India's Software Industry in Transition:
Lessons for other developing countries and implications for South-South Cooperation

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1. Introduction

It is generally perceived that the greatest contribution by the previous century in the sphere of technology to the current century and beyond is the revolutionary changes in the Information Communication Technology (ICT). While the genesis of such revolutionary changes could be traced to the technological changes in microelectronics, it has been sustained by the developments in software. The cumulative effect has been emergence ICT as the General Purpose Technology (GPT) of the new millennium that is instrumental in enhancing efficiency, competitiveness and growth in all sectors of the economy regardless of their stage of development and help achieving the millennium development goals by the developing countries. If the available evidence is any indication, there is hardly any developing country that has not undertaken policy measures and institutional interventions to develop ICT capabilities and harness the new technology as a short cut to prosperity.

In this context, India's success story which attracted the world attention mainly on account of her remarkable performance in the export of software services may be inspirational for other developing countries. The recorded growth in the software exports from India as well as the credibility that India earned there from has no parallels in India's economic history. It has also been shown that the organizational, managerial and other innovations introduced by the IT firms have been emulated by firms in other industries contributing to their enhanced performance (Arora and Athreya 2002).

Yet the more popular software stories (most of them dated) are on how India's software sector has been focusing on low end of the value chain?; how the availability of highly skilled labour at lower cost has resulted in comparative advantage in the export of software services?; How the excessive export orientation affected the innovative behavior?;. How the export oriented strategy

contributed very low rate of diffusion of ICT in different sectors of the economy? and how the varied projects that aimed at harnessing ICT for development remained at the pilot stage.

The moot question here is, given the changes in the environment, both external and internal, governing software sector, has there been any change in the landscape of India's software sector and the issues therein include; has there been an upward movement along the software value chain? How has the industry changed in terms of its orientation towards export vis-a-vis the domestic market? If the answer to the above questions is in the affirmative, it is also pertinent to explore the contributory factors and especially the role of state policies. Here it is especially relevant to place India's performance in contrast to that of China. Finally it would be of relevance to explore the lessons that India's experience offers to other developing countries and its implications for South-south Cooperation. These are some of the issues that the present paper intends to address.

The remainder of this paper is organized as follows; Section 2 analyses the performance of India's software industry. It begins with an analysis of the trend in production and exports and its contribution towards GDP growth and employment generation. Against this background, further analysis undertaken in this section presents evidence to suggest that there is an increasing orientation towards the domestic market and the industry is moving up the value chain. The third section presents a preliminary analysis of the performance of software industry in China with a view to locate India's performance in a perspective. Section 4 presents an overview of India's policy towards software and examines the influence of state policy on the observed shift towards the domestic market and reiterates the argument that this has not been the handiwork of the market but has been an outcome of the innovation system built up over the years mostly at the instance of state and also other stakeholders like industry associations including the innovative efforts by the individual firms[1]. Section 5, drawing from the previous sections, presents a perspective in terms of lessons for other developing countries and role of south-south cooperation in software development.

[1] See for details Joseph (2006) Kumar and Joseph (2006) Balakrishnan (2006) also A K Sen "looking beyond the traditional domain", *The Hindu*, 16, February 2007, Chennai,

2. Performance of Software Industry: Recent Trends

2.1 Trend in Production and Exports

Developing countries are known to have comparative advantage in the production of services. This is on account of the abundant supply of labour - the major input in the production of services - in developing countries leading to low wages. Since the technology of producing services does not differ significantly across counties, lower wages results in low cost of production of services in developing countries (Bhagwati 1984). However, most of these countries have been unable to tap this advantage mainly because most services are embodied in their providers and their export calls for the trans-border mobility of labour which is 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 have been hardly any relaxation in the restrictions on labour mobility. Hence, the production structure and employment in developing countries continues to be dominated by primary and secondary sectors. Nonetheless, India has been successfully participating in the global division of labour in different services and emerged as a leading player in the export of software services *inter alia* by taking advantage the opportunities opened up by new technologies that increasingly splintered off services from its providers. While earlier studies have argued that the performance of India's software sector has been unprecedented in India's economic history (Schware 1992; Arora et. al 2001, Joseph 2002; Joseph 2009; Joseph and Harilal 2001; Kumar and Joseph 2005 to list a few), they have also been concerned about the focus of software industry on the low end of the value chain, limited domestic market orientation and its associated opportunity costs. Against this background this section analyses the performance of software industry and explore if there are any evidence of transformation. More specifically, it examines the trend in domestic market orientation and movement along the software value chain in terms of move away from software services to other software activities involving higher skill and value addition like software products and software engineering research and design including embedded software development.

Before proceeding further, a brief discussion on the date base of India's software sector is in order. Most of the existing studies on India's software sector have been based on the data provided by the National Association of Software and Service Companies (NASSCOM).

NASSCOM, the leading association of software companies in India, has a total membership of over 1200 in 2011 and it has been claimed that these companies account for nearly 95 per cent of the total software exports from the country. NASSCOM also used to provide, until 2004-05, company level information on sales, export, employment and other information. Another source of firm level data is the Centre for Monitoring Indian Economy. Since this source covers only the companies listed in stock market, its coverage is much less as compared to NASSCOM. However, by comparing firm level information from these two sources, it has been shown that NASSCOM estimates on export involved some over estimation (Parthsarathi and Joseph 2002). Another source of data on software exports and production is the Electronics and Software Export Promotion Council (ESEC), an autonomous body under the Government of India and the Ministry of Information Technology. Yet, another source is the Reserve Bank of India (RBI) which is based on foreign exchange inflow into the country. RBI, however, reports only the total export earnings and is available only from 2004-05. While there existed differences in exports as reported by different sources, it appears that such differences have significantly reduced over the years. From table 1 it is evident that software export data as reported by NASSCOM which refers to the calendar year (Jan-Dec) is more or less comparable to the exports data for the financial year (March-April) as reported by RBI and Electronics and Software Export Promotion Council.

