Export of Software and Business Process Outsourcing from Developing Countries: Lessons from the Indian Experience*

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ABSTRACT

India's emergence as a globally competitive supplier of software and services has attracted worldwide attention. Against that background, this paper explores the contribution of this sector to the economy and highlights the role of policy initiatives and institutional interventions undertaken by the State in accomplishing this unique success, with a view to drawing lessons for other developing countries. It is shown that the software and service sector not only contributes significantly to export earnings and GDP but also emerges as a major source of employment generation in the country. Besides, the information technology (IT) sector has served as a fertile ground for the growth of a new entrepreneurial class with innovative corporate practices and has been instrumental in reversing the brain drain, raising India's brand equity and attracting foreign direct investment (FDI) leading to other associated benefits. These and other benefits, the paper argues, have had an opportunity cost in terms of the adverse impact on other sectors competing for skilled manpower. It is also argued that India's success owes largely to the cumulative investments made by the Government over the past five decades in building up a national innovation system, which laid the foundation for the development of skill- and technology-intensive

(Continued on page 92)

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(Continued from page 91)

sectors, such as IT software and related services. This included a system of higher education in engineering and technical disciplines, the creation of an institutional infrastructure for science and technology (S&T) policymaking and implementation, building centres of excellence, a national information infrastructure and numerous other institutions for technology development, among other initiatives. This is not to neglect the role that private sector investment played, especially during the last decade, in taking India's software sector to further heights. In a sense, India presents a case of proactive State intervention with an active role for the private sector. The Indian experience thus tends to suggest that the developing countries aspiring to develop a software and service sector cannot afford to neglect the development of a vibrant national innovation system while adopting a liberal trade and investment policy regime. On the whole, while a bad policy could drive investment away and impair growth, a good market-friendly policy per se does not necessarily attract investment and facilitate growth.

1. INTRODUCTION

Economists have long noted that services in general are cheaper in developing countries than in developed countries. This has been attributed mainly to an abundant supply of labour – the major input in the production of services – in developing countries, leading to low wages. Since the technology for producing services does not differ significantly from one country to another, lower wages result in a lower cost of producing services in developing countries (Bhagwati, 1984). Yet, developing countries in general have been unable to benefit from this cost advantage mainly because most of the services were embodied in their provider and their export called for the transborder movement of labour. But the movement of labour, unlike capital, was subjected to series of restrictions.

Though the process of globalization, which inter alia implied the free movement of products and factors, accelerated momentum during the last two decades, there has been hardly any relaxation of the restriction of labour mobility. However, advances in information and communication technologies (ICTs) have made possible the "splintering off" of many of the services from its providers, which in turn has led to what is often called the "offshoring of services".

No wonder India, with its large pool of skilled manpower, has emerged as a major exporter of IT software and related services, such as business process outsourcing (BPO). In fact, one of the notable achievements in India during the last decade has been the emergence of an internationally competitive IT software and service sector. A number of studies have looked into different aspects of India's IT software export boom (Schware, 1987, 1992; Sen, 1995; Heeks, 1996; Kumar, 2000, 2001; Arora et al, 2001; Joseph and Harilal, 2001; Parthasarathi and Joseph, 2002; Joseph, 2002).

With the recent emergence of business process outsourcing delivered over the Internet, the so-called IT enabled services (ITES-BPOs) as a major source of employment and foreign exchange,[1] an obvious issue arises: are there any lessons from India for other developing countries aspiring to take advantage of the opportunities offered by the export of ITES, which is considered less demanding as compared with software? In this context, this paper examines the various factors that facilitated the emergence of India as a major IT software and service provider in the world market.

The remainder of the paper is organized as follows. Section 2 highlights the performance of software and service sector in India, its contribution to the economy and also the opportunity cost of the export-oriented growth strategy. Section 3 undertakes an analysis of the various policy initiatives and institutional interventions made by the State in facilitating the observed growth performance, followed by the concluding observations.

2. RISE OF INDIAN SOFTWARE AND RELATED SERVICE INDUSTRY: A PERSPECTIVE

(a) Growth of output and exports

The Indian software and related service industry, which include ITES-BPO, has grown at an unprecedented rate over the past decade or so. The output value of India's software and service sector increased more than 18 times from less than US$ 830 million in 1994-95 to US$ 15.5 billion in 2003-04. The sector growth, fueled mainly by exports, is clear from the fact that exports of software and services increased by more than 25 times during the same period (see figure 1).

