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Nagesh Kumar

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Research and Information System for the Non-aligned and Other Developing Countries,
Zone 4B, India Habitat Centre, Lodi Road, New Delhi-110003.
Tel.: 468 2175, Fax: 468 2174;
Email: nagesh@ndf.vsnl.net.in

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Indian Software Industry Development in International and National Development Perspective

1. Introduction

The rise of the IT software and services industry (henceforth software industry) over the 1990s represents one of the most spectacular achievements for the Indian economy. The industry has grown at an incredible rate of 50 per cent per annum over the past few years, is highly export-oriented, has established India as an exporter of knowledge intensive services in the world, and has brought in a number of other spillover benefits such as of creating employment and new pool of entrepreneurship. The evolution of India as an exporter of these knowledge intensive services has also created much interest in the development community worldwide. Encouraged by the Indian success, a number of other developing countries are trying to emulate her in entering the industry. There are also questions on the sustainability of the high growth rates of Indian exports in view of emerging competition, growing scarcities of manpower in the country, eroding cost advantage, and the recent technology slow down in the US and other markets of Indian software.

In this context, this paper attempts to put the Indian software industry development in a perspective. First, the capability and strengths of the Indian industry is evaluated in an international perspective to gather a relative strength of the Indian achievement (Section 2). Then a national development perspective is applied to evaluate the achievement of the industry (in Section 3). Section 4 examines the challenges to sustainability of exports of the industry in the coming years and briefly overviews the steps taken by the government and industry to respond to them. Finally the paper is concluded with recapitulation of the main findings and a few remarks for policy.

2. Indian Software Industry Development in a Global Perspective

As shown in Table 1, the Indian software industry has grown at a phenomenal compound annual rate of over 50 per cent over the 1990s from a modest revenue of US $ 195 million in

1989/90 to evolve into a $ 8.3 billion industry by 2000/01. Furthermore, the industry has earned 75 per cent of its revenue (totaling $ 6.2 billion) from exports.

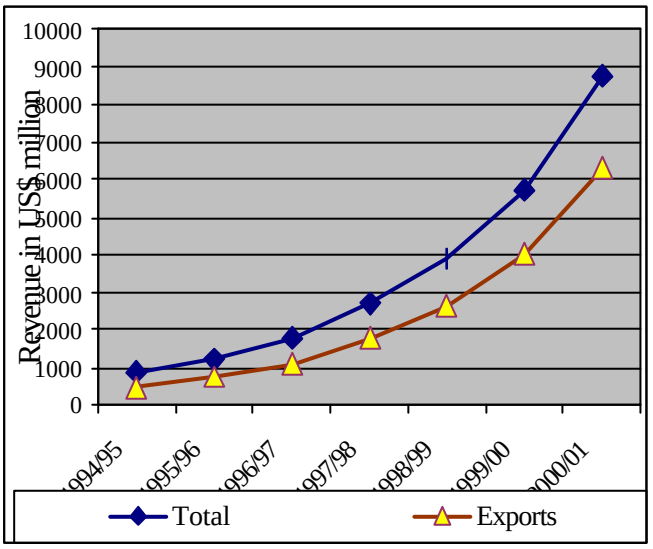
Table 1: Indian Software Industry Revenues and Exports

(US $ million)

Year	Total	Domestic	Exports
1989/90	197	97	100
1994/95	835	350	485
1995/96	1224	490	734
1996/97	1755	670	1085
1997/98	2700	950	1750
1998/99	3900	1250	2650
1999/00	5700	1700	4000
2000/01	8260	1960	6300
2001/02[p]	11200	2700	8500

Notes: [p]projection.
Sources: based on Hanna (1994), Heeks (1996) and Nasscom (2001).

Figure 1: Revenues and Exports of Indian Software Industry



Source: Table 1.

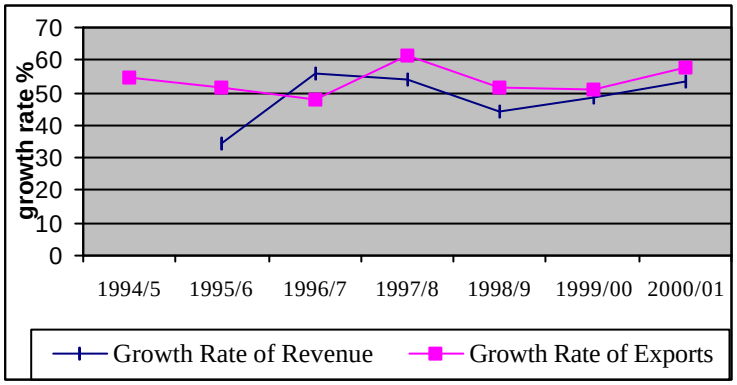
The growth rates of revenues and of India's software exports in US$ terms are summarized in Table 2 and Fig. 2. It is clear that except for 1996/7, the annual export growth rate has been higher than 50 per cent. The growth rate of overall revenue has been lower than that of exports except for 1996/7 on account of a somewhat slower rate of growth of the domestic software market. However, the growth rates of overall revenues and of exports have tended to converge over the past couple of years as a result of the growth rates of the domestic software market also picking up.

Table 2: Growth Rates of Magnitudes of Software Revenue and Exports

	1994/5	1995/6	1996/7	1997/8	1998/9	1999/00	2000/01
Growth Rate of Revenue in US$		34.61	56.14	53.85	44.44	48.65	53.5
Growth Rate of Exports in US$	54.46	51.34	47.82	61.29	51.43	50.94	57.5

Source: Based on Table 1.

Figure 2: Growth Rates of Software Revenue and Exports



Source: Based on Table 2.

To put the above growth performance in an international perspective, the Indian software industry would account for roughly about two per cent of the US$ 400 billion global software industry. However, India's share in the global market for customized software that is outsourced across borders is significant at 18.5 per cent in 1999 compared to 11.9 per cent in 1991 (Nasscom, 2000a: 4). The growth rate of the Indian software industry has been substantially higher than the global software industry. Apparently, India is the only country in the world to register a growth rate of around 50 per cent in the software industry.

Based on a vision document prepared by McKinsey for the industry body NASSCOM (Nasscom-McKinsey report), the Government appointed National Taskforce on IT and Software Development (NTITSD) has projected the Indian software industry to grow to US$ 85 billion in revenue by 2008 AD of which $50 billion coming from exports including $ 8 billion from export of products. The recent slowdown of the technology sector in the US, which consumes the bulk of Indian exports, however, has tempered some of the assumptions that underpin these projections. Effect of slowdown in the US has begun to be felt by Indian companies in the year 2001/02 in terms of slower growth of revenues than they had got used to over the past few years. Nasscom has already lowered the growth forecast for exports for

the year 2001/02 to 40 per cent compared to 57 per cent recorded in 2000/01(Nasscom, 2001).

Indicators of Capability

Although the magnitudes of exports of software and services from India have grown rapidly over the past decade, the general perception is that these exports comprise low value services. That perception emanates from the fact that in the early years, the bulk of the software export activity of Indian enterprises consisted in lending their software professionals to their clients to deliver their services 'on-site'. It was considered to be a rather lower level of skill-intensity compared to software product designing and development and has been termed as 'body-shopping' derisively (Heeks, 1996). However, the Indian software industry has since come of age in terms of capabilities, sophistication, range of expertise, and worldwide reach. In what follows we briefly review the performance of the industry in terms of certain indicators of growing capability.

Moving Away from Body Shopping

As observed earlier, the bulk of the software export activity of Indian enterprises in the early period comprised body shopping or on-site delivery. The advantage of Indian enterprises in the on-site work emanated largely from the lower salaries of Indian software professionals compared to those available in developed countries. However, Indian companies have progressively demonstrated their technological and project management skills by successfully completing turnkey projects for large companies. As a result the proportion of on-site exports has begun to come down in India's software exports from 90 per cent in 1988 to 56 per cent by 2000/01, as shown in Table 3. An increasing proportion of India's software is developed 'off-shore' at the home bases of exporters in India and exported. The 'off-shore' development, as it is called in the industry, has been partly facilitated by the improved communication links in the Software Technology Parks (STPs) set up by the government that allow teams of professionals at vendors' and clients' ends to be in constant touch on a real time basis, and by the growing visa restrictions in the US and Europe. It also turns out to be cheaper for the clients. Besides the 12 hour time lag between India and the US virtually doubles the working time per day and hence cuts the development life cycle by half. The share of off-shore development declined slightly to 44 per cent in 2000/01 compared to 44.4 per cent in 1998/9. This recent rise in the share of on-site development has been attributed to

rising focus on e-commerce related jobs in the recent years which requires a greater presence of software developers at the clients' sites.

