement in body-shopping activities quite significantly¹⁸.

From Onsite to Offshore contracts

Offshore work has now increased within individual firms, particularly the subsidiaries of multinational firms however onsite programming continues to form the larger share of the export activities. This is largely because of the continued existence of some barriers such (a) lack of confidence or a perception of risk by the clients vis-à-vis the contractor's skills and ability to deliver (b) cost, credentials, productivity and quality of workers for on site work. Indian firms working onsite perform well in such situations. In the case of offshore turnkey assignments, as observed by Heeks¹⁹, cost is less important while management skills, quality, proven expertise and access to technology all become much more important. Indian firms working offshore tend to score much less well on these, making a transition that much less likely to occur from onsite programming to offshore turnkey assignments.

Apart from these barriers there are two other significant issues: (i) overseas "brain drain" of the more experienced technical and managerial workforce has led to 85% of workers in Indian software exports being programmers. This therefore encourages programming-only contracts and (ii) managers in Indian companies prefer to retain some onsite work to retain their workforce as well as this provides exposure to changing technology and reduces the attrition rate since the workforce seeks international exposure.

As discussed earlier the advances in telecommunications technology has improved communication and by allowing access to the client's mainframe computer, based overseas, from terminals based in India, problem of hardware availability in India has been overcome. The improved communication has also facilitated regular diagnosis and maintenance work and has enhanced the ability of foreign clients and Indian developers to interact on a daily basis. This has given rise to the "24-7" culture (communication and work happening almost for 24 hours and 7 days in a week due to the time differential between the US and India) which Infosys is believed to have initiated. Retention (to some extent) of the intellectual property in India has also been possible since a larger amount of offshore work of greater quality and skills is available now.

Another recent development has been the relaxation of labor regulations for hiring foreign nationals²⁰. This would easily allow the clients from other countries to send project managers to India and coordinate long term offshore jobs more effectively as well as build sustained, long term relationships. Earlier the services of foreign nationals could be engaged for an aggregate period of only 12 man-months. As a result of the revision in the rules, prior clearance of the Ministry of Home Affairs, GOI in case of engagement of foreign nationals exceeding one year at a time, has been dispensed with provided the foreign national concerned holds a valid employment visa.

Moving up the value chain

With more offshore contracts, the Indian contribution is moving up the value chain working on system design rather than restricting to programming or coding, testing, installation and maintenance. Cases in point are the R&D Centres of TI, and Infineon Techno which have capitalized on the intellectual property in India putting Indians higher up on the value chain. TI's presence in India is in the form of its Asia R&D Centre in Bangalore. This is a design centre, primarily chip design, an offshore facility which exports all of its activities to TI Inc. via high speed data communication links. This is one of TI's four worldwide R&D centres. The other being in Dallas (US), Japan and France.

Infineon Techno has set up a design centre for software at the Information Technology Park in Bangalore. The focus of this centre's activities used to be hardware design but now it is embedded software which is useful in wireless, automotive remote access, in industrial networking etc. This is again a 100% exporting unit providing services only to Infineon Techno.

Out of its eight R&D Centres worldwide, IBM has located one on the IIT Delhi campus. The laboratory at Delhi is about two years old working on developing e-business solutions, speech recognition, IT applications for weather forecasts etc. Intel has technology laboratories at IIT Mumbai, Delhi and an Intel laboratory for Microelectronics in Mumbai and an Intel Multimedia laboratory in Bangalore. A Visual Computer Lab was established in 1997 at the National Centre for Software Technology – an autonomous unit of India's Department of Electronics – in Mumbai and a Center for Advanced Cinematics was launched at in Mumbai by Intel.

Industry watchers predict that over the next 8-10 years India may emerge as a global research and development centre for software. Apart from TI and Infineon mentioned above, ComputerVision does 80% of its global R&D at Pune in Western India. Novell has set up its R&D Center in Bangalore, and the operating system for Oracle's Network Computer (NC) was written in Bangalore. Baan from Europe has announced that it would undertake 80% of its global R&D in Hyderabad while Microsoft is setting up its first R&D center outside of the U.S. in Hyderabad¹⁶.

British Aerospace has set up a software R&D center at Bangalore in collaboration with Hindustan Aeronautics. Adobe has set up its R&D center at New Delhi. Lucent and AT&T have started their high-tech R&D in software in India in Pune and Bangalore. British Telecom has set up its software unit at Pune in collaboration with the Indian Industrial Group The Mahindras. IBM, Microsoft, Oracle, and Silicon Graphics are investing extensively in R&D schools in India¹⁶.

All this has resulted in creating more challenging jobs both in terms of pay structures, international working environment, and exposure to cutting edge technology – all of which is to some extent contributing to retaining the intellectual property.

3.2.2 Working conditions (including health and safety)

An examination of the issues pertaining to working conditions here includes workplace health and safety (including ergonomics) in manufacturing and software facilities. Manufacturing facilities for components necessarily require clean, enclosed, controlled temperature areas due to the strict product quality standards demanded by the industry. However, during component manufacture workers are exposed to soldering fluxes, solvents such as Isopropyl Alcohol, TCE, bonding and adhesives, etc. and typically with no significant personal protection like masks²¹.

One notable feature of all the IT companies visited was the stress and focus on fire safety.