With such rapid growth, the software and related service sector today accounts for over 2.6 per cent of GDP in 2003-04 compared with 0.5 per cent in 1996-97, representing a more than fivefold increase. Its share of India's exports of goods and services has increased almost seven fold (from 3.2 per cent to 21.3 per cent) during the same period. Viewed from an international perspective, India's share of the world IT software and service market is 3.4 per cent, compared with only about 0.8 per cent of global trade. Furthermore, India's share of the global market for customized software that is outsourced across borders is also more significant. According to one estimate, it had reached 18.5 per cent by 1999 (NASSCOM, 2000).

The rapid growth of software exports in the 1990s has been moderated since 2001. The annual compound growth rate of exports fell from 54 per cent during 1996-2000 to 25 per cent during the following three years. Another development taking place in the industry at the dawn of the new millennium was the rapid emergence of

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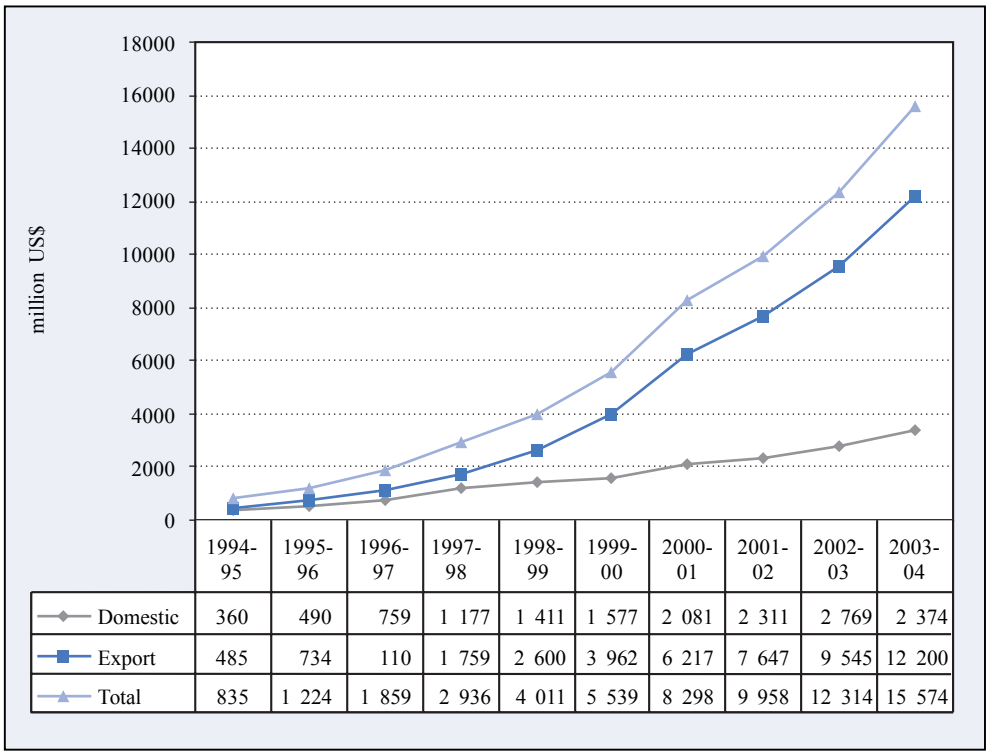
[1] Here it may be noted that the major importing country, the United States of America, has come up with measures to restrict the offshoring of services.

Figure 1. Trend in production and export of software and services



	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04
Domestic	360	490	759	1 177	1 411	1 577	2 081	2 311	2 769	2 374
Export	485	734	110	1 759	2 600	3 962	6 217	7 647	9 545	12 200
Total	835	1 224	1 859	2 936	4 011	5 539	8 298	9 958	12 314	15 574

ITES-BPO as a more dynamic component of software and service exports from the country. In 1999-2000, total ITES exports were only of the order of US$ 565 million and are estimated to have increased to US$ 3.6 billion in 2003-04. ITES-BPO exports grew by 59 per cent during 2002-03 to 2003-04. Hence, but for the rise of BPO exports, the growth of software exports would be even slower than what is shown above. As a result, the share of ITES-BPO in total software and service exports more than doubled, from about 14 per cent in 2000 to more than 29 per cent in 2003-04.