Table 3: Locational Division of Labour in Indian Software Development

Location of Work	1988	1995	1998/9	2000/01
On-site (at client's site abroad)	90	66	54.4	56
Off-shore (at vendor's site in India	10	33	44.4	44

Sources: based on Nasscom; Heeks (1996); *Dataquest (* various issues).

Increasing Focus on High Value Consulting and Packaged Software

So far the Indian software enterprises have generally focused on services that are considered to be low value adding. Having got themselves established as suppliers of these services, Indian companies are now making a conscious effort to increase exports of high-end consulting with the development of domain expertise and export of packaged software. Infosys, for instance, is focusing on the export of end-to-end services. As Indian software enterprises establish their credentials and competence, they are consciously seeking fair value for their work. This, however, may be applicable for leading companies such as TCS, Infosys, HCL Technologies, WIPRO, Satyam Computer Services, that are providing higher-end programming solutions to their clients. Infosys has successfully renegotiated its per manhour charges with its clients. It reportedly commands $90 per hour.

Over the past few years Indian companies have also managed to develop and launch a number of proprietary software products. A niche market has been created in banking, financial and accounting software. These include, for instance, I-Flex that has been used by over 240 financial institutions in 69 countries. Polaris has developed a proprietary retail banking software Polaris Point and is tying up with Bull, France for its marketing in Europe. Banking solutions from Infosys (Financle, Bankaway, and Payaway) have been adopted by 22 domestic and 16 overseas banks across 12 countries. TCS has launched packaged software for banking insurance, securities, accounting, and health care industries. It is currently developing industry specific software products for several manufacturing industries such as cement, steel, chemicals, petrochemicals, refineries in collaboration with industry firms. TCS is targeting 30 percent of its revenue from branded products within the next three years up from 5 percent at present. TCS has also launched its branded integrated suite of software tools Mastercraft which is claimed to have been received well in the US and Europe and

carries a price tag of US $ 150,000. WIPRO Technologies has recently launched two branded products viz. Teleprodigy, a billing system for ISPs, and WebSecure, an internet security package. It is focusing on global brand building and plans to come up with a branded product every year. NIIT and Pentamedia are developing multimedia products on CD-ROMs in large numbers. A number of even smaller software companies have developed packaged software which are sold in domestic market. For example, Tally, a popular accounting package for small and medium enterprises which is being used by 50,000 companies and has been approved by the Accountants' professional bodies in India and the UK has been developed by a smaller highly specialized software company (Kumar, 2000b, on the basis of company sources and media reports). Despite these efforts the share of products and packages in the Indian exports of software is still low at 7.9 per cent (Nasscom, 2000a). However, given the high entry barriers in the packages market, the entry of Indian companies in their exports is, nevertheless significant. Furthermore, success in markets such as those of software products is a cumulative process. Once the image or brand value of India as a reliable supplier improves with growing exports of products and services given the current trend and as leading companies augment the requisite scale of operations, global reach and financial clout for sustaining large marketing efforts, it would be easier for them to make a serious dent in the markets for products.

Broad and Expanding Supply Base

An interesting feature of the Indian software industry is the relatively large and growing number of companies participating in the development and export activity. One indicator of the supply base is the membership of the industry body, namely Nasscom that has grown from just 38 members in 1988 to 850 members in 2001. Nasscom members are generally medium and large companies (those with 20 employees or more). There are numerous small and informal sector enterprises as well that have displayed considerable dynamism (see Kumar, 2000a). As expected, larger firms do account for a disproportionate share of revenue and exports, with the top 25 companies accounting for 60 per cent share and the top five for 29 per cent share of exports in 2000/01 (Nasscom, 2001). However, the vendor concentration is not as high as prevalent in many other industries.

Locally Anchored Capability

There is a qualitative difference between export success of country based on subsidiaries of foreign based MNEs and another based on indigenous enterprises in terms of local anchoring

of capabilities. In terms of this the Indian export success is primarily driven by local enterprise, resources and talent. The role played by MNEs in software development in India is quite limited. Although all the major software companies have established development bases in India, their overall share in India's exports of software is rather small. MNEs do not figure among the top seven software companies in India, ranked either on the basis of overall sales or the exports. Among the top twenty software companies too, no more than six are MNE affiliates or joint ventures. Seventy nine of the 572 member companies of Nasscom are reported as foreign subsidiaries. Some of these are actually subsidiaries of companies promoted by nonresident Indians in the US such as Mastech, CBSI, IMR, Syntel, rather than associated with US MNEs (Arora *et al*. 2000). Some others were Indian companies to begin with but have been subsequently taken over by foreign companies such as Hinditron which has been taken over by TAIB Bank E.C., Bahrain; or IIS Infotech which has been taken over by FI Group of UK. The foreign subsidiaries include software development centres of software MNEs and also subsidiaries of other MNEs that develop software for their parents' applications. The latter include subsidiaries of financial services companies such as Citicorp, Deutsche Bank, Churchill Insurance, Phoenix Life Mutual; telecommunication MNEs such as Hughes, Motorola, among others. In addition MNEs have set up 16 joint ventures with local enterprises such as British Aerospace with Hindustan Aeronautics, Bell South with Telecommication Corporation of India (TCIL), British Telecom with the Mahindra Group, among others. In all, 95 companies have controlling foreign participation.

Table 4 summarizes the shares of these 79 foreign subsidiaries in the total sales and exports of the software industry. It would appear that MNE subsidiaries have a higher degree of export-orientation with 94 per cent of their earnings coming from exports compared to local companies. This is because often, they are exclusively catering to the demand of their parents. However, collectively they account for a less than 19 per cent share of exports in 1998/9.

Table 4: Share of Foreign Subsidiaries in India's Software Industry

Share of 79 Foreign subsidiaries in	**1997/8**	**1998/9**
Total Revenue	12.27	13.7
Total Exports	16.77	18.66

Source: Kumar (2000b).

Another aspect of the role of FDI and MNE subsidiaries in development of Indian software industry is apparent from the pattern of their entry. As Table 5 shows that the bulk of the entries took place since 1994 by which time India's potential as a base for software development was already established and not the other way round.

Table 5: Time Profile of Entry of MNEs in Indian Software Industry

Period	Entries of MNEs as subsidiaries or joint ventures
Upto 1987	11
1988-90	14
1991-93	15
1994-96	39
1997-99	16

Source: Kumar (2000b).

Increasing International Orientation of Indian Companies

The Indian software exporting companies themselves are sufficiently global in their outlook. As many as 212 Indian software companies have set up 509 overseas offices or subsidiaries. 266 of these 509 offices had been set up in North America, 122 in Europe, 59 in Asia excluding India, 25 in Australia-New Zealand, 25 in Africa and 12 in Latin America (Nasscom, 2000a). A few leading companies have established extensive networks of offices and subsidiaries all over the world to tap opportunities in different markets similar to the operations of a multinational corporation. These firms include TCS, HCL Technologies, Infosys Technologies, NIIT. Four Indian companies have got themselves listed on American stock exchanges and more are planning such moves.

International Quality Accreditations and Process Maturity Levels

International orientation and the increasing professionalism of Indian software enterprises has prompted them to align their processes with global best practices and to obtain international certifications. For instance, 250 Indian companies have obtained the International Standards Organization 9000 (ISO 9000) certification by March 2001 (Nasscom, 2001). Furthermore, as many as 38 Indian companies have received SEI-CMM (Software Engineering Institute, USA's Capability Maturity Model) Certification at Levels 3 or above. India's lead in high maturity levels is quite clear now with 29 of 31 non-US companies which have been certified at high maturity levels namely Level 4 and 5 in terms of SEI-CMM being Indian. Of the 31 companies certified at Level 5 world-wide, 16 that are outside the US are in India (Table 6).

Level 5 represents the Optimizing Level of process maturity and is the highest stage to be reached. Outside the US, Australia and Israel have one organization each qualifying Level 4. This shows that Indian software enterprises, especially the leading ones, have strived to attain excellence in their professionalism and best practices.

Table 6: High Maturity Organizations

Level	Number of Organizations Certified Worldwide, May 2000	Of which non-US	Of which in India
Level 4	45	15	13
Level 5	31	16	16
Total High Maturity	76	31	29

Source: Kumar (2000b) based on Software Engineering Institute (2000).

Geographical Reach

Indian software services are exported worldwide. However, the bulk (62 per cent) is concentrated in the North America, mainly the US, which is also the largest market for software. Europe accounts for 23.5 per cent of India's exports, and the Asia-Pacific for a further 10 per cent (Table 7). Language also contributes to a high concentration in the US.