Table 1: Data on total software export as reported by different data sources (US $ billion)

	Software exports (including BPO) as reported by				
Year	NASSCOM	ESEC	RBI	Exports excluding BPO (NASSCOM)	Share of software services, products and ER&D
2004-05	17.7	17.21	17.7	14.3	80.79
2005-06	23.61	23.72	23.6	18.41	77.98
2006-07	29.56	33.76	31.3	22.35	75.61
2007-08	40.42	43.47	40.3	30.51	75.48
2008-09	47.09	49.54	46.3	35.39	75.15
2009-10	49.69	51	49.71	37.29	75.05
2010-11	59.01	57.62	55.46	44.89	76.07

Note: NASSCOM data refers to the calendar year. That is, data for the year 2004-05 may be read as from January 2005 to December 2005

Here it is also to be noted that the different sources cited above uses different conceptual frame in defining the software sector. For NASSCOM the total exports/production included computer hardware, software services, Business Process Outsourcing (BPO) and software products including engineering research and design. NASSCOM, however, provides disaggregated data on each of these items. Data provided by Electronics and Software Export Promotion Council includes whole electronics production, software and BPO. Here, unlike in NASSCOM, both software services and products are clubbed together as software and no disaggregated data on software services and software products are given. While RBI provides only data on exports the above two sources provide aggregate data on both production and exports.

In what follows, we shall make use of the date provided by the Electronics and Software Export Promotion Council for the trend analysis. Here, total software exports and production include software services, Business Process Outsourcing (BPO) and software products along with engineering research and design (mostly embedded software) –hereafter referred to as software products. Since the focus of the present paper is on software industry, in the disaggregated analysis we shall not deal with BPO and therefore confine to software services and software products which is based on the data obtained from NASSCOM.

Data presented in the table 2 clearly reinforces the findings of earlier studies which indicated that the performance of software sector during the last two decades has been remarkable by any standard. During the decade of 1990s the total production of software sector increased by 26 fold; from a little over $200 million in 1990-91 to US $5.5 billion in 1999-00, recording an annual average growth rate of over 44 per cent. With a total production of about $75 billion in 2010-11, the observed high rate of growth during 1990s was sustained since 2000 recording an annual average rate of growth of over 35 per cent.

More remarkable has been the performance with respect to exports. Total exports increased from $ 110 million 1990-91 to nearly $ 4 Billion in 1999-00 recording an annual average growth rate of about 50 percent. Going by the available evidence, with a total export of $ 57.6 billion in 2010-11 the observed rate of growth was as high as 38 per cent since 2000 (see table 2) Thus viewed, in a context wherein India has been severely constrained by the availability of foreign exchange, software sector contributed significantly towards improving the external health of the economy.

Table 2 also indicates that with global financial crisis that affected initially the US - the leading market for India - and later spread to Europe, has had its adverse effect. This is evident from the drastic decline in the rate of growth in export from over 36 per cent in 2007-08 to 6.6 per cent in 2008-09. However as these economies are reviving from crisis, the adverse effect appears to have been short lived because the rate of growth in export also picked up as is evident from the higher export growth of nearly 24 per cent recorded in 2010-11.

Table 2: Trend in software production and export (including BPO) from India

Year	Software production ($ Mill)	Annual growth rate (%)	Exports ($ Million)	Annual growth rate (%)
1990-91	209		110	
1991-92	289	38.3	166	50.9
1992-93	382	32.2	221	33.1
1993-94	545	42.7	325	47.1
1994-95	803	47.3	473	45.5
1995-96	1182	47.2	711	50.3
1996-97	1798	52.1	1159	63
1997-98	2929	62.9	1813	56.4
1998-99	4009	36.9	2599	43.4
1999-00	5538	38.1	3962	52.4
Average growth 1991-99		44.2		49.1
2000-01	8021	44.8	5978	50.9
2001-02	9931	23.8	7653	28
2002-03	12376	24.6	9607	25.5
2003-04	16141	30.4	12608	31.2
2004-05	21587	33.7	17216	36.5
2005-06	30404	40.8	23718	37.8
2006-07	42312	39.2	33757	42.3
2007-08	55144	30.3	43467	28.8
2008-09	61984	12.4	49540	14
2009-10	64956	4.8	51001	2.9
2010-11	74890	15.3	57616	13
Average growth 2000-10		35.3		38.2

Source: Electronics and Software Export Promotion Council, Statistical Year book, different years. Note: Software includes the software services, software products and BPOs

2.2 Software in India's GDP and employment

Being one of the fastest growing sectors in the Indian economy software industry has also contributed towards the turnaround in India's GDP growth observed since 1991. Share of software production, which includes software services, software products and BPO, in GDP increased from 1.85% in 2000-01 to the highest level of 5.37% in 2008-09. Thereafter it has shown a marginal decline to reach 4.7% in 2010-11(Table 3). It is also evident that in the service sector driven growth of the Indian economy recorded during the recent years, software sector played a significant role as its share in service sector GDP increased by threefold since 2000. Equally remarkable has been its contribution in total exports which nearly doubled from 7.7 per cent in 2000-01 to 14.8 per cent in 2009-10 (see table 3)

According to NASSCOM Strategic Review (2012), the direct employment generated by the software industry (software services, products, BPO and hardware) is estimated at 600,000 in 2011 as compared to 160,000 in 1996. It is also estimated that the indirect employment is about four times the direct employment. The industry is creating job opportunities for highly qualified (majority with an engineering degree) young graduates with a relatively short experience.

Table 3: Contribution of software sector to India's GDP and exports

Year	% of GDP	% of Service GDP	% of total exports	% of Service exports
2000-01	1.85	6.48	7.73	18.61
2006-07	4.63	16.76	13.27	28.23
2007-08	4.85	17.55	13.82	29.26
2008-09	5.37	18.40	13.99	29.57
2009-10	5.06	16.68	14.77	31.24
2010-11	4.77	15.57	12.86	29.09

Source: Data on GDP: Government of India, Economic Survey 2012-13
Data on software production and export: Electronics and Software Export Promotion Council, Statistical yearbook different issues; Software includes the software services, software products and BPOs

The observed performance of software sector in employment generation appears highly impressive when considered against the fact that employment generation by the organized

manufacturing sector has been on the decline during 1990s (Nagaraj 2004) and according to NSS statistics during 1999-00 to 2004-05 growth in employment in the rural and urban areas has been only of the order of 1.97 per cent and 3.22 per cent respectively (Chandrsekhar et al 2006). While contributing significantly to GDP, export earning and employment the industry has been undergoing major transformation within.