At computer manufacturing units in the country, no chemicals are used and the process is largely automated in clean rooms with controlled environments. Ergonomic issues however are relevant from the point of health and safety.

In India the working conditions (including health and safety) at a manufacturing facility are regulated by the Factories Act, 1948 (amended 1987). Conditions and standards for workplace cleanliness, disposal of wastes and effluents, ventilation and temperature, exposure limits to dust and fume, definition of overcrowding (in terms of area / volume required per worker) and lighting are specified by this Act.

In terms of space available per person there typically is overcrowding in smaller operations where the space available per person is anywhere between 40-60 sq.ft. In the larger more established IT companies however it ranges from 80-100 sq.ft. providing very comfortable working conditions.

Apart from working conditions within a formal workplace, the software industry also raises the issue of working conditions in the case of working from home offices. To elaborate on this, the above discussion on trends in the use of intellectual property in India needs to be revisited. As discussed above, improved telecommunications has led to an increasing trend towards offshore work and this has led to a ".... delocalisation of information processing work....." described as "teleworking.²²" This includes using telecommunications to work within (telecommuting) and across national borders (teletrade).

While teletrade has been in practice in India for a while and is largely the mode of operation of the IT industry today, telecommuting in India is still in its infancy. Increasingly however with modification of Labor laws in the country both at the level of Government of India and the State levels on the anvil, working conditions will undergo significant changes.

Some of the main drivers for telecommuting to become a viable proposition in India are: working practices becoming flexible; commuting in cities like Mumbai and Bangalore is becoming increasingly resource intensive due to congestion; a high concentration of women in the IT sector (with family responsibilities); opportunities for self-employment and the mushrooming of 'SOHO' ('small office; home office') businesses; telemediated services such as telebanking and teleshopping are on the increase, telephone help lines are providing access to customer service departments or government information.

Working conditions and health and safety conditions will therefore vary between operations in an office and in the case of telecommuting.
While discussing these working conditions it is essential to recognize the typical health and safety issues associated with working with computers.

Health hazards due to working with computers

Literature has established five types of health hazards attributed to working with computers²³. This needs to be examined in the context of both office-based operations and telecommuting. The health hazards include:

<u>Musculoskeletal</u>: This includes a range of disorders of the neck, upper limbs, shoulders and back (well known among these being tendinitis and carpal tunnel syndrome). A category of injuries of musculoskeletal origin termed Repetitive Strain Injury (RSI) describes injuries to hands, wrists and neck.

<u>Visual capacity</u>: Deterioration of visual capacity, eyestrain and tiredness, loss of focus and mobility, reduction in capacity to dilate pupils, cataracts and a range of discomfitures due to eyestrain such as blurred and double vision, migraine, nausea etc.

<u>Stress and fatigue:</u> In the short-term it could include irritability, depression, headaches, insomnia etc. while in the long-term it could lead to heart disease, high blood pressure, anxiety, dermatitis, fertility problems among other problems.

<u>Reproductive Hazards</u>: Due to exposure to ionizing and nonionizing radiation from the Visual Display Units it is reported that reproductive hazards such as miscarriages are likely. However this is issue has been extensively contested.

Discussions with the various companies visited as part of the present study indicated that among the MNCs and large domestic companies workplace ergonomics was considered to be a significant issue. Employees were provided with instructions on optimal distance from the monitor, keyboard positioning, correct working posture, optimal lighting etc. Fire safety was accorded high priority at most of these companies.

In the case of Infineon Techno for e.g., corporate codes of conduct on ergonomics, health and safety are mandated in the policy by Infineon Techno in Munich. This is applicable across all facilities. Performance is assessed by an annual corporate security audit conducted by a team from Munich. The focus of this is to codify practices to ensure security of information as well as health and safety. At TI's R&D Centre, ergonomic experts from TI Inc. were brought in to provide advice on seating, correct working posture for more effective productivity.

At Agilent²⁴ and HP, Corporate EHS codes are applicable for software development as well. These include non-usage of Lead, Asbestos etc. in construction and ensuring ergonomically sound workplace conditions.

Increasingly, employee welfare in the form of good working conditions is becoming critical for the software industry to retain the skilled workforce. A number of companies

(both MNCs and domestic) are setting up offices in well equipped, state-of-art infrastructure like the ITPL at Whitefield in Bangalore, Software Technology Parks or specialized areas like Electronic City in Bangalore. Complexes like the ITPL (a private sector, Government of Karnataka collaboration) which offer modular offices with uninterrupted, clean power supply, domestic wastewater treatment facilities, well designed, illuminated and well ventilated working area, common recreation facilities such as gymnasium, restaurants, bookshops, landscaped open areas, banking facilities etc. provide working environments equivalent to any facility overseas.

However, the need to adhere to project deadlines, and ensure just-in-time delivery does create stressful work conditions. The duration of this study was not long enough to make a more categorical comment on the working conditions in some of the smaller operations.

Summarizing the status of health and safety at the workplace for the IT industry here is a quote from a study by the United Nations University on teleworking in India²⁵

....In chemical technology, the accepted guidelines of the ILO say that in case of transfer of technology, the companies should follow the same/similar stringent standards as they follow in a developed country. The same principle should apply to transfer of or sub-contracting of computer-related work. The Occupational Health and Safety standards of radiation, furniture like chairs, eye check-ups, regular breaks etc. should be implemented in India...