Table 7: Geographical Distribution of Indian Software Exports, 1999/2000

Region	Share of India's Exports	Share of Global Software Market
North America	62.0	45.1
Europe	24	27.6
Japan	4	16.9
South East Asia	3.5	2.8
Australia & NZ	1.5	2.1
West Asia	1.5	1.8
Rest of the world	3.5	3.7

Source: Kumar (2000b) on the basis of Nasscom (2000b, 2001), and OECD (1997).

Range of Domain Expertise and Applications

Indian companies have developed domain expertise in a wide range of domains and industries. Banking, insurance and finance has emerged as areas in which they have developed particular expertise and have even launched packaged software (Table 8). They are also able to undertake a variety of tasks as listed in Table 9.

An evidence of the growing ability and expertise of Indian software companies was provided by their ability to manage transition from Y2K-related projects successfully. In 1998/9, 16.5 per cent of the export earnings of Indian companies were derived from Y2K related projects. Over 1996-99, Indian companies are reported to have earned $2.5 billion from Y2K projects (Nasscom, 2000a). Hence, it was widely expected that the loss of these projects with the turn of the century would lead to a decline in the growth rates of exports. However, it is quite clear by now that the Y2K transition has been managed successfully. The industry has, in fact, clocked a 51 per cent rise in exports in 1999-2000 and a 57 per cent rise in the following year. This transition has been managed because of their ability to quickly diversify into internet and e-commerce related technologies and applications that are now booming. Evidently web-based revenue increased its proportion from 4.8 per cent to 15.6 per cent over the 1998/9 to 1999/2000. In fact Y2K projects provided Indian companies with an opportunity to know new potential clients and display their competence. According to surveys conducted by CMU, the expertise levels of Indian companies on UNIX and Windows NT platforms is considered to be on par with US firms. Indian companies have also grown in their ability to handle larger and more complex projects than in the past (Arora *et al*. 2000). Now 300-500 man year projects are not a rarity any more.

Table 8: Major Domain Specializations of Indian Software Companies

Domains/ Sector	**Number of companies Offering Expertise**
Banking, Insurance, Stock Exchange, Financial Accounting	247
Manufacturing, retail, trading &distribution	331
Transport/ airlines/ railways/ ports	157
Web Applications/ Online Information Services	295
Engineering, Electronics, Design Automation/ Robotics	224
Medical & Health	163
Education, training/ entertainment	115
Telecommunications	174

Source: Kumar (2000b).

Table 9: Major Areas of Specialization of Indian Software Companies

Areas	**Companies offering expertise**
Web technologies/ intranet/ internet/ e-commerce	319
Euro currency solutions	132
Software product development	286

Software maintenance and migration	233
RDBMS/ Data warehousing/ Datamining	215
ERP/ MRP Solutions	200
GIS/ Imaging	55
System Integration/ networking	192
Business Process Consultancy/ Reengineering	168

Source: Kumar (2000b).

Moving up the Value Chain?: Evidence from Recent Trends in Enterprise Performance

An important issue concerning the technological upgrading, international competitiveness and the ability to move up the value chain of Indian software enterprises is whether they are able to constantly improve their productivity, reduce the unit cost of production and improve profit margins. An attempt has been made to examine the performance of Indian software enterprises in terms of these indicators with the help of an exclusive panel data set covering a sample of 66 Indian software companies with a fair representation of small, medium and large companies for the period 1994-99 (see Kumar, 2000b, for more details). The patterns emerging from this analysis are summarized below.

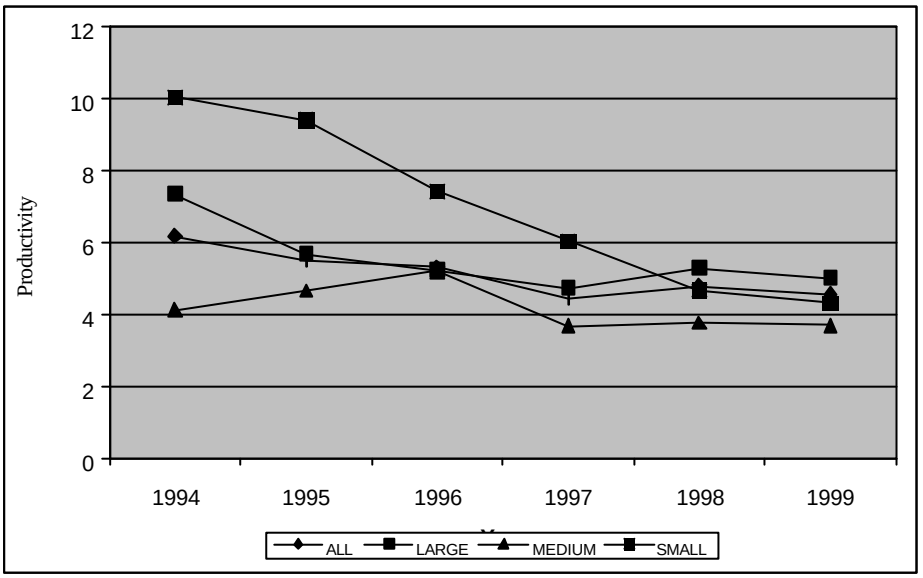
LABOUR PRODUCTIVITY

Productivity performance in the software industry has to be judged with respect to the key resource in the industry that is human resources. Labour productivity has been measured in terms of revenue per unit of wage bill to take care of possible differences in the quality of manpower and to capture the overall efficiency in use of labour keeping in mind rapidly rising salaries of the work force. Table 10 summarizes the patterns with respect to productivity measured in terms of revenue per unit of wage bill. The productivity measured this way declines over the period 1994-1997 for the full sample as well as for different groups of firms. Since 1997, however, Indian software industry is able to improve the productivity even after taking care of rising wage cost. It would appear that over the past few years Indian software industry has made an effort to improve the efficiency in the use of its key resource that is manpower. This effort might have been prompted by the rising costs and growing scarcity of trained manpower. Between the groups, smaller firms had the highest ratio of revenue per unit of wage bill in 1994, probably owing to lower rates of employee compensation. However, the tight labour market conditions that have prevailed in the subsequent years due to increasing competition for knowledge workers have led to a converging trend in productivity levels of larger and smaller firms. The productivity of

medium scale firms had roughly converged to the levels of larger firms in 1996. Since then, however, it has declined and has diverged from that of larger firms. Thus among the size classes, larger firms have best levels of efficiency in utilization of the key resource in the industry that is manpower.

Table 10: Trends in Labour Productivity

	1994	1995	1996	1997	1998	1999
Full Sample	6.21	5.52	5.33	4.46	4.81	4.58
Large Firms	7.36	5.69	5.27	4.76	5.31	5.03
Medium Sized Firms	4.15	4.68	5.22	3.71	3.80	3.72
Small Firms	10.06	9.43	7.45	6.07	4.69	4.35



Source: Kumar (2000b).

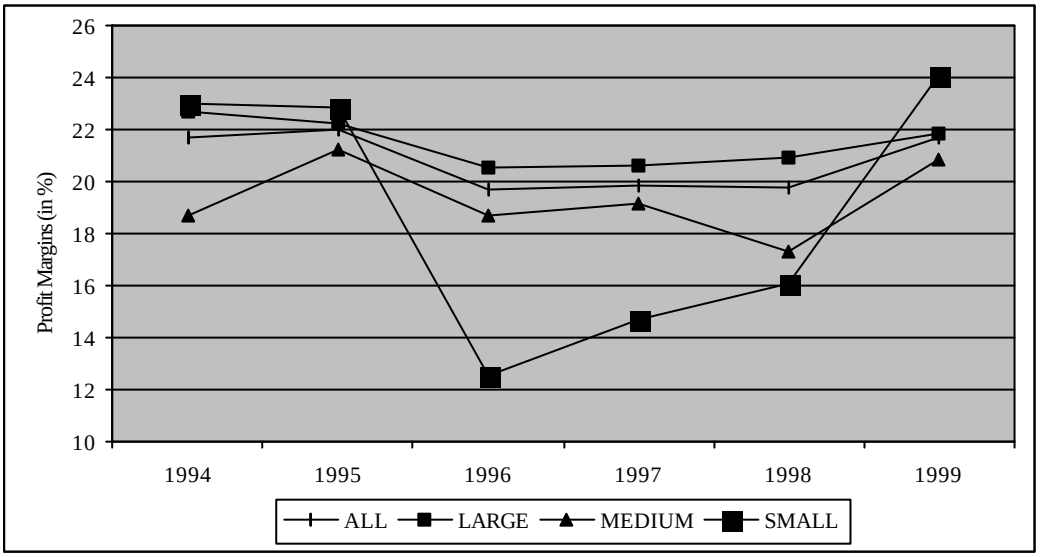
PROFIT MARGINS

Besides indicating the overall efficiency, profit margins of firms competing on the basis of costs are generally under pressure because of rising competition. On the other hand firms moving up the value chain may be able to improve their margins. Table 11 summarizes the trends pertaining to profit margins for the sample firms. Here profit margins have been measured in terms of proportion of profit before tax in revenue. Like productivity indicator the profit margins also show a shift in 1996. In the period 1994-96, the margins show a declining trend and a rising trend since 1996. It may have some thing to do with the effort of the industry towards improving the efficiency in resource use and rising export-orientation since 1996. Between the groups, smaller firms reveal lower margins during the period. However, they have improved their margins sharply since 1996. In fact in 1999 profit margins of smaller firms have exceeded those of other two groups. It is to be seen whether

this performance will be sustained in the future. Medium sized firms also have somewhat lower margins. However, the margins of these firms have tended to converge with those of larger firms.