2.3 Changing direction of exports

There is also evidence to suggest that the export market is becoming more diversified. Table 4 indicates that the share of North America, traditionally the leading destination of India's software exports has declined by more than six per centage points since 2005 while that of EU countries increased. There are also evidence to suggest in the shares of Africa and Latin America have increased which in turn cannot be delinked from India's regional trading arrangements and initiatives for greater integration with these countries under the auspices of IBSA and BRICS.

Table 4: Changes in the direction of software exports (including BPO)

Destination	Software			
	2005-06		2010-11	
	Value ($Million)	Share (%)	Value ($ Million)	Share (%)
North America	14727.81	62.10	32265.14	56.0
Europe (EU countries)	6098.94	25.71	17954.35	31.16
Singapore, Hongkong & Other south Asian Countries	632.48	2.67	1843.72	3.2
Japan Korea & Other Far east counties	722.84	3.05	749.12	1.3
Middle East Countries	564.72	2.38	1728.49	3
Europe(Non EU counties)	496.95	2.1	633.89	1.1
Australia & Other Oceanic counties	293.65	1.24	979.59	1.7
African Countries	96	0.4	691.4	1.2
Latin America	79.06	0.33	576.16	1
Russia & C.I.S Counties	5.65	0.02	194.47	0.34
Total	**23718.09**	**100**	**57616.33**	**100**

Source: Electronics and Software Export Promotion Council, Statistical Year book, different years

2.4 Leading role by domestic firms

Although Tata Consultancy Services had been exporting software since 1974, the entry for example, of Citicorp Overseas Software Ltd. (COSL) in Bombay in 1985 and of Texas Instruments (TI) in Bangalore in 1986 for software development highlighted India's potential to outside MNEs more vividly. Subsequently, a number of other western corporations began to follow the footsteps of COSL and TI, such as HP in 1989 and followed by Novell, Oracle, among others. Seeing the potential, a number of Indian companies engaged in the manufacture of computer hardware started to spin-off their software divisions (Kumar 2001 and Kumar and Joseph 2005, for more details). The use of satellite links for data communication by TI's development centre in Bangalore in 1987 also served to demonstrate to the government the critical importance of providing satellite data communication links for software exports from India. Hence, the government started to provide the high-speed communication links in the STPs.

Besides these demonstration effects, the role played by MNEs in software development in India has been quite limited. Although all the big software companies have established development base in India, their overall share in India's exports of software is rather small. According to NASSCOM (2012) Indian providers accounted for 60-65 per cent of the total IT BPO exports in 2011 and that of foreign captives was 20-25 per cent and foreign providers 10-15 per cent. While all the leading IT software MNEs have their presence in India, out of the 10 top software exporters the top three positions are still held by the Indian firms (see Table 5) and only three foreign firms (Cognizant Technology Solutions, IBM and Accenture) could make into the top ten list.

2.5 Opportunity cost of export

India takes pride in its software industry which helped the Indian organizations to emerge as global multinationals with over 400 delivery centres (outside India); across 200 cities in 170 countries with more than 10 organizations listed in overseas stock exchanges and with more than 400 Fortune 500 customers (MIT 2011). Further the large scale takeover of foreign IT firms by Indian firms appears to have contributed significantly towards enhancing India's credibility in the world market. Further the organizational, managerial and other innovations like the employee stock option introduced by the IT firms have been increasingly emulated by firms in other

industries contributing to their enhanced performance (Arora and Athreya 2002). Above all, the software sector has contributed significantly towards strengthening the external balance and the building of foreign exchange reserve of the country.

Table 5: Top 10 exporters of software from India in 2010-11

Company Name	Export US $ Mill	Website
Tata Consultancy Services ltd	5119.94	www.tcs.com
Infosys BPO Ltd	4456.37	www.infosys.com
Wipro ltd	3516.23	www.wipro.com
Cognizant Technology Solutions India pvt ltd	3284.36	www.cognizant.com
HCL Technologies	2129.85	www.hcltech.com/
IBM India Pvt Ltd	1357.93	www.ibm.com
Accenture Services Pvt Ltd	940.98	www.accenture.com
Tech Mahindra Ltd	905.78	www.techmahindra.com
Mphasis ltd	816.61	www.mphasis.com
Patni Computer Systems Ltd	624.16	www.ibm.com/contact/in/en

Note: Data includes software services, software products and BPO.
Source: Electronics and Software Export Promotion Council. Statistical Year book 2010-11

However, opportunity cost of software exports can be considerable. Kumar and Joseph (2005) argued that while India's best talents and capabilities are employed for exporting software services, software for domestic use is largely imported. 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. While different sectors of Indian economy missed the opportunity for productivity improvement through the use of software, Indian software companies' contribution to productivity improvements in the United States industry is shown to be significant. The prevailing fiscal incentive regime, i.e., the availability of tax incentives for exports[2], diverts

[2] The most important being the exemption of profits earned through exports from any tax for 10 years or until 2011 whichever is earlier. Moreover, most of the state governments have liberalized their labour laws to facilitate 24*7 operation by the software firms.

attention towards exports by making them more rewarding compared with serving the domestic market.

It has also been argued that 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 software 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 Parthsarathi and Joseph 2002).

Yet another adverse effect refers to the increased competition between software firms and other firms leading to movement of skilled manpower to software industries and a sharp rise in salaries. Increase in salaries and resultant increase in cost of production is shown to have adversely affected those industries which compete with software sector for skilled manpower and not having booming world demand (Joseph and Harilal 2001). Thus viewed, the observed deceleration in the rate of growth of manufacturing industry since 1991 cannot be delinked to the boom in the export of software industry.

2.6 Trend in domestic sales and domestic market orientation

Given that the domestic use of software could be instrumental in enhancing competitiveness of all the sectors of the economy and the welfare of all sections of the society, the social marginal benefit of a dollar worth of ICT consumed domestically could be much higher than that of a dollar worth of software exported (Kumar and Joseph 2005). In the current context where international competitiveness is the key to survival for all the sectors of the economy and that the major export markets are in the grip of crisis and growing opposition to offshoring of jobs, it is

of relevance to examine if there has been an increased focus on domestic market by the Indian software industry.