No information was however available regarding how these aspects are integrated into the EHS audits at MNCs and into day-to-day operations.

3.2.3 Working hours

The working hours at the manufacturing facilities, like in the case of all other industrial sectors, are regulated by the Factories Act 1948, (amended 1987) which stipulates 48 hour week for adult workers and 9 hour days. In Offices however a work-week is generally considered to be 35 to 40 hours.

Increasingly, flexi times are being permitted for the electronics sector. In Mumbai where software processing is done for foreign airlines at the Santa Cruz Electronics Export Processing Zone (SEEPZ), many software companies have been operating under flexi time conditions since 1996-97.

The working shifts are also as applicable for other industries i.e., three shift system. Women, according to the Factories Act however are not allowed to work more than one shift. They can work only between 06.00 h and 21.00 h. Flexibility under this provision is also being practiced by many companies. In fact the State Government of Karnataka proposes to modify the labor law to permit women to work in three shifts with a caveat placing the onus of employee safety on the employer.

Smaller software companies are regulateable by the Shops and Establishments Act and not under the Factories Act. Typically official working hours for many of these software

companies is 42-45 hrs. For e.g., in Infineon Techno and TI in Bangalore the employees clock 42 h, 5 day working weeks with flexi times.

Increasing competition from countries like Taiwan, Singapore, Korea and Philippines, has led the Government of India to consider simplification of labor laws limited to the IT industry to remain on par with the labor laws in these countries. Some of the major changes suggested by the IT Action Plan II (more detailed discussion on this is provided in Chapter 4.0) for the manufacturing sector include flexi times, increase in working hours, and night shift for women.

3.2.4 Wages

India not only has a skilled labor force but also inexpensive vis-à-vis international standards. Studies¹⁷ suggest that in the mid-1990s, salaries for programmers and systems analysts were 4-5 times lower in India than in the UK and 6-8 times lower than in the United States.

More recent data however indicates that wages in the Indian software industry have been rising consistently at over 20% a year since the early 1990s. NASSCOM estimates that the average basic salary rose by over 23% in 1995. These rates are not very different to the software industry in other countries. Studies by Lateef¹⁷ and Heeks¹⁸ attribute much of the rise in wages to the tight labor market in this industry and the very high turnover rate of 16%. A three year long study (1997-1999) by the UNU INTECH²² showed that even with rising wages, wages in India were 16% of those in the US in 1999.

Apart from the wage increases the overall monetary compensation has increased significantly with schemes like the ESOP (Employee Stock Option Scheme) being announced by a number of the larger IT companies with Infosys being one of the leaders.

These wage increases however, are primarily in the large Silicon metros like Mumbai and Bangalore. This may present a problem for India in the future as lower cost locations begin to enter the market and to compete for similar projects. Today the IT industry is one of the highest payers in the Indian market. This also has been responsible to some extent for retention of some of the talented workforce and marginally deterring the "brain drain."

This rising rate in wages will very soon have to be reflected in corresponding rise in productivity if the process is to be sustainable. Moreover charges, such as overheads, transportation costs, telecommunications costs, office space, travel allowances etc. are not that much lower than in other countries. This according to Lateef¹⁷ weakens India's advantage, although it still figures as a low cost location.

Wages are not uniformly high across the IT sector however. For e.g., in subsidiaries of multinational companies, particularly of airline companies, and companies outsourcing medical transcription that undertake back office functions for core companies in the US and Europe, in the Santa Cruz Export Processing Zone in Mumbai, the wage differential between India and the US is as follows: An average medical transcriber in India has a

salary of US\$1200 per annum compared with that of US \$25,000 in the US. As a result of which IT enabled services has a huge growth potential in India²⁵.

3.2.5 Unionized representation

The IT industry in India is characterized by absence of unionization. Discussions with the MNCs and domestic companies during the field visit indicated that unionization was probably absent in the sector due to the highly skilled nature of the workforce and the relatively smaller size of the workforce in any one facility vis-à-vis other industry sectors. Lateef¹⁷ in her study on the Bangalore software industry also found that as the workforce is largely made up of professionals, and unionization is very low. This is probably because as educated, highly skilled professionals they are able to negotiate effectively and protect their rights.

The Industries Commissioner of the Government of Karnataka attributed the lack of unionization to the high attrition rate of this sector which continues to be high and of the order of 9-10% with job changes happening every 1 to 2 years.

A study on organized labor and economic liberalization in India²⁶ notes that "...since the mid-1980s the practice of human resources management has significantly altered traditional union-management relations in the advanced sectors of production, notably in multinationals and other private firms....". The modern human resource management practices operational today in the private sector are characterized by more direct communication between managers and employees; individualized and/or contingency pay systems; flatter organization structures through work teams with team leaders who often form part of the management structure and carefully designed and fairly objectively implemented performance appraisal systems.

This apparently does not seem to have affected union effectiveness at least in the manufacturing sector in India. However the study goes on to note that "....in the skill-intensive service sectors such as information technology, human resource management practices continue to pose a challenge and possibly create permanent barriers to union entry and organization....."