Table 11: Trends in Profit Margins

	1994	1995	1996	1997	1998	1999
Full Sample	21.70	22.03	19.66	19.88	19.74	21.69
Large Firms	22.71	22.24	20.55	20.64	20.89	21.82
Medium Sized Firms	18.69	21.22	18.66	19.13	17.33	20.86
Small Firms	22.98	22.88	12.52	14.72	16.07	24.11



Source: Kumar (2000b).

The overall conclusion emerging from the above analysis of enterprise performance suggests that 1996 (that is financial year 1995/6) was a year of transition for the industry. The trend with respect to a number of indicators shows a change with this year. This include rise in export-orientation, rising net exports, rise in profit margins and decline in unit cost of production. These trends got reflected in terms of improved productivity since 1997. Small scale firms are quite different from medium and large sized firms with a greater focus on domestic markets. However, they are fast catching up with the larger ones. Finally, the analysis also indicates the presence of economies of scale in utilization of foreign exchange and human resources. Hence, some consolidation of the industry may lead to improvement of overall competitiveness.

3. Development Implications of India's Participation in International Division of Labour in Software

India's participation in the global division of labour in software services industry has created much interest worldwide. What does it imply for the parameters of economic development of the country? In what follows an overview of the implications of the software industry development for different macro parameters is presented. In addition, the development of export-oriented software industry also has important externalities that constitute its indirect impact on India's development, as will be seen in this section.

Direct Developmental Impact

National Income and Growth Rates

The software industry still accounts for a rather marginal share of India's GNP but it has been rising fast. In 1998/9 the industry accounted for just one per cent of India's GNP. Its share has nearly doubled by 2000/01 (Table 12). Even with marginal shares in income, the sector contributed nearly 12 per cent of the growth of national income. Given the rate at which it is growing, it is bound to emerge as an important sector of the Indian economy in the future. The NASSCOM-McKinsey Report projects a 7.7 per cent share of the sector in the overall economy by 2008.

Table 12: Software Industry in Relation to India's Macro Parameters

(in billion US$)

	1998/99	**1999/00**	**2000/01**
India's GDP	379.7	404.7	427
Indian Software Industry Revenues	3.9	5.7	8.3
Share of Software Industry in the GNP, %	1.027	1.41	1.94
India's exports of Goods & services	60.07	67.85	79.76
Exports of Software Services	2.65	4.0	6.3
Share of Software in exports, %	4.41	5.89	7.89

Source: based on India, RBI, and Nasscom (2001).

Exports and Foreign Exchange Generation

The share of software exports to India's exports of goods and services has risen from a negligible in 1990, to nearly 8 per cent 2000/01 as is clear from Table 12. The Nasscom-

McKinsey Report and NTITSD project that by 2008, software and services exports would account for 35 per cent of India's exports.

The magnitude of exports could be a poor guide, however, of the amount of actual foreign exchange earned by the country in view of the expenditure of foreign exchange by software companies in the process of implementing the contracts for their clients which often involve posting their personnel at the clients' sites. Net export earnings are usually much smaller than the overall export magnitudes that are publicized. Therefore, exports net of foreign exchange expenditure would be the more appropriate indicator of the generation of domestic value addition or net foreign exchange. The movement in proportion of foreign exchange utilization per unit of exports over time could also indicate some trends in terms of efficiency in foreign exchange conservation or in domestic value addition. The figures of foreign exchange utilization by the industry are not provided by Nasscom or the government. However, data compiled for a representative sample of 58 companies for the 1994-9 period to examine the trends summarized in Table 13 show that foreign exchange utilization per unit of exports by the sample industry firms is quite substantial compared to some manufacturing industries. Hence, the total exports figure gives a highly exaggerated picture of the industry's contribution to the foreign exchange earnings. However, the foreign exchange utilization of the industry has declined in a steady manner since 1996 from 62 per cent in 1996 to 48 per cent in 1999. That suggests that the proportion of net exports in total exports has gone up since 1996 from 38 per cent of total exports to 52 per cent of total exports. It is a healthy sign and suggests that the proportion of domestic value added has gone up in the Indian software export activity. To some extent it reflects the increasing importance of off-shore development and hence savings of foreign exchange on travel, etc.

Table 12: Net Exports of Sample Software Companies

	1994	**1995**	**1996**	**1997**	**1998**	**1999**
Foreign Exchange Utilization per unit of exports	57.41	56.39	61.66	54.65	51.11	48.01
Net Exports per unit of Exports	42.59	43.61	38.34	45.35	48.89	51.99

Source: Kumar (2000b).

Employment and Job Potential

According to Nasscom Surveys, the software industry employed some 340,000 professionals on 31 March 2000 including software professionals working in software user organizations compared to 160,000 professionals in 1996. Therefore, the industry generates about 60,000-

70,000 more jobs every year and may have created so far no more than half a million jobs including ancillary jobs such as those of data entry operators despite so much rhetoric about its expansion and job potential. The compound annual growth of employment at 28.5 per cent recorded over the past three years, though impressive from the standards of growth of jobs in the national economy, is only half of the growth of the revenues in the industry. However, the potential of the industry to sustain its growth momentum does suggest its potential to emerge as a source of significant employment in the Indian industry in time to come. The NTITSD has projected that the software industry will employ 2.2 million workers by 2008. Half of these jobs, i.e. 1.1 million jobs will be created by an expansion of IT-enabled services in the country by the year AD 2008 compared to 23,000 in 1998/99. Of these nearly 560,000 jobs are expected to be in back office operations and in content development (compared to 15,200 jobs at present).

The other characteristics of the jobs created by the software industry can be seen from Table 14. The industry is creating job opportunities for highly qualified (majority with an engineering degree) young graduates with a relatively short experience. The salary levels here are among the best across industries within the country and have been growing at a healthy rate of 16-21 per cent. In addition, the companies have begun to offer stock options to their employees to retain them. Despite this, the attrition rate is quite high although it has shown a decline over the past few years. The industry loses quite a substantial proportion of its brightest professionals every year as they migrate to better paid jobs in other countries.

Table 14: Key Characteristics of Employment in Software Industry

Parameters	**1996**	**1999**	**2000**
Software Professionals (including those in non-commercial organizations and user organizations)	1,60,000	2,80,000	3,40,000
Of which engaged in			
-Software Development (%)	70	67	63
-Marketing and relationship development (%)	10	11	14
Median Age (yrs)	28.4	26.2	25.7
Proportion of IT Degree holders (%)	75	n.a.	n.a.
Proportion of those having 5 yrs. experience (%)	60	50	60
Rise in Basic Salary over previous year (%)	21	21+ESO*	16+ESO*
Attrition Rate (%)	17.2	16	14

Notes: *Supplemented by Employee Stock Options. 41 companies have offered ESOs to their employees.
Source: Kumar (2000b) based on the respective Nasscom Surveys.

Besides the organized segment of the software industry, employment opportunities are fast expanding in the smaller or the so-called informal or micro-enterprise segment in software

and services. Kumar (2000a) in a recent study found smaller enterprises in software customization, data entry, and internet bureau to be growing in terms of numbers and size at a very fast pace. As a result these employment in enterprises is expected to grow between 50-100 per cent per year. Although the salaries in these enterprises are relatively low to begin with but the sector provides opportunities for fast mobility of personnel upwards. While the larger and more organized enterprises are driven largely by the external demand, the informal establishments cater to rising demand of domestic industry especially the SMEs for their office automation and customization needs. The sector also provides opportunities for self employment for trained personnel who work as data entry operators at the lower end of the skill spectrum, to web page designers, and to software consultants at the upper end.