(b) Employment generation and other indirect externalities

(i) Creating jobs

As shown in table 1, the software and ITES-BPO sectors accounted for 813,000 jobs by 2003-04. Of these, nearly 500,000 (260,000 jobs in software industry and 245,000 jobs in ITES-BPO) have been primarily for export-oriented activities. In particular, jobs in ITES-BPO have risen rapidly, from 42,000 in 1999-2000 to 245,000 in 2003-04. One may argue that the ITES-BPO services that are booming currently are relatively low value-

adding and low skill-intensive activities. However, because ITES-BPO services are low value-adding, they are likely to make a greater contribution to the local economy in terms of creating job opportunities for millions of college pass-outs without technical or professional qualifications. Our estimate of the employment per million dollars of exports in the ITES-BPO sector is found to be about 70, which is more than twice that of the software sector. Thus viewed, ITES-BPO appears to have the potential of generating substantial employment for the growing number of educated youth in the country.

Table 1. Indian software and ITES sectors: professionals employed

	1999-2000	*2000-01*	*2001-02*	*2002-03*	*2003-04E*
Software exports sector	110 000	162 000	170 000	205 000	260 000
Software – domestic sector	17 000	20 000	22 000	25 000	28 000
Software – captive in user organizations	115 000	178 114	224 250	260 000	280 000
ITES-BPO	42 000	70 000	106 000	171 000	245 500
Total	284 000	430 114	522 250	661 000	813 500

Source: NASSCOM, 2004.

Note: E – estimated.

(ii) Expanding the base of entrepreneurship

Apart from creating jobs for highly qualified professionals as well as ordinary college pass-outs, 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 were started by first generation entrepreneurs. Infosys, Satyam, Mastek, Silverline and Polaris, among numerous others, were started by software professionals and engineers with small savings and loans at very modest scales to begin with (Kumar, 2001). 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 the software and services industry in India reveals how many rewarding entrepreneurship opportunities exist for low initial set-up costs. The rates at which even these smaller enterprises have been growing means that they do not stay small for very long (Kumar, 2000).

(iii) Reversing the brain drain

The rapid rise of the software industry in the country has also helped to reduce the extent of the brain drain by creating rewarding employment opportunities within the country, a trend also supported by the availability of venture capital to implement new

ideas. The rise of the software industry has also prompted a number of non-resident 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. Apparently, in Hyderabad alone, about 100 companies have been set up by returning software professionals (Kumar, 2001). Furthermore, the export orientation of the Indian software industry benefited from the presence of a substantial number of non-resident Indian engineers working in United States multinational enterprises (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 contacts between buyers in the United States and potential suppliers in India. Non-resident Indians in the software industry in the United States have also invested back home in subsidiaries that develop software for their United States operations. These include investments in subsidiaries of Mastech, CBS Inc. and IMR, among others.

(iv) Creating a brand value for the country in knowledge-based industries

Despite the large pool of trained engineering 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 such a highly knowledge-intensive service as software is helping to change the public perception of India and is focusing attention on the potential of the country in knowledge-based industries. This changing perception is helping India emerge as a destination for the global or regional research and development (R&D) centres of MNEs (see Kumar, 2003). This changing perception about the country's strengths is also shaping bilateral relations with different countries.

(v) Facilitating capital inflows

The development of the software industry has led to an increased flow of capital to the country in three forms: foreign direct investment (FDI) by outside MNEs in their subsidiaries and joint ventures in India, foreign institutional investments (FIIs) in software companies in India through stock purchases, and capital raised abroad by Indian software companies. It has been estimated that MNE affiliates account for 23 per cent of exports of software services and 26 per cent of ITES-BPO exports.

(vi) Spatial agglomeration and regional distribution

The development of the software industry in different parts of the world is characterized by a strong tendency towards clustering because of agglomeration economies. In India, the software industry developed initially in Mumbai. Bangalore subsequently emerged as a centre of software industry development, especially after the entry of Texas Instruments in the mid-1980s. In addition to Bangalore and Mumbai, Delhi and the suburban communities of Noida and Gurgaon have emerged as

the third most popular location for software units. As Bangalore has become saturated owing to the limits of its infrastructure and the scarcity of space, Hyderabad and Chennai have started to provide alternative locations in the south. The top five cities together account for 80.5 per cent of the top 600 companies. But other cities, such as Calcutta, Pune, Thiruvanantpuram, Ahmedabad and Bhubneswar, are becoming increasingly popular locations. Two important factors in this agglomeration are the availability of high-speed data communication links and built-up space provided in software technology parks and the availability of skilled manpower. The less skill-dependent nature of the ITES-BPO activity makes it more easily diffused across the country, thus generating linkages with the rest of the economy.