The issue here really is whether unionization is needed in the IT sector given the highly technically professional workforce who are capable of protecting their rights. However, what happens in situations such as for e.g., IT enabled services where the workforce will not be as technically skilled and in situations of contractual labor where the operations are very small or people telecommute? Some system of organized counseling or human resource management will have to be devised to ensure that worker rights are protected.

3.2.6 Gender issues

Manufacture of electronics, has traditionally employed women particularly for the assembly operations due to their greater dexterity. Discussions with Compaq also indicated that there was a greater preference for women due to their dexterous skills. At Compaq women also head and manage shifts. Studies by the UNU INTECH also found a

similar preference shown by many IT companies to recruit women. This was reportedly also due to the attrition rate among women being lower than that among men.

A gender division of labor was however observed due to the "body shopping" phenomenon in studies by Heeks¹⁹. This study reported that only about 10% of Indian software developers are female. When onsite work was the predominant export earner for the software industry, many women faced difficulties at having to work overseas. However discussions with some of the women employees indicated a preference for software development careers as it ".....offered a more relaxed and less discriminatory atmosphere than many other Indian employment options.."¹⁹.

Lateef¹⁷ reports that the software industry in India, like in other countries, is highly male dominated, with about 86% of the labor force being men. In terms of remuneration, women are paid at an equal pay-scale.

Surveys carried out during the UNU INTECH study²⁵ indicated that in software women enjoy preferences on a scale that they never experienced in any other field of engineering and science. In the metro cities like Calcutta and Bangalore, the percentage of women is higher than 19% - the average figure for India. In both of these cities women typically occupy 20- 25% of professional jobs. Neither in Bangalore nor in Kolkata did the researchers find any evidence of discrimination, either at the point of recruitment or in career progression. Women receive a very large proportion of remote processing jobs. In Mumbai, in large subsidiaries of multinational airline companies, for example, 60% or more of the employees are women. The salaries, at Rs 5000 (US\$ 100 approximately) per month for a trainee, are good by Indian standards.

The UNU INTECH study also reports that from over 500 employers interviewed across all sectors software was the only sector, barring one or two instances, which said that they prefer women. In fact some of the larger companies have taken proactive steps such as providing crèche and other facilities to retain women. Telecommuting is being tried by some software houses in Bangalore to make it easier for women with children to be in the profession. As more women have become eligible for recruitment, the gender balance of the workforce has changed.

At Infosys, for e.g., women employees who have children can take advantage of a company run crèche. Some firms, such as Novell Software and WIPRO for instance, are experimenting with telecommuting in order to maintain the skill-levels of female workers with young children.

Companies such as Datamatics receive assignments from their international clients. In turn, they pass these to women teleworkers who work from their homes, mostly on-line, and with their own computers. These home-based teleworkers comprise a wide range of women: housewives, doctors, lawyers, chartered accountants.

The IT industry thus appears to be bringing some attitudinal changes in gender issues.

Another important gender issue is that of exposure of pregnant women to monitors at the workplace. There do not appear to be any studies done in India on this aspect and even internationally, the cause - effect relationship between exposure to monitors and reproductive disorders has not really been established.

3.3 IT industry and the Community

The interaction and impact of the IT industry on the community has been at two levels: local and national. At the local level it has meant: changes in the local infrastructure, pressures on utilities due to growth of the city, growth of the local economy and the employment opportunities, sociological changes due to changes in the socio-economic structures, changes in land use, rising real estate prices, and focus of the educational system becoming strongly "IT centric."

At the National level the IT industry has brought about, growth of the economy and a pre-eminent position in the global market, very rapid growth of the large and small metros, employment opportunities and increasingly greater retention of intellectual talent in the country and access to latest technology. Communication will improve with the increased access to Internet while e-governance hopes to enable greater transparency and accountability in governance. Civil society's participation in governance will be enhanced. E-commerce will have great implications for trade and business.

The various impacts of the IT industry will be considered in greater detail in the following sections of the Chapter under various headings. Here the categorization is in terms of the impact of the IT industry and the local and national level manifestations will be discussed as and when appropriate and relevant.

<u>Contribution to growth of the economy</u>: As discussed in great detail in Chapter 2.0 of this report (section 2.3), the IT industry's contribution to the Indian economy has been significant in the last few years. The sector contributed 15% to the country's export earnings during the last fiscal year 1999-2000 vis-à-vis 12.4% in 1998-99. At the State levels also this economic growth has been reflected in terms of local economic growth. What is essential now is to put policy and governance in place to sustain this growth.

A strongly export oriented industry can also have repercussions on local economic growth particularly since tax holidays are being provided as incentives for establishment of export oriented units, software and hardware parks etc. This would lead to a reduction in tax revenues, thereby affecting the State's ability to provide supportive infrastructure for the growth of the industry. In tandem with such tax incentives, alternatives such as an increasing need to privatize infrastructure development and services are being explored.

<u>Creation of employment opportunities</u>: The IT industry has tremendous potential to create employment opportunities. Some industry observers argue that the jobs created can be accessible only to the fairly well off and educated sections of society and that even

jobs that are at the lowest rung of the hierarchy may not be available to the poorer sections.

However, given the projected growth of IT enabled services: NASSCOM reports that in 1998-99 IT-enabled services employed 23,000 people. Projections for employment in this sector for 2008 is 1,100,000. This will therefore create greater employment per unit of capital and the requirement is not for a highly skilled technical workforce.