Quality of Jobs Created: The Gender Dimension

The jobs created in the software industry are generally physically less demanding than those in other manufacturing and are white collared ones. Hence, they are also well suited to women. Nasscom surveys reveal that although the share of women in software professionals is low at 19 per cent at the turn of the century, it has increased steadily from just 10 per cent in 1993 (Nasscom 2000a). In the IT-enabled services segment, women account for 37 per cent of jobs. It is projected to rise to 35 per cent by 2005. Earlier studies on the industry had reported an even higher domination of the industry by men with a share of women ranging between 5-10 per cent (see Mitter and Pearson, 1992; Heeks, 1996). The domination of the workforce by men, however, does not seem to be due to a gender bias. Even the early surveys such as those conducted by Jayanthi and Madhavan in the mid-1980s (cited in Heeks, 1996) and another by Mitter in 1990 (cited by Mitter and Pearson, 1992) do not report any overt discrimination against women in the industry. Both these studies have reported that the industry offered a more relaxed and less discriminatory atmosphere than most other occupations and that women stand a better chance of reaching a position of seniority in this industry than others. Among the reasons cited in those surveys for women's observed under-achievements include, a lack of international mobility because of family commitments, regulations against night work preventing companies from hiring them for round-the-clock contracts, and some international clients' reluctance to hire women consultants, especially in the Middle East. The declining dependence of the industry on on-site contracts may help it to remove some biases against women.

Furthermore, the IT-enabled services that are projected to expand in the coming years will also create more job avenues for women and will increase their share in employment. The call centres and back-office services, especially data entry operations for instance, are predominantly staffed by women world-wide. Quite a large part of these services can be delivered from home. For instance, a home-based worker answers a call from her home or enters data that are transmitted electronically to the client. These types of 'teleworking' opportunities, as they have begun to be called, are particularly well suited for self-employed women workers who wish to stay at home for family reasons or because of young children (see Hoon, Ng, and Mitter (1999) for more details).

The bulk of the jobs created in sector by 2008 as per the projections of the McKinsey Report and the NTITSD, will be in IT-enabled services such as back-office operations, medical transcriptions, call centres, etc. in a significant manner. Given a rather low-skill content of these jobs, they will be of foot-loose nature and may move to other destinations as and when a cheaper competing location is available, as it happened in the case of other low skill export-oriented manufacturing such as garments. Hence, the move from export-oriented manufacture to export-oriented services may not alter the basic pattern of the international division of labour for developing countries (Mitter and Efendioglu, 1999). Finally, these activities, having a rather low-skill content provide limited scope for knowledge spillovers in the host country.

Externalities or Indirect Effects on Development

The rise of software industry in the country over the past decade and a half has also generated a number of important externalities many of which are of favourable kind. These include development of entrepreneurship and reversal of brain drain. Some are less desirable ones such as lack of linkages with the domestic economy and a possible neglect of the domestic software sector in the process of pushing exports, and perpetuating urbanization and concentration, etc.

Expanding the Base of Domestic Entrepreneurship

The rise of the software industry has provided opportunities for expanding the local base of entrepreneurship. The initial start-up costs in the sector are rather low and economies of scale are not particularly significant especially for service enterprises. Hence, the entry barriers are

low. This has helped a number of technical professionals to start on their own. Many of the leading software enterprises of today have been started by first generation entrepreneurs. Infosys, Satyam, Mastek, Silverline, Polaris, among numerous others, for instance, were started by software professionals and engineers with small savings and loans at very modest scales to begin with. At a smaller level too, it has provided opportunities for the development of entrepreneurship among the relatively less qualified professionals as well. A study of smaller or informal sector enterprises in software and services industry in India corroborated the rewarding opportunities for entrepreneurship for little initial set up costs. The growth rates at which even these smaller enterprises have been growing means that they do not stay small for very long (Kumar, 2000a).

Software Industry Development and Brain Drain: Counteracting Influences

The brain drain has been a major problem facing the country in respect of highly trained manpower. According to a study 58.5 per cent of graduates in computer science from IIT, Madras during the period 1964-86 migrated abroad (IAMR, 1999). Thus India has been losing highly valuable IT human resources created at considerable cost to the country on a regular basis to the western world. The rise of the software industry in India is associated with two counteracting trends with respect to the extent of brain drain. First, is positive in that the emerging opportunities in the industry helped to stem the outflow of manpower from India to some extent. The other is the possiblity of losing more talent to the outside world in the near future given the rising shortages of IT-trained manpower in the western world.

REVERSAL OF BRAIN DRAIN

The rapid rise of the software industry in the country has helped to reduce the extent of brain drain by creating rewarding employment opportunities within the country, a trend also supported by the availability of venture capital to implement new ideas. According to a partial data base maintained by the IIT Delhi Alumni Association (IITDAA), the rate of brain drain seems to have declined from 21 per cent during the 1990-92 period to 18 per cent during 1997-99 period (Sachdev, 2000). Besides the rewarding job opportunities coming up within the country in the software industry, a number of graduates of IITs are assisted by the on-campus incubation centres in implementing their ideas and in getting them funded by venture capital funds.

The rise of the software industry has also prompted a number of nonresident Indians to return to the country to start software ventures. According to some estimates, the rate of returning of professionals increased from 2 per cent in 1991 to 8 to 10 per cent in the late 1990s with several senior software professionals returning to India to set up their own companies here. Apparently in Hyderabad alone about 100 companies have been set up by returning software professionals (*Express India*, 2000). Furthermore, the export-orientation of the Indian software industry benefited from the presence of a substantial number of nonresident Indian engineers working in US MNEs. Lateef (1997) and Arora *et al.* (2000) observe that some of them have played an important, though yet to be documented, role in facilitating the contacts between buyers in the US and the potential suppliers in India. Nonresident Indians in the software industry in the US have also invested back home in subsidiaries that develop software for their US operations. These include investments in subsidiaries of Mastech, CBS Inc., IMR, among others.

FRESH SPURT IN BRAIN DRAIN?

The software export industry has also contributed to brain drain in the course of executing projects on-site or through 'body shopping'. A number of software personnel who went to other countries for assignments of their employers have stayed on. For instance, 10,000 of the total 100,000 software professionals in Australia are Indians, who stayed on after completing their assignments for TCS there (Lateef, 1997). Although the proportion of onsite work is now decreasing, the rapid growth of the software industry worldwide has created fresh possibilities of a further and potentially sizeable wave of brain drain. The recent emergence of India as a centre of software development has focused attention on the country as a potential source of trained manpower for IT industries to meet the growing shortages in other countries. According to IDC in the US half of all IT jobs now go 'begging'. In Western Europe the shortfall of IT workers has risen from 6 per cent in 1998 to 14 per cent in 2000. It is expected to rise to 23 per cent by 2002 (IDC, 2000). As a result a large number of countries have been planning to import software engineers from India. These include Germany's offer of 20,000 green cards for software workers; Japan seeking 10,000 IT workers from India over the next three years, apart from projections as: Ireland, 32,000 by 2005; France, 10,000; Italy, 8000; and Korea another 10,000 (Kumar, 2000b, based on media reports). There are other countries like Belgium, Syria, Iran, Singapore, and Spain, which have also shown interest in importing Indian talent although precise figures are not indicated. The British government has recently enacted a special fast track work permit system to allow IT workforce into the

country to meet an estimated demand for about 150,000 professionals. This system will reduce the time needed for issue of a work permit for IT professionals from six to eight weeks to only two weeks. In the US too the gap between demand and supply of IT manpower has been increasing and this shortfall has been bridged with imports from India among other countries (ESA, 2000). Due to growing pressure from the industry the administration has recently raised the annual cap on H1B visas from 115,000 to 195,000 for the next three years.

This trend raises the prospect of a further rise in the rates of brain drain of software manpower from India. It is not clear as yet, how many of Indian personnel will leave the country to take advantage of these opportunities. There are some media reports that in response to an offer of 20,000 green card visas by Germany to IT workers, it has already received 10,000 applications including 2000 from Indians. However, an outflow will certainly add to the growing scarcity of software talent, thereby pushing up the salaries of software professionals in India. That in turn may have an adverse bearing on the external competitiveness of software exports from India. Thus it has the potential of adversely affecting the domestic software industry and its export performance. Much will depend on the ability of the country to increase the supply of software manpower quickly. In the meanwhile, however, the slowdown in the US has led to retrenchment of a large number of Indian knowledge workers who have been returning home after being served with the 'pink slips'.