(c) Upgrading and capability-building

How about Indian performance in terms of indicators related to the upgrading of capability? Certain indicators suggest that Indian industry has been moving up the value chain while also expanding exports of relatively lower-end BPO services.

Although the magnitude of exports of software and services from India has grown rapidly over the past decade, the general perception is that these are exports of 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 of 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 with software product designing and development and has been derisively termed "body shopping" (Heeks, 1996). However, the Indian software industry has since come of age in terms of capabilities, sophistication, range of expertise and worldwide reach.

(i) Moving away from body shopping

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 ("body shopping") in India's software exports has begun to come down, from 90 per cent in 1988 to only 40 per cent by 2003-04. The bulk of India's software is now developed "offshore" at the home bases of exporters in India and exported.

(ii) Increasing focus on high-value consulting and packaged software

Thus far, Indian software enterprises have generally focused on services that are considered to be low value-adding. Having established themselves 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 the 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 and Satyam Computer Services, which are providing higher-end programming solutions for their clients. Infosys has successfully renegotiated its per man-hour charges with its clients. It reportedly commands US$ 90 per hour (Kumar, 2001).

(iii) Growing product development capability

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 I-Flex, which has been used by over 240 financial institutions in 69 countries. Polaris has developed a proprietary retail banking software called 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 in 12 countries. TCS has launched packaged software for the banking insurance, securities, accounting and health-care industries. TCS has also launched its branded integrated suite of software tools, Mastercraft, which is claimed to have been received well in the United States 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 is sold in the domestic market. For example, Tally, a popular accounting package for small and medium-sized enterprises used by 50,000 companies and approved by professional accountants' associations in India and the United Kingdom of Great Britain and Northern Ireland, was developed by a smaller, highly specialized, software company (Kumar, 2001). Despite these efforts, the share of products and packages in Indian exports of software is still marginal at 3.2 per cent. However, given the high entry barriers in the package market, the entry of Indian companies is nevertheless significant.

(iv) Locally anchored capability

There is a qualitative difference between achieving export success on the basis of subsidiaries of foreign-based MNEs and achieving it on the basis of indigenous enterprises that keep capabilities anchored locally. India's 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 six software companies in India, ranked either on the basis of overall sales or exports. Among the top 20 software companies too, no more than 6 are MNE affiliates or joint ventures. Foreign subsidiaries include the software development centres of software MNEs and subsidiaries of other MNEs that develop software for the applications of the parent company. The latter include subsidiaries of financial services companies, such as Citicorp, Deutsche Bank, Churchill Insurance and Phoenix Life Mutual, and telecommunication MNEs, such as Hughes and Motorola. In

addition, MNEs have set up 16 joint ventures with local enterprises; examples include British Aerospace with Hindustan Aeronautics, Bell South with the Telecommication Corporation of India and British Telecom with the Mahindra Group. In all, 95 companies have controlling foreign participation. Exports by MNE affiliates accounted for 23 per cent of total software and services exports in 2003-04 compared with 19 per cent in 1998-99 (see Dataquest, 2004 and Kumar, 2001, respectively).

(v) 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, almost all major Indian software companies have obtained the International Standards Organization 9000 (ISO 9000) certification (Nasscom, 2004). Furthermore, as many as 50 Indian companies have received SEI-CMM (Software Engineering Institute, Capability Maturity Model of the United States) Certification at Level 5 from 74 such organizations worldwide, 54 of which are outside the United States (NASSCOM, 2004). This shows that Indian software enterprises, especially the leading ones, have strived to attain excellence in their professionalism and in their adherence to global best practices.