The employment opportunities in the IT sector particularly software and IT enabled services could quite easily be realized by the physically disadvantaged and disabled section of the community as well. A pioneering effort by IBM has been the donation of computers and providing training expertise to the Victoria School for the Blind, while developing and promoting use of software and hardware for the blind.

In essence therefore, with the right thrust to formal and vocational education in IT, the employment opportunities thrown up by the sector can be effectively used.

<u>Changes in educational system:</u> The meteoric growth of the IT industry has led to introduction of IT based courses and programs in schools, colleges and universities. Apart from premier institutions like IITs and IIMs and the various engineering and science colleges and institutions, which were and are the main sources of technical skills in the country, specialized IT institutes i.e., the Indian Institute of Information Technology (IIIT) are being set up across the country. Large IT companies both MNCs and domestic players are setting up laboratories in these institutes. Computer training institutes are mushrooming all over the country, offering skills ranging from basic computer literacy through programming to web design.

MNCs such as Intel and IBM are investing in intellectual skill development through various community based programs.

Intel has a program called Teach for the Future through which it is cooperating with the National Council for Education, Research and Training (NCERT) and a number of schools to promote computer literacy. Intel also sponsors an educational initiative for kids encouraging scientific thinking and creativity with incentives like visits to Intel's laboratories in the US and state-of-art PCs as awards for the winners.

Hardware and software has been donated by IBM to the Bharatiya Vidya Bhavan's school in Mumbai to enable free computer education to the economically disadvantaged. Also, a commitment to underwrite the operation and maintenance cost for the school for three years has been made by IBM. A Memorandum Of Understanding has been signed by IBM with the State Government of Maharashtra to offer free copies (not requiring licensing) of Lotus Notes, etc. to all government schools and colleges in the State.

There is thus a multi-pronged approach both by Government and the private sector at eventually ensuring that a large pool of technically skilled workforce is available for the IT sector.

The flip side of this is of course the mushrooming of a number of mediocre "training" institutions that offer attractive "training packages" to students eager to be part of the IT boom. Mere computer literacy or familiarity with standard word processing software does not guarantee a slice of the pie!

<u>Greater access to new technology:</u> With the increasing entry of MNCs, widespread access to the Internet and overall improved communication India has obtained greater access to new technology. This combined with the fall in computer prices has enabled the average consumer to access international quality products.

Falling prices of PCs has also provided access to more state-of-art machines for the Indian consumer. Initiatives by Intel such as the Genuine Intel Dealer (GID) program has encouraged vendors of Intel chip sets (in India as well) to become Genuine Intel Dealers. As a result, customers are able to get quality, cost effective computers and therefore Value for Money²⁷. This scheme aims at raising the technology access to the customer and improve the quality and technology level of the SSI of assembled machines. IDC India is currently carrying out a survey to assess how the GID program has improve the quality of the SSI i.e., the assembled machines sector.

PC Parties²⁷ have been held by Intel in many cities in India in the last year. Through PC parties, Intel is able to reach the home users, disseminate PC knowledge and uses. It lets people experience how they can use a PC at their home – to help kids' education, to help organize their home life, and how they could use it in their business life too if their workplaces are not yet computerized

Impact on infrastructure of cities: The IT boom has led to a rapid growth of cities like Bangalore, Hyderabad, Mumbai (the first city to have experienced the growth). As discussed in Chapter 2, the impact of unprecedented growth of Mumbai as the commercial capital of India led to soaring property prices, congested roads, long commute hours as the city grew linearly into suburbs and overall a deteriorating quality of life. The IT industry then moved to Bangalore where the dust-free, pleasant climate, reserve of technically skilled workforce was very conducive for growth.

Since 1992, Bangalore has become Asia's fastest growing city. Population had grown from about 4.8 million in 1991 to about 5.6 million in 1996. A part of this growth is attributed to the relocation of other high-tech industries from Mumbai to Bangalore. As in the case of Mumbai, Bangalore has grown in size spreading into suburbs.

Infrastructure and utilities such as roads, water supply, power, telephones are under tremendous stress. The situation in Bangalore and Mumbai is probably the most stressed. Road space in Bangalore (11.9%) is significantly lower than the international norm of 20-30%¹⁷. Congestion and lack of good, broad roads has led to environmental pollution and detrimental effects on health.

Electricity supply in Bangalore is inadequate as discussed earlier. There are daily scheduled power cuts since the demand exceeds supply at peak periods.

Bangalore which has always been a green city is experiencing the impacts of large scale construction activities. Green areas are being cleared for construction. However, corporate citizenship initiatives by IT companies such as Wipro, and Infosys are resulting in the creation of green islands, and landscaping of roads. Some companies like SAP Systems are setting up solar powered bus stands for the community in their attempt to offset and alleviate their impacts on the city.

Growth of the IT industry in Bangalore has not been supported by an anticipated development of infrastructure by the Government of Karnataka. Many industry observers and residents of Bangalore are of the opinion that the ability of the city to accommodate new investment and migration was overestimated.