Creating a Brand Value for the Country in Knowledge-Based Industries

Despite the large pool of engineering trained manpower, India's image in the world has been that of a poor and underdeveloped economy having a comparative advantage only in low-skill and low-technology industries. As a result the country has suffered from a disadvantage in exporting knowledge-intensive goods. The emergence of the country as a centre for outsourcing a highly knowledge intensive service such as software is helping to change the public perception about India and is focusing attention on the potential of the country in the knowledge based industries. Perhaps as a related development, a significant number of MNEs in other knowledge based industries have set up global or regional R&D centres in India to benefit from the expertise available in the country much in the same way as software houses (see Kumar 1999, for illustrations).

Improving India's Bilateral Relations

A recognition of India as the leading source of expertise and talent in the industry has also contributed to the improvement of bilateral relationships of India and the US and also other industrialized countries. President Clinton's visit to India in 2000 was after a nearly two decade gap of any visit to the country at that level from the US. The agenda of his visit was heavily loaded in favour of IT-related issues. Several other top leaders from different parts of the world have visited the country in 2000, all of them seeking India's trained manpower and expertise in high-tech education. These include Japanese Prime Minister Mori, Singapore's Prime Minister, among others.

Facilitating Capital Inflows?

The software industry development has led to an increased flow of capital to the country in three forms. These include foreign direct investment (FDI) by outside MNEs in their subsidiaries and joint ventures in India, foreign institutional investments (FIIs) in the stocks of software companies in India, and capital raised abroad by Indian software companies.

FDI INFLOWS AND DISTRIBUTION OF GAINS FROM MNE ENTRY

Despite the entry of all major IT MNEs in to the country and the forming of subsidiaries and joint ventures for software development, the FDI inflow has not been substantial. Total subscribed capital of 79 foreign subsidiaries that have been set up in the country by 1999 is Rs 4713 million (or US$ 115 million at the Rs 41 to a $ exchange rate). So the total inflow of FDI by the MNE subsidiaries over the past one and a half decade of development of industry is no more than $115 million, not a considerable amount in comparison of the annual inflow of about $3 billion worth of FDI that India has received in the past few years.

Furthermore, the distribution of gains of from the activity of MNE subsidiaries in software industry between home and host countries seems to be grossly in favour of the former. Apparently some of the MNE subsidiaries in software development are doing pioneering work for their parents. For instance, Oracle Software Development Center located in Bangalore has been responsible for designing the 'network computer' introduced by Oracle entirely (*Dataquest*, 15 July 1999; Arora *et al.*2000). SAP of Germany has recently launched its internet-enabled distributor reseller management (DRM) solutions for high-tech industry developed entirely at SAP Labs, India, a Bangalore-based subsidiary of SAP. Many other design centres of MNEs in India are doing highly valuable development work for them.

However, the Indian subsidiaries of these MNEs do not share the revenue streams generated by their developments worldwide. MNEs tend to invoice the exports of their subsidiaries to them at cost plus 10-15 per cent (Mehta, 1996:44). Therefore, the distribution of gains is grossly in favour of the home country of MNEs and against the host country, that is India in this case.

FII INVESTMENTS AND ADRS

FIIs investments in the IT stocks including some software companies in India has been considerable. However, these investments have been highly unstable given the volatility of the Indian stock markets in the recent years. The rise of some Indian software companies has enabled them to get listed at the American stock exchanges and raise capital abroad. Infosys became the first Indian software company to get listed at Nasdaq on 11 March 1999 and to raise US$ 70.38 million through the issue of American Depository Receipts (ADRs). Subsequently, Silverline Technologies raised $101 million at the New York Stock Exchange on 20 June 2000. The success of these two companies in raising capital abroad has prompted a number of others to plan US listings. These include HCL Technologies that is planning a US$ 500 issue of ADRs. The ADRs by Indian software companies may become a significant source of capital inflow to India. A US listing helps the company in many ways. These include their ability to offer ADR-linked stock options to their employees as a part of their strategy to retain talent, as is being pursued by both Infosys and Silverline thereby making the option more attractive than the ESOPs of their competitors in the labour market. It helps them to fund acquisitions abroad to widen their client base. It also helps them in their marketing and in creating a brand value.

In addition the rise of the software industry has attracted the attention of foreign venture capital funds and angel investors to the country. According to Nasscom, the investments made by venture capital funds in high technology firms in India (not just software ventures alone) in 1999-2000 amounted to US$ 370 million rising from just $20 million in 1996-97. A considerable part of this investment, however, has gone into e-commerce start-ups and dot.com companies. The software industry may have received a relatively small part of this amount. This channel of investments may grow in future.

Opportunity Cost of Exports and Domestic Linkages

The opportunity cost of software exports could be considerable. On the one hand, India's best talents and capabilities are employed for exporting software services, software for domestic use is largely imported from abroad. Inadequate attention being paid to the domestic market by the industry has stunted the diffusion of IT technology. For instance, the availability of software in local languages could have facilitated a widespread diffusion of IT in the country. The lost opportunity of productivity improvement through the diffusion of IT in India could be substantial. On the other hand, Indian software companies' contribution to productivity improvements in the US industry over the past five years that has resulted in an average rate of growth of over 5 per cent over the second half of the 1990s could be significant. To some extent the prevailing fiscal incentive regime i.e. availability of tax incentives for export profits divert attention towards exports by making them more rewarding activity compared to serving the domestic market. There is need for rethinking on the relevance of the tax incentives to software industry.

Most of the export-oriented software companies operate as 'export enclaves' with little linkages with the domestic economy, if at all. MNE subsidiaries in software development, in particular, derive almost all of their income from exports to their parents. Hence, hardly any vertical linkages are developed with the domestic software market or the rest of the economy. The enclave nature of operation generates very few knowledge spillovers for the domestic economy. The bulk of the work done is also of highly customized nature having little applications elsewhere. Given the high salaries and perks of foreign travel, the movement of personnel from these companies to domestic firms also does not take place. The employees of export-oriented firms are generally lured by foreign companies. However, there is considerable movement of personnel from domestic market-oriented firms to export-oriented firms or foreign subsidiaries. A survey of the software industry suggested that 45.6 per cent of the professionals were recruited by software firms from other companies (Rajeswari, 1995). The domestic market also supports the exports of products that are first tried locally and are improved on the basis of feedback data generated before being exported (Heeks, 1996). In terms of technological complexity and sophistication, some projects in the domestic market are more advanced and challenging than export projects (Arora *et al*. 2000).

The engineers employed by the software industry need not possess exceptional ability but they are generally trained extensively by their employers in software development

(Balasubramanian and Balasubramanian, 1997). However, the rise of the software industry has suddenly caused a general scarcity of engineers in all disciplines and this has led to sharp rise in their salaries. The engineering industry in the country is finding it difficult to find an adequate number of engineers for their requirement. The impact of rising salaries on the competitiveness and bottomlines of the engineering and other industries that compete for the engineering talent with the software industry is not yet clear. However, it has certainly made it difficult for them.

Spatial Agglomeration and Regional Distribution

Software industry development in different parts of the world is characterized by a strong tendency of clustering because of agglomeration economies. In India, the software industry developed initially in Mumbai. Subsequently especially after the entry of Texas Instruments in the mid-1980s, Bangalore emerged as a centre of software industry development. Bangalore enjoyed several attractions for the industry. These included the availability of a pool of trained manpower given the existence of Indian Institute of Science, Indian Institute of Management, and many high technology industrial complexes such as Bharat Electronics, Hindustan Aeronautics, Bharat Heavy Electricals, among others. Besides the mild climate also made it attractive. The development of infrastructure under the aegies of Software Technology Park and subsequently private IT Park helped in the agglomeration of the industry in and around Bangalore (see Lateef, 1997; Kumar, 2001). Besides, Bangalore and Mumbai, Delhi along with its suburbs namely Noida and Gurgaon has emerged as the third most popular concentration of software units (See Table 15). Hyderabad and Chennai have started to provide alternative location in the South after the saturation of Bangalore in terms of available infrastructure and scarcity of space. The state government's promotional role has also contributed to the emergence of Hyderabad as the fourth most important centre of concentration of software companies. The top five cities together account for 80.5 per cent of the 600 top companies. But other cities such as Calcutta, Pune, Thiruvanantpuram, Ahmedabad, Bhubneswar are coming up as increasingly popular locations. One important factor is the availability of high speed data communication links and built-up space provided in the Software Technology Parks (STPs).