(vi) Moving up the value chain: evidence from recent trends in enterprise performance

An analysis of enterprise performance found Indian software enterprises moving up the value chain in terms of rising productivity, net export earnings, export intensity, declining unit cost of production and improving profit margins since 1997 (Kumar, 2001). Another study has shown that there has been upward mobility in the competence of firms (Joseph and Abraham, 2002).[2]

(d) 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, while 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 United States industry could be significant. To some extent, the prevailing fiscal incentive regime, i.e., the availability

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[2] Since conventional measures of innovation, such as R&D, are limited when it comes to capturing innovation in a service sector, such as ICT, the study developed an index of claimed technological competence (ICTC) using information from the firms themselves on their areas of specialization. The theoretical base of the index has been drawn from the literature on technological opportunity.

of tax incentives for export profits, diverts attention towards exports by making them more rewarding compared with serving the domestic market. There is a need to rethink the relevance of the tax incentives for the software industry.

Most of the export-oriented software companies operate as "export enclaves" with little linkages with the domestic economy, if at all (D'Costa, 2003). 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 the operation generates very little knowledge spillover for the domestic economy. The bulk of the work done is also of a highly customized nature having little application elsewhere. Given the high salaries and the perks of foreign travel, there is no movement of personnel from these companies to domestic firms. The employees of export-oriented firms are generally lured by foreign companies. There is considerable movement of personnel from domestic market-oriented firms to export-oriented firms or foreign subsidiaries (Kumar, 2001; Joseph and Harilal, 2001). 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 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 having difficulty finding an adequate number of engineers. The impact of rising salaries on the competitiveness and the bottom line of the engineering industry and other industries that compete for engineering talent with the software industry is not yet clear. However, it has certainly made their work more difficult.

3. RISE OF SOFTWARE AND SERVICE EXPORTS IN INDIA: THE ROLE OF GOVERNMENT INTERVENTIONS

It is clear from the above that the rise of the export-oriented software and related service industries in India has been an interesting development with a number of valuable development consequences. Some observers have tended to argue that India's success in the software industry has been an outcome of free play in the market and of benign State neglect (Arora et al., 2000). It is argued here that India's success in the industry is owed primarily to cumulative investments made by the national Government not only in building a supply base for qualified manpower but also in building institutional infrastructure for capability development. While the series of policy initiatives and institutional interventions made by the national Government during the 1960s and 1970s laid the foundation for the development of a vibrant software industry in India (Kumar and Joseph, 2004), it was the Computer Policy of 1984 that gave a special thrust to software development by highlighting the need for institutional and policy support on a number of fronts. The policy, for example, called for the setting up of a separate Software Development Promotion Agency (SDPA) under the erstwhile Department of Electronics (DoE). The import of inputs needed for software development was made more liberal. The policy emphasized that:

> "Effective software export promotion on a sustained basis can be effective in the long run only if it is planned as a part of an overall software promotion scheme covering both export and internal requirements including import substitution. Also planning for software development is integrally connected with the plan for hardware development and system engineering" (Government of India, 1985).

Against this background, the need was felt for more concrete policies towards the promotion of software development and export. Accordingly, an explicit software policy was announced in 1986 and software was identified as one of the key sectors in India's agenda for export promotion. The policy underlined importance of integrated development of software for the domestic and export markets (India DoE, 1986). To facilitate the stated objectives, the policy emphasized the need to simplify existing procedures pertaining to all aspects of software development and production for the domestic as well as the export market. It also provided software firms with various commercial incentives, such as tax holidays, a tax exemption on income from software exports, export subsidies and the duty-free import of any hardware or software to be used 100 per cent for export purposes.

With the initiation of economic reforms in the early 1990s, the Finance Ministry made an assessment indicating that, apart from the general orientation of all industries towards export markets, India's comparative advantage was in software and not in hardware. Therefore, a major thrust was consciously given to software exports. Accordingly, new policy measures have been initiated, among which are the following: (a) the removal of entry barriers against foreign companies; (b) the removal of restrictions on foreign technology transfers; (c) the participation of the private sector in policymaking; (d) provisions to finance software development through equity and venture capital; (e) measures to make available faster and cheaper data communication facilities; and (f) the reduction and rationalization of taxes, duties and tariffs (Narayanamurthy, 2000).[3]

Recognizing the potential of IT-related industries and software for India's development, the Prime Minister created the National Task force on Information Technology and Software Development (NTITSD) in May 1998 under the chairmanship of the Deputy Chairman, Planning Commission. NTITSD submitted a report outlining a national IT plan comprising 108 recommendations for software and 87 recommendations for hardware (India, NTITSD, 1998). These recommendations have since been notified by the Government in the *Gazette of India* dated 25 July 1998 (India, MIT, 2000). NTITSD has set before the country an ambitious target of US$ 50 billion worth of software exports by 2008. DoE was upgraded to a full-fledged Ministry of Information Technology (MIT) in October 1999 to coordinate the promotional role of the Government in the industry.