However, there are again serious data limitations to address this issue. The reported data on domestic sales is likely to involve gross underestimation of domestic consumption because it will not include those software services rendered by the software personnel employed by the users. In India the common practice with larger organization with legacy systems have been to employ in-house software professionals for software development. The software development and maintenance undertaken by such professionals will not get reported as domestic sales where as such services, if rendered by a software company will be recorded in domestic sales. Just like the man who married his housemaid would reduce GDP, the commonly prevalent practice of appointing in-house software personnel is likely to reduce the value of domestic consumption of software. As per NASSCOM (2011) even today the common practice is to undertake most of the software development work in-house supported by a software firm. Even in 2010, the extent of software development outsourcing ranged between only 20 to 70 per cent across different sectors with telecom at the highest with 70 percent.

Nonetheless, table 6 indicates that the domestic sales of software have also been highly vibrant and it is more so in the recent years. The observed rate of growth in the sale of software in the domestic market recorded an annual average rate of growth of over 36 per cent during 1990s, albeit from a lower base and over 30 per cent since 2000. Here it is worth noting that while the rate of growth in exports declined by 11 per cent (see table 2) as we move from the first period (1990s) to the second period (since 2000), the recorded rate of decline in domestic sale was only at much lower pace of about six per cent. More importantly, until 2005-06 the recorded annual rate of growth in the export of software in all the years was consistently higher than that of domestic sales. However, since 2005-06 there has been a reversal wherein the rate of growth in domestic sales exceeded that of exports in all the six years, the exception being only two years wherein export growth was marginally higher.

Table 6 also indicates that the share of domestic sales in total production has been showing a steady decline until 2004-05 to reach the lowest level of 20 per cent. However, after 2004-05, despite a vibrant export market, the decline in the share of domestic market observed up to 2004-05 got arrested. If the empirical evidence for the last three years is any indication, a turnaround

towards domestic market has already set in because; it is for the first time since 1991 that the share of domestic market has shown an upward trend consecutively for three years from 20.08 per cent in 2008-09 to 23.07 per cent in 2010-11.

Table 6: Trend in Domestic sale of Software and share of domestic market in total production

Year	Domestic Sale ($ Mill)	Annual growth rate (%)	Domestic market share in production (%)
1990-91	99		47.37
1991-92	123	24.2	42.56
1992-93	161	30.9	42.15
1993-94	222	37.9	40.73
1994-95	330	48.6	41.1
1995-96	471	42.7	39.85
1996-97	724	53.7	40.27
1997-98	1150	58.8	39.26
1998-99	1379	19.9	34.4
1999-00	1537	11.5	27.75
Decadal growth		36.5	
2000-01	2043	32.9	25.47
2001-02	2278	11.5	22.94
2002-03	2769	21.6	22.37
2003-04	3533	27.6	21.89
2004-05	4371	23.7	20.25
2005-06	6686	53	21.99
2006-07	8555	28	20.22
2007-08	11677	36.5	21.17
2008-09	12444	6.6	20.08
2009-10	13955	12.1	21.48
2010-11	17274	23.8	23.07
Average growth 2000-10		30.6	

Source: Same as table 2; Total exports includes software services, BPO and Software products including embedded software.

Empirical evidence presented so far is further substantiated by the observation by NASSCOM that the domestic market for software has been experiencing a gradual upswing since 2003 (NASSCOM Newsline January 2011). Initially it was the Small and Medium sized software companies that focused on domestic sector. But over the years, especially during the global slowdown, the large players have also began addressing the untapped domestic market.

NASSCOM strategic Review (2011) states that, there has been an increasing demand from Indian clientele during the last four to five years. During 2010 there were 93 domestic deals (see table 7 for the major domestic deals in 2010). Though the total number of deals declined to 65 in 2011 the average contract value ($23,000 to $24,000) was about 50 per cent higher than in 2010. The observed trend towards the domestic market and increase in the share of ICT expenditure in GDP has to be seen in the context of various e-governance initiatives along with the spread of various ICT projects oriented towards addressing varied developmental issues (see section 4).

Table 7: Major domestic software deals in 2010

Name of the software Firm	Name of the Client	Project details
TechProcess	Indian Overseas Bank	Online payment services to the customers and expand the market each of its associated web merchants
Wipro	Janalakshmi	Implementation of public cloud CRM solution to support the new retail liability business
HCL technologies	National Power corporation	$100 million project for implementing smart grid solutions in the power sector
Spanco Ltd	Maharashtra State Electricity Distribution Co.	Rs 950 Million project on power distribution
IBM	Bharti Airtel	Infrastructure to support 500 million customers
TCS	Karnataka State Govt	Establishing and maintaining State data Centre
Consortium led by Wipro	Andhra Pradesh State Government	Health care system for public hospitals
SAP	Indian Navy	Online financial information system
ORG Informatics	BSNL Ltd	Rs 140 Million project for commissioning sitcom network for Indian Air Force

Source: Based on NASSCOM News line January 2011

2.7 Moving up the value chain? From services to products and embedded software

It was generally held that the comparative advantage of Indian software firms has been in the on-site export of services such as customized software development (Arora et al 2001). Moreover, Indian firms have been operating mostly at the lower end of value chain by carrying out low-

level design, coding and maintenance. As a result, revenue per employee in 1999 ($ 16,000) was found to be only about one-tenth of Israel and one-fourth of Ireland (Arora et al 2001).

However, there are indications to show that the trend is changing. This is manifested in the greater focus on software product development along with engineering research and design mostly embedded software. Though, the development of packaged software as a segment of the industry has its origin in 1980s, the industry was faced with problems like distance from clients abroad, lack of financial strength for marketing, and weak copy right regime leading to rampant software piracy. Moreover, the product quality has not been world class; partly due to the lack of product management related talent as well as lack of proximity to friendly and sophisticated customers. Most of the early firms in the software industry, therefore, moved from developing products to concentrate on exporting software service s which was less risky and offered better returns (Athreye, 2005).