The development of the software industry is, therefore, largely concentrated in select major urban centres and their suburbs. This pattern of concentration owes itself to the clustering tendencies of the knowledge-based industries because of the high economies of

agglomeration. In India the availability of communication infrastructure and manpower and other facilities have also contributed to it. Since all these centres have already been well developed compared to other parts of the country, possible spillovers of software industry development for balanced regional development have not accrued. The concentration of the industry in particular cities has in fact added to the congestion. For instance, real estate prices have reportedly risen in cities like Chennai because of the growth of the software industry that now accounts for 70 to 80 per cent of all industrial space taken up in the city between 1999-2000.

Table 15: Patterns of Clustering of Top 600 Software Companies

City	Number of Company Headquarters Located	Percentage share
Mumbai	131	21.83
Bangalore	122	20.33
Delhi and Around	111	18.50
Hyderabad	64	10.67
Chennai	55	9.16
Calcutta	25	4.16
Pune	23	3.83
Thiruvanathapuram	14	2.33
Others	55	9.16

Source: Adapted from Nasscom (2000a).

4. Challenges for Strengthening India's Position in the International Division of Labour

A number of favourable factors have helped in the rise of the Indian software industry so far. These include the availability of a large pool of talented English-speaking manpower at low wages, a tradition of logic and mathematics, past investments by the government in national innovation systems and building capability in the computing and networking technologies (see Kumar 2001, for a detailed analysis), availability of infrastructure and communication links, favourable policy regime, networks of expatriate Indian technical and managerial personnel working in the Silicon Valley who facilitated contacts with Indian companies, coupled with the growing scarcity of trained manpower in the West. The Y2K bug also created a valuable opportunity for Indian software companies. It will be a challenge to sustain the growth rates achieved in the past in the medium term and to fulfil the Nasscom-McKinsey-NTITSD targets of exports and domestic industry. The factors that challenge the growth of Indian industry include rising wage costs, growing scarcities of talent, emerging competition, etc. as summarized below.

Growing Scarcity of Trained Manpower

India's comparative advantage for software industry development is primarily based on the availability of quality trained manpower. Although India has traditionally been surplus in highly qualified engineering and technological manpower, with the rapid growth of the IT industry over the past decade demand is outstripping the supply. In particular, the experienced personnel and project managers are becoming highly scarce (Arora, *et al.* 2000). The situation is further aggravated by a growing drain of trained manpower from India to other countries. With the growing shortfall of IT-trained manpower, a large number of countries and companies from the western world are turning their sights towards India to bridge the gap. A number of large IT MNEs regularly recruit engineers and managerial manpower in India through advertisements in the national media and even through campus interviews for their worldwide requirements. Recently, a number of countries such as Germany, Japan, Korea, Switzerland, France, among others, have announced their intention to import trained IT manpower from India, as observed earlier. All these attempts increase the demand for manpower in India and will make it more difficult for the local industry to attract and retain talent. A major challenge for the policy makers is to increase the supply of trained manpower quickly enough so as to satisfy the growing demand of domestic industry as well as that of other countries. Increasing competition for knowledge workers means that management of human resources is becoming a key to corporate success in the industry.

Eroding Labour Cost Advantage

With the growing scarcity of trained manpower, the salaries in the software industry have been rising at the rate of over 20 per cent per annum. In addition, the employers are offering other incentives such as stock options and are spending on making the working environment more attractive for their workers. The rising salaries have reduced the margin of the advantage in wage cost that Indian software companies enjoyed initially. The cost comparison figures as given in Table 16 suggest that the Indian salaries of comparable personnel ranged between 20-42 per cent of US levels and between 38-53 per cent of Irish levels for different personnel in 1995 itself. Arora *et al.* (2000) find that after factoring in the associated costs of Indian workers, the cost of Indian workers comes to only half of US levels. Hence, the strategy of competing on the basis of cost will become increasing difficult for Indian enterprises especially with emerging competition from other low wage countries as seen later. Indian enterprises will have to deal with this by moving up the value chain as

salaries rise and will have to increase the overall efficiency of utilization of human resources or increasing the productivity faster than the wage cost.

Table 16: Labour Cost Comparison for IT Personnel (US $ per annum)

	Switzerland	USA	Canada	UK	Ireland	Greece	India
Project Leader	74,000	54,000	39,000	39,000	43,000	24,000	23,000
Business Analyst	74,000	38,000	36,000	37,000	36,000	28,000	21,000
Systems Analyst	74,000	48,000	32,000	34,000	36,000	15,000	14,000
Systems Designer	67,000	55,000	36,000	34,000	31,000	15,000	11,000
Development Programmer	56,000	41,000	29,000	29,000	21,000	13,000	8,000
Support Programmer	56,000	37,000	26,000	25,000	21,000	15,000	8,000
Network Analyst/Designer	67,000	49,000	32,000	31,000	26,000	15,000	14,000
Quality Assurance Specialist	71,000	50,000	28,000	33,000	29,000	15,000	14,000
Database Data Analyst	67,000	50,000	32,000	22,000	29,000	24,000	17,000
Metrics/process Specialist	74,000	48,000	29,000	31,000	na	15,000	17,000
Documentation/Training Staff	59,000	36,000	26,000	21,000	na	15,000	8,000
Test Engineer	59,000	47,000	25,000	24,000	na	13,000	8,000

Note: Figures are averages for 1995. They are likely to rise c.5-10% per annum, with rates being slightly higher in lower-income countries

Source: Richard Heeks adapted from H.A. Rubin et al. (1996) *Worldwide Benchmark Project*, Rubin Systems: Pound Ridge, NY.

Emerging Competition from Other Countries

So far the Indian software industry faced little competition from other countries, if at all. This is because India enjoyed the first mover advantage in the software outsourcing. A survey conducted by the Carnegie Mellon University found that 82 per cent of competititors of Indian software firms were located within India (see Table 17). The second largest source of competition was US-based firms that 'extensively recruit Indian software professionals' (Arora et al. 2000). Firms based in Singapore, Israel, Ireland, Philippines, Russia and Eastern Europe were mentioned as competitors for a relatively small number of cases. However, in future, Indian software companies may face more competition: in high end jobs from firms based in Israel, Ireland, Singapore, East Europe among others; and from those in the Philippines, China, Malaysia and other South Asian countries in low end routinized jobs. Hence, it will be important to strengthen international competitiveness through various measures such as productivity improvement, maintaining the quality of service, and establishment of long terms relationships with important clients, marketing and after-sales service, and moving up the value chain if India is not to lose her status as a preferred destination for software outsourcing.

Table 17: Location of Primary Competitors of Indian Software Firms

Location of Competitors	No. of Firms	% of Firms
India	75	82
USA	58	63
Israel	12	13
Ireland	12	13
Singapore	19	21
Philippines	6	7
Eastern Europe/Russia	10	11

Note: N=92; Firms were asked to list up to three countries.

Source: Arora et al (2000).

Infrastructural Bottlenecks

The rapid growth of the software industry is also dependent upon the infrastructural development keeping pace with it. These include adequate bandwidth for data transfer, built-up space for software development and other facilities. According to the industry association, available bandwidth, in particular, is not adequate and is becoming a bottleneck. Hence it needs to be augmented soon.

Low R&D Thrust

The Indian software industry has revealed little thrust on R&D so far compared to the knowledge intensity and its international orientation. Nasscom (2000b) finds that R&D spending in the industry has increased from 2.5 per cent of total spending on R&D in 1997/8 to about 4 per cent during 2000/01. Although leading companies such as TCS, Infosys and WIPRO do have R&D labs, the proportion of revenue devoted to it is rather low compared to software companies in the developed world. For instance, Adobe Systems, Novell, Lotus Development, SAP, Microsoft, all reportedly spend between 14 to 19 per cent of their revenue on R&D (OECD, 1997). Given their huge revenues the scale of R&D conducted is much larger. Compared to this, even a leading and fast-growing Indian software company Infosys Technologies reports R&D expenditure to form only a 0.89 per cent of its turnover. Furthermore, a declining output of engineering doctorates in India from 629 in 1990-91 to 298 in 1996-97 (DST, 1999), is also a damaging trend as it has implications for availability of research personnel for the industry. A bigger R&D thrust will be necessary for Indian software enterprises to upgrade their export profile to higher value adding services and products and establish themselves as innovators and developers of new products and technologies rather than just providers of coding and programming services. Such an

evolution of Indian software enterprises is important if they are to realize the target of generating revenues equal to $8 billion from export of products.