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[3] Mention needs to be made of the substantial reduction in duties and tariffs across the board for components and sub-assemblies, zero duty on software imports and zero income tax on profits from software exports.

(a) Supply of trained manpower for software development

The Government has permitted private investment in IT training since the early 1980s. Privately run centres offer courses of varying duration, ranging from short-term specialized courses to longer-term basic courses. However, the quality of the training imparted by these institutions has been uneven. In 1990, DoE devised a scheme called DOEACC jointly with the All India Council for Technical Education (AICTE) to provide accreditation according to the specified level of a course.[4] By January 2004, the DOEACC Society had accredited a total of 850 institutes. The Society conducts examinations in all four levels twice a year and grants certificates and diplomas (India, DIT, 2004).

The demand for software personnel, especially engineering graduates, has grown rapidly since the mid 1990s owing to the expansion of software development activity in India as well as the growing brain drain. In view of this, increasing the supply of IT professionals is one of the challenges that the country has faced. NTITSD has made a number of recommendations for augmenting the quantity and quantity of trained manpower for the software industry. In line with these recommendations, the capacity of the higher education system in engineering has been expanded, and new institutions have been set up (Kumar, 2000). In India today, 253 universities and 13,150 colleges produce 2.46 million graduates and about 290,000 engineering degree and diploma holders every year. English is widely used as a medium of instruction, which in turn provides an ample supply of manpower for ITES services at a much lower cost as compared with other countries. It has been estimated that, on average, the labour cost in the Indian ITES sector is only about 14 per cent of that in the United States. While the current supply of IT manpower is considered adequate, there is concern about the quality and supply of middle-level manpower (India, MIT, 2001).

(b) IT infrastructure: software technology parks

A notable institutional intervention has been the establishment of software technology parks[5] (STP) to provide the necessary infrastructure for software export. The first ones to come into being were those in Bangalore, Pune and Bhubaneshwar in August, October and December 1990, respectively. In 1991, four more STPs were set

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4 Foundation course (O); Advanced Diploma (A); MCA Level (B); and M. Tech Level (C).

5 A software technology park in all respects is similar to a free trade zone exclusively for software. The specific objectives are:

- To establish and manage infrastructural resources, such as data communication facilities, core computer facilities, built-up space and common amenities;
- To provide services (import certification, software valuation, project approvals, etc.) for the users who undertake software development for export purposes;
- To promote the development and export of software and software services through technology assessments, market analysis, marketing support, etc;
- To train professionals and to encourage design and development in the field of software technology and software engineering (India, DoE, 1996).

up by DoE in Noida, Gandhinagar, Trivandrum and Hyderabad. There are currently 39 centres with about 7000 units registered and in 2002-03 they accounted for about 80 per cent of the country's software exports. The infrastructure facilities available in these STPs include, among other things, modern computers and communication networks, which are beyond the reach of individual firms. The STPs also envisage a transparent policy environment and a package of concessions (India, DIT, 2004).

In June 2000, a new STP was set up in Silicon Valley, composed of a Business Support Centre and an India Infotech Centre, with a view to facilitating software export by small and medium-sized firms to the United States.[6] The centre also fosters business relationships by providing access to financial institutions in the United States, venture capital funds and specialized trade bodies to promote partnerships and strategic alliances between American and Indian ICT software and service companies.

(c) IT infrastructure: reforms in the telecom sector

Realizing the importance of telecommunication in the overall development of the economy in general and that of the IT and software service sector in particular, the Government initiated a number of policy reforms that helped create a highly competitive environment, leading to a drastic reduction in telecom costs but also to increased access and better quality services. Perhaps the first step was the announcement of the National Telecom Policy in 1994, opening up the telecom sector to competition in basic services as well as value added services, such as cellular mobile services, radio paging and VSAT Services. It also set targets for the provision of telephone on demand and the opening up of long distance telephony. This was followed by the Telecom Regulatory Act of 1997, which led to the establishment of the independent Telecom Regulatory Authority of India (TRAI). Later, the New Telecom Policy of March 1999 focused on removing some of the bottlenecks and moving the liberalization process forward (Singh, et al., undated). These policy reforms have resulted in a very rapid expansion of the telecom network in the country. This has been possible because of all telecom services were opened to the private sector without any restriction on the number of operators, except for the cellular mobile phone segment because of frequency constraints. Private sector investment has been helping to bridge the resource gap to a considerable extent, as was envisaged.