Over the years, firms have been building up capabilities. International orientation and the increasing professionalism of Indian software enterprises have prompted them to align their processes with global best practices and to obtain international certifications. As per the available data, as early as in 2005-06 among the 401 firms that reported different international quality standards; 82 had SEI CMM level 5 - the highest level of quality accreditation across the globe. This accounted for more than two-thirds of such firms in the world over[3]. As many as 123 had SEI CMM level 2 or above. And 330 had ISO 9001 (NASSCOM Strategic Review 2006). If the available evidence is any indication most of the Indian software enterprises have strived to attain excellence in their professionalism and best practices.

While the firms have been building up capabilities, the availability of skilled manpower, along with greater access to venture financing and series of measures initiated by the Government to address piracy[4] provided conducive environment for software product development. As a result, organizations increasingly also began to offshore software product development to India.

[3] Level 5 represents the Optimizing Level of process maturity and is the highest stage to be reached.

[4] The copy right of computer software has been protected under the provisions of Indian Copy Right Act of 1957. Major changes were made to the Copy Right Law in 1994. Accordingly, it was made illegal to make or distribute copies of copy righted software and therefore punishable. Section 63 B of the Act stipulated a minimum jail term of 7 days extendable up to three years. The Act further provided for a fine ranging from Rs 0.05 million to Rs 0.2 million. In addition, the government, in co-operation with the NASSCOM, conducted regular anti piracy raids to discourage software piracy.

Moreover, Internet emerged as a major platform for lead generation and product delivery providing even the small firms an opportunity to reach out to the market at lower cost. For instance, Druvaa developed fully automated lap top backup software which protects corporate data for office and remote users. Today Druvaa has over 200 customers spread over 22 countries. The software is currently used by NASA and it is the only product to be implemented by the US space organization. Interestingly, NASA came to know of the software through the company's web site and the purchase was made on line (NASSCOM Newsline October 2009). Even in 1990s software products developed by Indian firms like FINACLE by Infosys, Tally accounting software by Tally has been oriented mainly to the domestic market.

The software product firms see products as a means to satisfy the twin objectives of improving margins and getting deeper into a client relationship. Services have, by and large remained a labour arbitrage game, with revenues having a direct relationship with the number of people. Though Indian firms have improved their productivity and processes, products are IP-led and hence revenues are not a simple multiple of manpower cost as the marginal cost in case of products is negligible as compared to software services. With margins under pressure due to rising wages products are being looked at as an effective way of bettering margins (Malik and Ilavarasan 2011). Firms have also been adopting innovative business models to enhance the sale of software products. In a context wherein the high cost of software products acted as a deterrent to domestic market, new pricing strategies like subscription/on demand transactions to reduce the upfront cost is increasingly being followed though the traditional licensing model still continues (NASSCOM strategic Review 2011).

NASSCOM Newsline (October 2009) reports that over 400 software product companies were founded since 2001 and the pace of formation of new companies continues. These firms focus on five customer segments1.Product and platform for IT and BPO sector (Eg Stelae Technologies). 2. Platforms and products for domestic e-governance projects (Eg ABM OrangeScape) 3. SaaS solutions for Small and medium enterprises and India (Eg ImpelCRM and Zoho) 4. MVAS solutions for India consumers (Eg Netcore, Apalaya) and 5. Online solutions for US SOHO customers (Eg. Fusion Charts, DeskAway).

Of late, the disruptive technologies in mobile and cloud computing are providing Indian software product firms with new revenue streams. It is estimated that about 66 per cent of the top 30

product firms (MNCs and Indian) in India provide cloud offerings. These technologies also have offered the start up firms the level playing field to compete with other well established firms through enabling innovative solutions aimed at niche markets, access to wider customer base, different delivery mechanisms and competitive pricing (NASSCOM 2012).

The anecdotal evidence towards moving up the value chain could be empirically analyzed by examining the changing structure of software production and export. Since the focus of our analysis is software we have not taken into account the BPO services. Total production and export of software is divided into software services and software products which also include the engineering research and design mostly embedded software development. Since the level of skill intensity and value addition is higher in software products and embedded software, an increase in their share may be considered as indicative of moving up the value chain. In case of software services, the traditional practice has been on-site development and studies have already indicated a shift from on site to offshore development (Malik and Ilavarasan 2011, among others)

Evidence presented in table 8 clearly indicates that there has been a shift from software services to high value adding and skill intensive software products and engineering research and design,

Table 8: Change on the structure of domestic sales and export of software

Year	Domestic sales of software $ billion	Share of		Export of software$ billion	Share of	
		Software services	Software products and ER&D		Software services	Software products and ER&D
2005	4.2	83.33	16.67	13.1	76.34	23.66
2006	5.81	77.11	22.89	17.31	76.89	23.11
2007	7.13	77.56	22.44	21.99	77.54	22.46
2008	10.11	77.94	22.06	30.5	72.79	27.21
2009	10.92	75.37	24.63	35.4	72.88	27.12
2010	12.03	75.39	24.61	37.29	73.18	26.82
2011	14.49	75.91	24.09	44.84	74.60	25.40

Source: NASSCOM, IT BPO Strategic Review Different years.

mostly embedded software. The shift has been highly pronounced in case of domestic sales where in the share of software products increased by about eight per cent age points and that of

software services declined correspondingly. In case of exports, though the decline in case of low value adding services has been at a lower level, a shift towards a more value adding activities like software products could be discerned from the table. Entry of large number of new companies into software product development notwithstanding, this segment is still dominated by a few leading firms. In 2008, top five companies (Oracle/i-Flex Technologies, TCS, Infosys, 3i infotech, Subex) accounted for nearly 66 per cent of the total sales in India. While the share of top 10 companies is estimated at 84 per cent, that of top 200 climbs to 93 per cent.

3. Software industry in China: A comparative perspective

With a total production of $ 5.0 billion in 1999-00, the size of China's Software industry[5] was comparable to that of India. But unlike India, China's export was only $254 Million accounting for only five per cent of total production (see table 9) when India exported software worth $3.9 billion. By 2006 China's production increased to $64 billion – nearly 13 fold increase – and reached a level much higher than India's production of $ 43 billion (Gregory et al 2009).