States like Andhra Pradesh however have been more proactive in terms of infrastructure. The infrastructure in Hyderabad for e.g., has significantly improved over the last 5-6 years. Development of the Hi-Tech city and hi-tech parks outside the city limits have been done in preparation of the anticipated growth. Other states in India, like Maharashtra and Haryana, for e.g., have anticipated the electricity needs of their industries and are continuously upgrading. Maharashtra, for example, is an electricity-surplus state.

Encouragement of EOUs by providing tax holidays as an incentive for location in India can have repercussions on the local economy argues Lateef¹⁷. In cities like Bangalore where the more profitable businesses are 100% EOUs, tax revenues would reduce. As a result the resources for infrastructure improvement would have to be drawn from State grants which may prove to be unsustainable. Privatization of infrastructure development and services is necessarily therefore emerging as an alternative.

Both the hi-tech park in Hyderabad and the Information Technology Park Limited in Bangalore have been established through public-private partnership. The entire infrastructure, including the road, the electricity power plant and water supply, the buildings, and the telecommunications facilities are all provided by the company.

The GOK has initiated a number of projects to improve the roads, increase power generation and improve transmission and distribution. An elevated light train mass rapid transit system covering 90 kms is being planned to be carried out on a build-own-operate basis. It is aimed at easing some of the pressure on the roads and reduce the pollution.

To reduce commuting stress and increase productivity, the GOK is encouraging establishment of townships for the IT sector for e.g., the Electronic City where offices and residential blocks will be provided proximal to each other. Today, the Electronics City, is 18 kms outside the city centre and a number of software firms are located here including Infosys, Hewlett-Packard, 3M etc., but it is increasingly difficult for them to rely on public transportation to get their workers to work on time. Many of them have their own team of buses that make the trip between Bangalore, where most of the software professionals live. However the poor roads makes this commute extremely stressful.

The Bangalore, Mumbai situation could be repeated in other metros and probably more intensively in smaller cities as they enter the IT stage. Anticipatory policy measures in terms of water and power management, improved infrastructure, zoning of industries would need to be put in place to make the growth of this industry sustainable.

Land use changes and real estate pricing: To ensure sustained growth of the industry, land use changes are being sought in cities like Bangalore and Hyderabad. Acquisition of land for the IT industry has been simplified in many States. Subsidies and rebates on cost of land per a definite number of jobs created are provided by the Government of Andhra Pradesh as an incentive. The GOK is acquiring more land for hardware units and its is changing land use patterns in the city by allowing establishment of software companies in residential areas. This is aimed at reducing commuting time, decongesting the city and facilitating night shifts for women.

The State Government of Maharashtra, in its IT policy (1998), has permitted software companies to be set-up in residential areas and the inclusion of software industry in the list of users permitted in the No-Development Zone. In addition, permission to use agricultural land for non-agricultural purposes will not be required for the software industry in residential areas.

Zoning is being initiated through schemes such as Electronic City and Hi-tech City, Software and Hardware parks in various parts of the country. In the early days of growth of the IT industry in Bangalore, there was no demarcation between IT and the electronics industry, but increasingly specialized hardware and software parks are being established. A specialized IT corridor between Whitefield and Electronic City in Bangalore is being proposed with a Ring Road to connect the corridor. IT companies are being encouraged to establish offices and townships in the suburbs and the city is thus spreading out – like Mumbai did some years ago and continues to even today.

Property prices and rents in Mumbai had sky-rocketed 4-5 years ago and in spite of a fall in the real estate prices continues to be the highest in the country. Bangalore is also increasingly experiencing this rise in property prices. In 1995, interest in Bangalore real estate by NRIs from Hong Kong and Singapore led to a 200% increase in land prices in some areas.²⁸ Although real estate prices have risen faster than those of Bombay and Delhi, Bangalore is still cheaper.

Sociological changes: The impact of the IT industry has been on every aspect of Indian society ranging from education to life-style. Greater access to information and technology has increased awareness. With the onset of SOHO and telecommuting (although slowly) working styles become flexible, women's employment opportunities are undergoing a change and entrepreneurship has increased. It is beginning to influence people's perceptions of what it can do for their businesses, in terms of efficiency and in terms of linking them up with the global economy. Work culture of the global software industry is starting to permeate to other sectors, either through the movement of people between sectors or through the use of computers. Till date however this influence is largely on

metros. Here life-styles have become more affluent and international life-styles brought about by the "IT salaries."

The flip side of this of course is the pressure created on sections of society who are not a part of this industry. The pressure could range from affordability of housing to lifestyles. The growing difference between incomes in this sector and other sectors of the Indian economy, will thus have a significant impact on Indian polity and society.

In smaller cities and rural areas what will create sociological changes will be the intended plan of the government to provide Internet for All and the policy of e-governance already underway in some states in the country. Access to information in the local language will cut across barriers to education and awareness and will contribute to elevation of literacy. The benefits of which will be reflected in health, agriculture, business and the local economy.

Accountability and transparency in governance²⁹: One of the greatest fallouts of the IT wave has been the country-wide efforts at e-governance. This will definitely increase the accountability and transparency in governance and enable greater civil society participation.

Many Indian States have made significant advances towards implementation of egovernance. It is expected to improve efficiency, introduce transparency in governance, enable a dialogue between people and the government, lead to a more economical form of governance, and enhance public participation in governance.

The passage of the IT Bill, 1999 has provided an impetus to the establishment of egovernance by considering issue such as digital signature, security of electronic records and digital signatures, cyber laws etc.