In order to deal with the above challenges a number of steps have been taken by the Government. In particular, a number of steps have been taken as a part of the IT Action Plan formulated by the NTITSD accepted by the Government. Some of these steps include

- Initiatives to ease the supply of engineering personnel: expanding the capacity of IITs, upgrading the existing institutions (e.g. RECs), and setting up new IIITs.
- Augmenting infrastructure for software development: steps to augmenting the bandwidth, setting up of technology parks and more STPs.
- Expanding the Domestic Software Market: increasing PC penetration, tax incentives for IT investments, trade liberalization in IT equipment and software, checking software piracy, e-governance.
- Facilitating the availability of venture capital
- Facilitating Internationalization of Indian enterprises: assistance in overseas acquisitions, and for building indigenous brands others (see India, MIT, 2000a, b; NTITSD, 2000, for more details).

The leading Indian enterprises are also adopting strategies to strengthen their place in the industry. These include knowledge management strategies to recruit, train and retain talent; moving up the value chain by focusing on high value consulting and packaged software; building long-term relationships with clients, geographical diversification to reduce their vulnerability to slow down in the US market, among others (see Kumar 2000b, for illustrations).

5. Concluding Remarks

The emergence of a developing country like India as a significant supplier of software services in the world market has attracted a lot of attention in the developmental literature. The growth of exports of software from India at an over 51 percent compound annual rate over the past decade has led policy makers within the country to view it as an engine of growth, a source of employment and foreign exchange, among other favorable effects. Indian software enterprises have been able to grow fast and expand the exports at phenomenal rates and now account for a significant share of the world market in outsourced software services.

Although MNE entry in mid-1980s helped to demonstrate the potential India had as a base of software outsourcing, the Indian development is largely driven by indigenous entrepreneurship, talent and resources. A large number of firms that have entered the industry, have grown in their capability, demonstrated their commitment to international best practices in process quality, expanded their geographical reach and have progressively widened the range of products and services offered and domains served. Initially starting off as suppliers of manpower to undertake jobs at clients' sites, the software development progressively takes place at exporters home bases in India. There is also a conscious move away from low value adding coding and programming to export of high-end consulting and packaged software. This performance over the past few years has led industry and government to set ambitious targets for the future such as an annual export earnings of US $ 50 billion by AD 2008. The realization of these targets, however, is a challenge given the rising scarcity of trained manpower, eroding labour cost advantage, emerging competition from other countries, infrastructural bottlenecks and low R&D thrust. Furthermore, the recent US slowdown has tempered the assumptions underlying the projections and projected growth rates of the industry have been revised downwards. Nevertheless, the software industry is likely to continue its growth at rapid pace in the medium term even though at slightly lower than that of the past few years.

From a national perspective, software accounts for a marginal (nearly 2 percent) share of India's GNP but it has contributed nearly 12 percent of her GNP growth. Software accounts for nearly 8 percent of India's exports of goods and services. The net foreign exchange realization, however, is much smaller because of substantial foreign exchange expenditure on on-site delivery of these services. Although foreign exchange utilization per unit of exports has decreased since 1996, net exports realization is still less than 52 percent of gross exports. The industry, despite all the euphoria creates jobs for 60-70 thousand highly talented engineering graduates per annum. The IT-enabled services such as back-office operations, call centers and medical transcriptions could create over one million jobs by 2008 according to projections. However, these jobs are of footloose nature given the low skill content and routinized nature. They will move away from India as wages rise and other cheaper locations emerge. The jobs created in the industry, however, are physically less demanding and hence have great potential for women in the workforce. The software industry has helped in expanding the domestic base for entrepreneurship and has helped in creating a brand equity for the country in knowledge- based industries. Its development helped in reversing the trend

of brain drain in the 1990s by creating rewarding career opportunities for professional manpower in the country. However, the growing scarcity of IT trained manpower in the western countries has led them to turn their attention to India as source of supply of trained manpower. This trend threatens to lead to a fresh rise in brain drain from India and in the process adversely affect the competitiveness of Indian industry by aggravating their growing scarcity for talent. The entry of MNEs in the industry has not resulted in a substantial inflow of capital. Furthermore, the distribution of gains from the export activity of MNEs in the industry has been grossly in favour of the home country. The export enclave nature of the industry has generated little if at all, vertical inter-firm linkages with the rest of the domestic economy. There is also evidence that by sucking up the bulk of the engineering graduates, the industry has affected the other engineering industries adversely, although the precise impact is not yet clear. The industry is clustered around 6-7 cities which had well developed infrastructure and communication facilities. Its impact in reducing regional disparities is negligible if at all.

The main resource that has attracted the industry to the country is the pool of trained manpower generated through investments in human resource development over decades. Subsequently, the government facilitated the development of industry by providing dedicated high-speed data communication links and built up infrastructure in the software technology parks. Several initiatives are being taken by the government and the industry in response to the challenge the country is facing for further strengthening its place in the international division of labour. These include steps to increase the supply of trained manpower and other promotional facilities. The enterprises themselves have responded to the emerging challenges by adopting strategies for acquiring, upgrading and retaining the talent. There is clear evidence that human resource management is becoming a key aspect of the enterprise strategy in the Indian software industry. The companies are also attempting to move up the value chain by moving towards off-shore development, by focusing on domain expertise, high-end consulting and proprietary packages, and value pricing strategies. These strategies have been reflected in the trends in enterprise performance. There is an evidence of an improvement in the proportion of net exports, in labour productivity and in profit margins over the past couple of years.

Despite the strong performance of Indian software industry over the past decade, there is no room for complacency in view of competition from emerging countries especially China, and

Philippines, among others. While the Indian software enterprises have a headstart in the form of reaching the international benchmarks of process maturity, the competition will start biting in short and medium term especially in low value adding services such as coding, custom software, IT-enabled services etc. The Indian industry, therefore, needs to consolidate its strengths and take advantage of the head start over the potential competitors to quickly move up the value chain and establish themselves as leading sources of software products. However, entry into product market is ridden by high entry barriers that make it difficult for new entrants. In this respect following measures may be fruitful.

Paying Attention to R&D and Product Development: The Indian software industry needs to strengthen its thrust on R&D activity especially for product development. India's domestic market is sizeable enough to provide a testing ground for these products. Increased thrust on R&D activity is important for sustaining their long-term comparative advantage. In this context, the declining output of PhDs in engineering and technology in the country is a matter of concern. Increasing emphasis on R&D by industry, establishment of industry-University/ IIT linkages may help to make improve the career prospects for researchers in engineering/ technology and draw more talented people to join PhD programmes.

Strategic Acquisition of Global Marketing Channels and Brands: The global marketing and after sales service networks and globally recognized brands act as barriers to entry of new firms. To overcome these problems, Indian companies could plan to acquire stakes in a few Silicon Valley based software companies that have established niche markets for their products. Leveraged buyouts of much larger enterprises are now possible (as demonstrated by the recent takeover of Tetley by Tata Tea). The government financial institutions may assist the Indian companies in such strategic acquisitions. These acquisitions could serve as the vehicles for entry of Indian software in the markets for shrink wrapped software and give them a fuller control over the value chain.

Industrial Restructuring and Cosolidation: The analysis of firm size in enterprise performance suggests the presence of economies of scale in utilization of foreign exchange and human resources. Hence, some consolidation of the industry may lead to improvement in overall competitiveness.

Reorienting the Governmental Promotional Measures: The Government of India has played an important role in evolution of the industry by creating a pool of trained manpower, and by taking several important initiatives in setting up institutional infrastructure in computing and networking research since the late 1960s (see Kumar 2001, for a detailed analysis). The government has also assisted the industry by way of providing infrastructural facilities in STPs among other facilities. In addition, software exporters receive a income tax holiday for profits from software exports. There is need to rethink the relevance of these tax incentives. In an industry where India enjoys a natural comparative advantage (on account of low cost manpower), where exports have been growing at more than 50 per cent rate p.a., where profit margins are around 22 per cent of revenue (much higher than any industry in the country), there seems to be little relevance of these tax breaks on a sustained basis. Furthermore, given the opportunity cost of software development for the domestic markets, the bias created by tax breaks in favour of exports is not desirable. The revenue loss on account of these tax breaks is substantial. Our back-of-the-envelope calculations suggest that the loss of revenue to the exchequer on account of these tax incentives to the industry could be of the order of Rs 20 billion (or Rs 2000 crores). A part of this amount leaks out to foreign countries in the form of tax benefits absorbed by foreign MNEs which relocate software development activity in the country to take advantage of availability of low cost trained manpower. Besides strengthening the physical infrastructure for the industry, this amount would be better spent on supporting higher education and research in software technology that would be of long term strategic interest to the industry, assisting the industry in product development, building brands and international marketing networks, foreign acquisitions and other strategic support.

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