As per the data provided by Chinese Ministry of Industry and Information Technology (MIIT) in 2007 there were more than 13,000 software companies and their exports was of the order of $9596 million. China's eleventh five year plan (2006-2010) had a target of 30% growth rate to reach an output level of US$ 125 billion and aimed at an export of $12.5 billion. The five year plan also aimed at having approximately 15 major software enterprises with annual sales exceeding RMB 10 billion. Going by the available statistics, China appears to have exceeded the plan target for the 11th plan. Software production is reported to have reached $197 billion in 2010 from $77 billion in 2007 (see table 7). The reported production for the year 2011 is as high as $285 billion. When it comes to export it increased from $9.5 billion in 2007 to 30.4 billion in 2011. When it comes to growth rate, the observed annual compound growth rate in production (44.4%) export (43.6%) and domestic sales (54.6%) in China is at a much higher level than that was recorded by India's software industry since 2000.

[5] It may be noted that we have very limited understanding on how software production is estimated and what are its components. However, going by the available information from different sources, it may be inferred that, unlike in India, BPO has very limited presence. So is the case with software services. Further, there is a greater presence of software products mostly for the domestic market and a embedded software mostly exported to Japan.

While India's software industry with a total turnover of $ 75 billion in 2010-11 has been attracting world attention, China whose software production is reported to be nearly three times than that of India has not attracted in any world attention. But, the distinguishing characteristic of China's software industry is that it is mostly oriented towards domestic market. Going by the available evidence, while China exported only a little over 10 per cent of its production in 2011, the export intensity in India is around 80 per cent. While the United States is the major market for India's software industry about 60 per cent of China's export is for the Japanese market. Another point of interesting contrast between the software industry in China and India is the character of the leading firms. In China, major players in software industry, especially the top three, are embedded equipment manufacturers -Huawei, ZTE, and Haier. In case of India, on the other hand, leading firms are specializing in software with no presence in hardware.

Table 7: Trend in Production, export and domestic sale of Software in China ($ Million)

Year	Total	Domestic	Export	Export as %of production
1990	5006	4754	254	5.07
2000	6772	6373	399	5.89
2001	8883	8167	726	8.17
2002	13360	11860	1506	11.27
2003	18116	16304	1812	10.00
2004	29060	26260	2800	9.64
2005	48400	44810	3590	7.42
2006	64000	57940	6060	9.47
2007	77009	67413	9596	12.46
2008	109050	94736	14314	13.13
2009	145931	126331	19600	13.43
2010	197415	171761	25654	12.99
2011	285900	255500	30400	10.63
AGCR	44.4	43.6	54.5	

Source: Up to 2006 Gregory et.all (2009) and China, MIIT, thereafter
Note: Data of software industry from the MIIT of China was gathered with the help by Prof Xuelin (Chinease Academy of Social Sciences and Prof Zhang Liyan, Tiajin University

The performance of China becomes all the more remarkable when it comes to hardware production. Data from the statistical year book of China (different years) indicates that China's

electronic hardware industry is many times higher than that of India. In 2010, the hardware industry is found to be consisting of 14,836 enterprises with a total production of $820 billion - nearly 30 times that of India- and generating employment of the order of 7.7 million (see table 8). China is also found to be vibrant in hardware trade. Total export of hardware from China in 2010 is found to be $440 billion and that of import is of the order of $290 billion with a substantial trade surplus in hardware. Thus China appears to have a software industry integrated with the hardware wherein hardware production capability was developed in the first stage and later diversified into software.

The above discussion tends to suggest that while India has been able to develop capabilities in different spheres of software development it has lagged behind in hardware. China, by realizing that the social marginal product of dollar worth of software domestically consumed is much higher than that of a dollar worth of export, has been able to evolve a vibrant software industry which is mostly oriented towards domestic market. Moreover, while India lagged behind the hardware China has successfully developed a massive hardware industry which is highly integrated with world market. In general, China appears to have more facilitating environment for harnessing ICT for development as compared to India.

Table 9: Output, employment and number of units in China's Electronics Industry

Year	No. of Units	Output ($ Billions)	Employment (Mill)
2006	9709	418.69	5.05
2007	11220	516.09	5.87
2008	14347	636.26	6.77
2009	14284	655.3	6.63
2010	14836	820.44	7.73

Source: China Statistical Year book; different years

4. Recent Policies for software development

Studies (Kumar and Joseph 2006, Joseph 2009) have shown that the observed growth performance of software industry has not been an outcome of benign state neglect but could be attributed to a vibrant national system of innovation in general and sectoral system specific to the software industry in particular which was manifested in varied policy measures and institutional

interventions. Since the role of National and sectoral systems of innovation in the development of India's software industry has already been subjected to exploration here we shall focus only on recent policy initiatives in explaining the observed in the previous section.

In terms of the policy stance of the government towards software development, two phases could be discerned. During the first phase (up to early 2000) the focus has been on evolving a software industry as a foreign exchange earner in a context wherein the country was starved for foreign exchange. The major policy initiative undertaken during this period included, those relating to the building up of IT manpower, computer policy of 1984, software policy of 1986, establishment of software technology parks, initiatives in venture financing, and the setting up of National Taskforce on IT and Software development which aimed at $50 billion software export by 2008 and made various recommendations both for software and hardware. Along with the various policy initiatives by the Central government, almost all the state governments, beginning with the state of Karnataka, have enacted IT policy of their own and some of the states like Tamil Nadu and Karnataka have policies specific to ITES sector as well. A perusal of these policy documents tends to suggest that the focus of most of the states in the early years have been to attract export oriented investment in software sector of respective states through fiscal concessions.

During the second phase, since the early 2000, in a context of comfortable foreign exchange reserve and the realization of the need to harness ICT for enhancing efficiency, competitiveness and social welfare, there has been a shift in policy towards harnessing software for development which is manifested in various e-governance initiatives by the central and state governments. The recent IT policies by different state governments also aimed at enhancing the IT spending by the state governments to the tune of 3.5 per cent of State Domestic Product (SDP) and facilitation of wider use of IT in different sectors of the economy. At the same time, there were various projects initiated by the private sector and NGOs to harness ICT for addressing developmental issues. In what follows we shall briefly highlight the recent policy initiatives having bearing on the development of software industry in general and greater domestic use of software in particular.