Andhra Pradesh pioneered the concept of e-governance in India under the leadership of its cyber savvy Chief Minister Chandrababu Naidu. Streamlining of government procedures, greater accessibility to information by the public, aiming towards introduction of the Right to Information Bill, ensuring performance accountability of every officer in the State government are some of the results that the State aims at achieving. Andhra Pradesh is working at providing infrastructure, and secured environment to the IT market. Today there are 200 Software Technology Park companies in Hyderabad.

Closely following Andhra Pradesh in e-governance implementation is Madhya Pradesh. Citizen's right to information has been accorded high priority. The year 2003 has been set as a target to computerize and network all the district and local government (tehsil) offices of the State government. IT awareness and training programs run by the State Government are in operation. Hardware technology parks are proposed and 28,000 public call booths in the State are planning to be converted into information kiosks with assistance from the private sector. Rajasthan has leapfrogged into implementing IT in governance by passing the Right to Information Bill, 2000 on 1st May, 2000. Software technology parks have been set up at Jaipur in association with Rajasthan Industrial Development and Investment Corporation Ltd. Assurance of uninterrupted power supply and investor friendly land-use rights are some of the incentives to investors. Districts in the state are to be networked and through information kiosks data provided to citizens on demand.

Kerala announced a Computer Policy as early as 1970s and was the first State to tie-up with NIC for computerization of government offices as early as in 1986. Government has signed an MoU with WorldTel to set up Community Internet Centers throughout the State. STPs have become operational in Cochin, Trivandrum and Calicut. Small and tiny IT units are being encouraged in Thrissur, Kottayam and Kollam. Easy financing schemes for home computers have been launched to achieve PC penetration of 10 per 1000 by 2001.

Karnataka was the State to announce an IT Policy in 1997 with an emphasis on using IT to empower women. Of the 280,000 IT professionals employed in India, about 25% are employed in Karnataka only. An autonomous IIIT with state-of-art infrastructure and facilities has been established. Laboratories here have been sponsored by Sun Microsystems, IBM, Microsoft, Informix, Oracle, Apple, Adobe, Novell, Compaq, PTC, CISCO, Ramco, SAP and Computer Associates. 9 of the 19 SEI CMM level 5 companies are in Karnataka. Easy tax structure, venture capital schemes are some of the incentives for investors.

Delhi proposes to set up a High Tech City for IT at Dwarka Phase II over 100 acres of land and is expected to house 100 software units and employ about 10,000 software professionals. A Citizens' Discussion Forum is an electronic platform available on the Net facilitating public participation in governance.

Maharashtra was where the foundation of the IT industry was laid with the setting up of SEEPZ in 1972. The International Infotech Park at Vashi, Navi Mumbai is a futuristic IT village. Millenium Business Park a project by the Maharashtra Industrial Development Corporation (MIDC) is proposed 25 km from Mumbai over 18 acres and is proposed to have 32 buildings specially designed for software and IT-enabled services. First of its kind telecom ducts in the country to be laid for laying fibre optic cables.

What this widespread move towards e-governance has meant for the domestic software industry has been a large market for local language software.

At the level of the Central Government, the Planning Commission has instructed all the Government Ministries and Departments to earmark 2-3% of their allocated budget for usage in IT related area. An Electronic Governance Division has been created in the MIT which would strengthen and promote applications, application software and related hardware in this priority area to make information accessibility easier, faster and transparent.

Comprehensive synergic collaboration of concepts and implementation mechanism/methodologies are being firmed up with professional organizations of international repute. These efforts are expected to lay the groundwork for sustained appropriate and workable models of Electronic Governance. As a necessary support for e-governance and e-commerce, an 'Information Technology (IT) Bill' has been formulated to cater to the legal requirements.

3.3 Tailpiece

In conclusion it appears that based on their presence in the market and response to environmental, health and safety issues the industry representatives covered during this study may be categorized as those who:

Manufacture and sell: This includes companies who largely focus on manufacturing and sales of computers only, as well as computers and peripherals. Two types of players belong to this category (a) those who follow EHS corporate codes of conduct applicable to the local situation e.g., HP, Compaq, Intel and IBM (b) those who do not have an environmental management function in place e.g., Wipro and Zenith.

Create a market through innovative practices: Long term vision to establish themselves as market leaders in India puts Intel and IBM in this category.

Intel through its GID program is providing customers with greater value for money as well as working at creating a whole new set of small scale assemblers using Intel products. This is also contributing to eroding the grey market to an extent.

Both IBM and Intel are investing in intellectual capital by creating awareness and participating in computer literacy and education in India through community initiatives. While IBM provides free hardware and software to schools such as Bharatiya Vidya Bhavan, Intel promotes scientific curiosity and thinking in students through science competitions.

Are extensions of the principals: This category includes R&D Centres which are typically 100% subsidiaries of MNCs and who service only their principals. TI and Infineon Techno fall in this category. They operate like divisions / departments of their principals and follow corporate codes of conduct. Infineon Techno is a growth centre and not a profit centre and like TI exports all of its activities to the corporate office.