The Government also permitted foreign investment in laying submarine cables, which led to such joint ventures as the one between Bharati Telecom Singapore Telecommunications, Ltd. (SingTel) and Bharti Enterprises of India, a US$ 650 million joint venture to build the world's largest cable network in terms of capacity. Today, submarine cables account for about 30 per cent of international long distance dialing and, with additional investment in the pipeline that share is expected to increase in the near future.

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6 "STPI now opens office at Silicon Valley, USA", *The Economic Times*, New Delhi, special supplement on software technology parks in India, 11 June 2000.

Recent initiatives include permission to offer Internet telephony, and the opening of national long distance service to private operators by abolishing the monopoly of VSNL in international long distance. Along with these policy measures, a liberal policy for Internet service providers was announced. As of December 2002, licenses had been granted to 573 ISPs, of which 24 had been given clearance to commission 55 international gateways for the Internet using satellite media (India, DoT, 2004).

As a result of the liberalization of the policy towards FDI in general and foreign investment in the field of IT and telecommunications, between August 1991 and December 2002, 858 proposals for FDI amounting to Rs. 5,627.9 million were approved and the actual flow for FDI during the above period was Rs. 956.2 million. In terms of approval of FDI, the telecom sector is the second largest after the power and oil refinery sector. From January to December of 2002, the actual FDI inflow was of the order of Rs. 108.1 million.

(d) R&D capability-building

DoE has placed heavy emphasis on R&D activities relating, among other fields, to the development of computer software by supporting these activities at different institutions, such as TIFR, IITs, IISc, select universities (such as Jadavpur University), ISI, and CSIR Laboratories since the early 1970s. The Technology Development Council has been supporting R&D projects since its inception in 1973 (India, MIT, 2000a). These programmes for technology development have led to the building of capabilities and have provided experienced manpower for the rapid development of the industry in the coming years.

For instance, the capabilities built in the process of early work on data communication at TIFR, started in the late 1970s and anchored at the DoE-supported National Centre for Software Technology (NCST), which was set up in Bombay in 1984, proved instrumental for the development of country wide networks and the Internet in the country in the 1990s. Government S&T agencies have set up a parallel Supercomputer Education and Research Centre (SERC) and Department of Computer Science and Automation at IISc, which provide high-end expertise and manpower to the industry in software.

Apart from NCST, DoE has set up another institution for technology development in the 1980s, viz. the Centre for Development of Advanced Computing (C-DAC). C-DAC has developed India's first supercomputer, Param, and has developed software in Indian languages. Electronics Research and Development Centre (ER&DC) set up by the DoE also plays an important role in R&D in IT and electronics. The Government has also stimulated and supported R&D activity through tax incentives and direct funding on a limited scale by DoE.

(e) Institutional infrastructure and patterns of spatial agglomeration in the IT sector

IT and software development in different parts of the world is characterized by a strong tendency towards clustering because of agglomeration economies. As mentioned above, the software industry was initially concentrated in Mumbai (formerly Bombay) and later spread to Bangalore, Delhi, Hyderabad and Chennai. Today, the top five cities together account for the bulk of total exports. The pattern of concentration in the software development industry in and around select cities illustrates the key importance of institutional infrastructure for the activity.

Table 2 shows that the cities with a high concentration of software development activity enjoy a disproportionate share of the national innovative infrastructure, the skill base and other resources for technology development. Because of significant agglomeration economies present in skill- and knowledge-intensive activities, such as software development, the fact that these cities have this disproportionate share of the national innovative infrastructure has served as a magnet for software development activity.