4.1 Legal framework

In 2000 the national Government passed the Information Technology Act[6]. This act envisaged providing legal sanctity to all the electronic records and other activities carried out by electronic means. The Act also attempted to change the outdated laws and provided for ways to deal with cyber crimes. It also provided legal sanctity to digital (later amended as electronic signature) and this provided the legal infrastructure for the development of e-commerce. This act also made possible the electronic filing of documents with the Government agencies. In addition with passing of the Right to Information (RTI) Act in 2005 by the central government and some of the state governments ever before 2005, different agencies under the state and central governments are expected to maintain the data base on various aspects on a systematic manner which in turn also led to greater investment in IT and software within the country.

4.2 Working group on IT for masses

In 2002 Planning Commission constituted a Working Group for formulation of plan proposals for Tenth Plan (2002-2007). The Working Group had inter-alia recommended that a Plan Scheme on 'IT for Masses' may be formulated for taking IT to the masses. The following focal areas were considered to be covered under 'IT for Masses':

- IT infrastructure
- Electronics Governance
- Education
- Mass Campaign for IT Awareness

Accordingly, during the Tenth Five Year Plan activities proposed under IT for Masses were focused on Technology and Application Developments and IT Awareness Campaigns. As the spectrum of activities proposed by the Working Group was expansive on account of fund constraints, during the first four years of the tenth plan, under the IT for Masses, scheme projects were initiated in Telemedicine & Digital Library only. During the Eleventh Plan (2007-12) the IT for Masses scheme has been restructured to focus on Women Empowerment and uplifting of backward communities like scheduled castes (SCs) and scheduled tribes (STs) through ICT.

[6] For details please visit http://eprocure.gov.in/cppp/sites/default/files/eproc/itact2000.pdf

4.3 The National e-Governance Plan (2006)

The National e-Governance Plan was approved by the Government in May 2006 with a vision to provide public services to the common man in his locality at affordable cost. The NeGP is a multi-stakeholder programme which primarily focuses on making critical public services available and promoting rural entrepreneurship[7].

NeGP consists of 27 Mission Mode Projects (MMPs) encompassing 9 Central MMPs, 11 State MMPs and 7 integrated MMPs that span multiple backend Ministries/ Departments. It also includes 8 program support components aimed at creating the right governance and institutional mechanisms, core infrastructure, policies & standards and the necessary legal framework for adoption of e-Governance in the country. It is implemented at the Central, State and Local Government levels. MMPs are owned and spearheaded by various Line Ministries concerned for Central, State, and Integrated MMPs. The concerned Ministry/ Department is entirely responsible for all decisions related to their MMPs. There is also provision for each State to identify up to 5 additional State-specific MMPs relevant for economic development within the State.

The objective of NeGP is to transform traditional processes and service delivery mechanisms and create an environment that is citizen-centric, with rights based approach to governance while making interaction with Government easier, effective and transparent. NeGP is unique in itself. It is not restricted to Government or Industry, or Public alone, but has expanded its reach to all strata of society especially at the grassroots. NeGP's endeavour has been to improve the quality of life, by facilitating socio-economic development across the nation by giving access to crucial services and information in particular to the underserved population.

Out of the 27 Mission Mode Projects, 24 have been approved by the Government. 15 MMPs have gone live and are delivering services electronically by harnessing software, though may not be in the entire country or the entire set of services[8]. To facilitate the e-governance plan a State Wide Area Network (SWAN) with substantial software component has been envisaged as the

[7] For details please visit http://india.gov.in/outerwin.php?id=http://mit.gov.in/content/national-e-governance-plan

[8] For more details please visit http://www.mit.gov.in/content/mission-mode-projects

converged backbone network for data, voice and video communications catering to the information communication requirements of all the Departments in all the states. By the end of 2010, SWAN was operational in all 23 States/UTs.

In addition, the Government approved the Common Services Centres (CSCs) scheme for providing support for establishing 100,000 Common Services Centres in 600,000 villages of India. The objective is to develop a software–hardware platform that can enable Government, private and social sector organizations, to align their social and commercial goals for the benefit of the rural population in the remotest corners of the country. As per the Annual Report of the Ministry of Information Technology (2011), as of December 2010, 87,594 CSCs have been established across the country. Today there are a number of e-governance initiatives undertaken at the instance of central and different state Governments and the IT policies announced by most of the state governments envisage 3.5 per cent of the State Domestic Product as IT spending that which generates demand for software.

A more recent e-governance initiative involving substantial investment by the state and harnessing the capabilities of software firms in the private sector involves setting up of the Unique Identification Authority of India entrusted with the task of issuing unique identification number (*Aadhaar* meaning foundation) for all the citizens of India. Apart from providing identity, the UID will enable better delivery of services and effective governance. As the unique identity database comes into existence, the various identity databases (voter ID, passports, ration cards, licenses, fishing permits, border area ID cards) that already exist in India are planned to be linked to it (see box 1)

Box 1

Unique Identification Number (UID): A major Domestic IT Project

A major recent initiative in India that involves harnessing of ICT and thereby substantial demand for software and hardware in the domestic market is the UID project being implemented by the Unique Identification Authority of India (UIDAI). This is headed by one of the most successful IT entrepreneurs of India and one of the founding members of Infosys, who has assumed the charge as Chairman with the rank of a Cabinet Minister. While there is hardly any software project in India that brings together different software firms with significant credentials, this

project is being implemented with the active participation of a number of leading Indian IT companies.

The project involves the issue UID (Aadhaar) - a 12-digit unique number of all the Indian citizens and is implemented by the Unique Identification Authority of India (UIDAI). The number will be stored in a centralized database and linked to the basic demographics and biometric information – photograph, ten fingerprints and iris – of each individual. It is easily verifiable in an online, cost-effective way. By providing a clear proof of identity, Aadhaar will empower poor and underprivileged residents in accessing services such as the formal banking system and give them the opportunity to easily avail various other services provided by the Government and the private sector. The centralised technology infrastructure of the UIDAI will enable 'anytime, anywhere, anyhow' authentication.