Through discussions on the environmental and labor issues and the response of industry and civil society as well as the impact that the IT industry has had on Indian society so far, it is evident that there is more to come! Since policy has largely shaped the way the IT industry has grown, it is fitting at this stage to take a look at the existing and emerging environmental and labor policies and regulatory framework that have and will shape the industry. This is the subject of the next chapter.

Endnotes

¹ Supply Chain Environmental Management: Lessons from leaders in the Electronics Industry. CTEM Program of USAEP. October 1999. <u>http://www.usaep.org</u>

² Based on an interview with the program co-ordinator Dr. U.C. Pandey, Director, Ministry of Information Technology, GOI. More information on this project is available at UNDP's website <u>http://www.undp.org</u>. The program is titled Environmental Management in Semiconductor and Printed Circuit Board Industry in India.

³ For information on end-of-life policy options see: Mid-Atlantic Consortium of Recycling and Economic Development Officials. End-of-Life Computer and Electronics Recovery Policy Options for the Mid-Atlantic States, 2nd Edition, March 2000. <u>http://www.libertynet.org/macredo/2elecinf.htm.</u>

⁴ Based on a field visit to the scrap market at Bhendi Bazaar in Mumbai, during this study.

⁵ Toxic Trade Campaign – Fact Sheet. Greenpeace. <u>http://www.greenpeace.org</u>

⁶ Based on email interview with Dr. U.C. Pandey, Director, MIT.

⁷ Captive power policy and cogeneration. Tata Energy Research Institute. 1999. <u>http://www.teriin.org/energy/global.htm</u>

⁸ Karnataka Industrial Policy and Incentives Package, 1996-2001. Also based on personal interview with Mr. V.P. Baligar, Industries Commissioner, Government of Karnataka. July 2000.

⁹ Based on a personal interview with Ms Sandhya Ranjit, Manager, Corporate Communications, Wipro Ltd. in Bangalore, July 2000.

¹⁰ Based on an email interview with Mr. Laksmanan, Vice President, Manufacturing, Zenith Computers Ltd., July 17th, 2000.

¹¹ <u>http://www.ibm.com/ibm/environment</u>

¹² Based on a personal interview with Mr.P.D. Jain, Director FORCE. He has worked in the computer industry for close to 20 years. He worked at IBM during a large part of his career.

¹³ See Recycling Old Computers at <u>http://kerr.arborlink.com/computers/recycle.html</u>

¹⁴ Based on email and personal interviews with Lipi Datasystems Ltd. in Mumbai. July 2000.

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¹⁷ Lateef, A. 1997. Linking up with the global economy: A case study of the Bangalore software industry, New Industrial Organization Program DP/96/1997 ISBN 92-9014-599-4. International Institute for Labor Studies.

¹⁸ Heeks, R. 1996. India's Software Industry. New Delhi: Sage Publications.

¹⁹ Heeks, R. 1998. The Uneven Profile of Indian Software Exports, Development Informatics Working Paper Series, Institute for Development Policy and Management, University of Manchester, Manchester, UK. <u>http://www.man.ac.uk/idpm/idpm_dp.htm#devinf_wp</u>

²⁰ <u>http://itfriend.mit.gov.in/advantage.htm</u>

²¹ Discussions with component manufacturers at SEEPZ and Bangalore, June-July 2000. Many of these are assembly units where chemicals used are fluxes for soldering, bonding and adhesives, solvents such as TCE, IPA etc. Clean room conditions have to be maintained during assembly but the workers do not use masks. Powder coating is also carried out wherein protection is provided in the form of masks. No environmental clearances are required when facilities are located in EEPZs. The only requirement is quality standards where there is a need for a clean room. Volatile Organic Compounds would be emitted from the ventilation systems but India has no standards for VOCs.

²² In July, 1997, the United Nations University's Institute for Technology (UNU INTECH) embarked on a major initiative to investigate the international trade in services ('teletrade') and telecommuting in the Asian context. One of the main components of the project was Telework and Teletrade in India. For more information on this project which was concluded in November 1999 visit <u>http://www.intech.unu.edu/program/proj9899/telework.htm</u>

²³ Pearson, R. 1995. Gender perspectives on health and safety in information processing. In: Women encounter technology: Changing Patterns of Employment in the Third World. Edited by Swasti Mitter and Sheila Rowbotham. Routledge London and New York. The United Nations University INTEC - Institute for New Technologies. 1995

²⁴ Based on telephonic interview with Mr. Ranjiv Mehta, Work Place Manager (with country-wide EHS responsibilities) Agilent Technologies, India, July 2000.

²⁵ Mitter, S. 1999. Teleworking and Teletrade in India: Combining diverse perspectives and visions. UNU INTECH. <u>http://www.intech.unu.edu/ program/proj9899/telework.htm</u>

²⁶ Bhattacharjee, D. 1999. Organized labor and economic liberalization. India: Past, Present and Future. Indian Institute of Management, Calcutta, 1999. http://www.ilo.org/public/english/bureau/inst/papers/1999/dp105/.

²⁷ Based on an email and personal interview with Ms Rema Menon, Head of Public Relations, Intel in Bangalore, July 2000.

²⁸ Financial Times. 1995. Survey: The Indian State of Karnataka. Thursday Oct. 5, pp.23-26.

²⁹ A large part of this section has been drawn from : Jha, A. Cyber States in India and e-Governance. PC World, June 2000. p.52-69