To sum up the discussion, it has been shown that India owes its success largely to the cumulative investments made by the Government over the past five decades in what is now termed national innovation systems (NIS). These include a system of higher education in engineering and technical disciplines, the creation of an institutional infrastructure for S&T policymaking and implementation, and the building of centres of excellence and numerous other institutions for technology development. The Government of India recognized the potential of the country in computer software in the early 1970s and started building the necessary infrastructure for its fruition, in particular, for manpower training. The Government also facilitated technological capability-building with investments in publicly funded R&D institutions and supported their projects by creating computing facilities and developing infrastructure for data transfer and networking. The patterns illustrated by the clustering of software development activity in select centres are further evidence that publicly funded technological infrastructure serves as a magnet for investment from private sector and foreign firms in skill-intensive activities, such as software development. While government interventions laid the foundation, it was the high rate of growth in world demand, due, inter alia, to the Y2K problem and greater participation by the private sector, that enabled the industry to take off.

4. CONCLUDING OBSERVATIONS

The export performance of India's software and service sector during the last decade has been unprecedented. As a result, the software and service sector accounts for over 20 per cent of India's total exports and 2.6 per cent of GDP. In addition, there has been a marked decline in the share of on-site services and today almost 60 per cent of India's software and services export takes the form of offshore services. Furthermore, India's software sector is moving up the value chain, albeit slowly. The rise of the

Table 2. Illustrative S&T infrastructure in four IT clusters in India

Type of NIS Infrastructure	*Bombay*	*Bangalore*	*Delhi and environs*	*Hyderabad*
Institutions of Higher Technical Education and Excellence	IIT-B; Bombay University; SNDT Women's University; Bajaj Institute of Management and several other engineering and management institutes	IISc; University Visvesraya College ; of Engineering;; SKSJ Technology Institute; 28 private engineering colleges; Indian Institute of Management	IIT-D; Delhi College of Engineering; Delhi University Department of Computer Sciences, Roorkee University of Engineering (within 200 kms) J.N. University; Jamia Milia Islamia Engineering College; FMS; IIFT; plus several private institutions	J.N.Technological University; Hyderabad University; Osmania University; Kakatiya University
Public Funded Research Laboratories and Institutions	TIFR; NCST; BARC; UDCT; SAMEER	ISRO; NAL, CMTI; Electronics and Radar Development Establishment; Aeronautical Development Establishment; Gas Turbine Research Establishment; Centre for Aeronautical Systems Studies and Analysis; ER&DCI	NIC; NPL; Institute for Systems Studies and Analysis; SPL; C-DOT	National Remote Sensing Agency; RRL; NGRI; IICT; Defence Electronic Research Laboratory; DRDL
Local Software Champions	TCS; PCS; Tata Infotech; Mastek; L&T ITL; APTECH; COSL; Datamatics; Silverline	Infosys Technologies Ltd.; WIPRO Information Technologies	HCL Technologies; NIIT Ltd.; CMC Ltd.	Satyam Computer Services Ltd.
High Speed Data Communication Facilities	Earth Station of STPI	Earth Station of STPI	Earth Station of STPI	Earth Station of STPI
High Technology Enterprises (mostly public sector)	L&T; Godrej; Tata group and a large number of engineering and electronics enterprises	ITI; BEL; HAL	Central Electronics Ltd.; NRDC; EIL; RITES; ETTDC; ET&T; RITES; TCIL	ECIL; BHEL

Source: Kumar, 2001.

software and related service industry has also generated jobs and a number of other favourable externalities. However, the industry is characterized by high spatial concentration and the software export activity continues to be an enclave, with limited linkages with the rest of the economy. Given the fact that IT users benefit somewhat more than IT producers (IMF, 2001) and that the marginal social benefit of a dollar's worth of software consumed is more than a dollar's worth of exports, India needs to focus more on the diffusion of ICT into different sectors of its economy.

While it has been argued that India's success in software and related services is the outcome of benign State neglect, the present paper shows that such conclusions not only conceal more than they reveal but are of little relevance for countries that are in the process of developing such capacity because there are many developing countries that have assigned a prime role to the market and have nonetheless achieved limited success. While India's success is due to the cumulative efforts of the last five decades and transplanting experience from one country to another has its limits, developing countries aspiring to develop a software and service sector can learn much from the Indian experience. In general, while developing countries can adopt liberal trade and investment policies, they can hardly afford to ignore the development of a national innovation system, which is a prerequisite for building capabilities in skill- and technology-intensive sectors, such as software and services. The Indian experience tends to suggest that, while a bad policy could drive investment away, a good market-friendly policy per se does not necessarily attract investment or facilitate growth.

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