Since the existing identity databases in India are fraught with problems of fraud and duplicate/ghost beneficiaries the UIDAI plans to enroll residents into its database with proper verification of their demographic and biometric information.

The UID project will generate domestic demand for the services of firms involved on software, hardware and communication services. Mindtree Ltd has been entrusted with task of application software development. For the collection of biometric and demographic data 209 agencies have been selected and the service of additional 91 more will be needed. Telecom companies like Aircel, Airtel, BSNL, Reliance, Tata telecom and Railtel have been entrusted with the task of providing connectivity between enrolment agencies and the Central ID data depository. Software companies involved in the implementation of biometric solutions include Mahindra Satyam and Accenture Services Pvt Ltd. Firms like Sagem Morpho Security Pvt. Ltd. Linkwell Telesystems Pvt. Ltd, Totem International Ltd, Sai Infosystem (India) Ltd. HCL Infosystems Ltd., Geodesic Ltd., I D Solutions will be engaged in the purchase of biometric Authentication systems. Wipro has been entrusted with task of supply, installation, commissioning for hardware and software for data centre at Bengaluru and National Capital Region.

In addition, Accenture Services, HCL Infosystems, HP India, HCL technologies, IBM India Pvt Ltd, Mahindra Satyam, TCS , Tech Mahindra and Wipro have been short listed to overlook the day to day functioning of the UID project once implementation is complete. Since the authentication of identity at the time of service delivery by different agencies will call for standardization of the data gathered across different users, there will be additional demand for software and integration services.

The official estimates for the project is $ 3.59 Billion (Rs 18,0000 Million) and for the opening year 2009, the central budget made an allocation of $19.95 Million (Rs 1000 million). This was followed by a budgetary allocation of $379.5 million for the year 2010-11 and $350.7 million for the year 201-13.

By February 2012 out of the total revenue expenditure of Rs 8132 Million Rs1224 million has been for information technology and out of the total capital expenditure of Rs 2545 Million, Rs 1789 has been for IT hardware.

Source: http://uidai.gov.in/ and NASSCOM Strategic Review 2011

Thanks to these initiatives, in the Networked Readiness Index (NRI), featured in the World Economic Forum's *Global Information Technology Report* series, India ranked 48th for the ICT usage of its government, clustering with Brazil (45th) and outperforming comparators Vietnam (68th), Indonesia (86th), and Pakistan (91st), as well as the lower-middle income group and Developing Asia averages (Mia 2010).

4.4 Further focus on Domestic Market: Draft National Policy on IT 2011

The draft policy brought out by the Ministry of Information Technology in October 2011, brought out against the backdrop of global slowdown, provides for an unprecedented focus on domestic market[9]. To quote

> "Current negative trends in many economies around the globe provide both challenges and new opportunities. This necessitates the absolute imperative for Indian IT and ITES Industry harness emerging technologies such as Mobile Technology, Localization, Virtualization, and Cloud Computing provide Indian IT/ITES industry a major opportunity to become partners in value creation and drive transformation domestically"

The draft policy further states;

> "India today stands at the cusp of development. The Indian workforce is young - with 50% of the population below 25 years. The younger generation is also quick to adopt new technologies. This factor is one of our core competitive strengths. Relying on this advantage, enhanced use of ICT (information & Communication Technologies) can help usher in sustained growth of the Indian economy. For India to retain its competitive edge in sectors in which it is traditionally strong like textiles as also in emerging sectors, it is imperative that ICTs are appropriately adopted. Similarly, the importance of ICTs in strategic sectors like Defence, Atomic Energy, Space etc is paramount".

[9] For details please visit http://mit.gov.in/sites/upload_files/dit/files/National_Policy_on_Information_Technology_07102011%281%29.pdf

The Draft National Policy on IT focuses on application of IT enabled approaches to overcome monumental developmental challenges in education, health, skill development, financial inclusion, employment generation, governance etc. to greatly enhance efficiency across the board in the economy. The policy seeks to achieve the twin goals of bringing the full power of ICT within the reach of the whole of India and harnessing the capability and human resources of the whole of India to enable India to emerge as the Global Hub and Destination for IT and ITeS Services by 2020.The focus of the IT policy is therefore on deployment of ICT in all sectors of the economy and on providing IT solutions to the world. With a view to promoting the use of software by the Small and Medium enterprises, the policy has the provision for fiscal benefits to for adoption of IT by these units. This is expected to create major boost for the domestic market for software. The policy, among others, also aims at integrating Aadhaar, financial and location-based services to foster an ecosystem for innovation in services, create a pool of 10 million additional skilled manpower in ICT and make at least one individual in every household e-literate.

In addition to the various e-governance initiatives by the government there have been various initiatives by the private sector and NGOs towards harnessing ICT for addressing the development needs which in turn acted as a catalyst for domestic demand for both software and hardware. Among these ICT projects e-choupal deserves special attention (see annexure 1)

4.5 Role of Private sector and Industry Associations

It may be myopic to attribute the observed dynamism of the industry entirely to the policy initiatives by the state. While the state initiatives laid the foundation for faster growth, the industry associations[10], particularly the National Association of Software and Service Companies (NASSCOM) played an important role. In addition to lobbying at the Central and State governments levels, the NASSCOM also played a key role in projecting India's image in the world IT market. For example, in 1993 NASSCOM appointed a full time lobbying firm in Washington. It facilitated the participation of Indian firms in a large of international IT exhibitions and projecting India's

[10] To begin with, there was the Computer Society of India, which is essentially an association of academics and professionals and did not address many of the issues faced by the industry. Hence a new association called Manufacturers Association of Information Technology (MAIT) was formed in 1982. This consisted both the hardware and software firms. Later an association, currently known as NASSCOM, was formed to address specific issues being faced by the software and service companies. The Electronics and Software Export Promotion Council, an autonomous body under the MIT, though its various, initiatives also made significant contribution towards India's IT export growth.

capabilities in the sphere of IT. Role that NASSCOM played in getting the visa rules relaxed by the developed countries, especially USA, is well known. Also, in 1994 NASSCOM initiated the anti piracy initiatives in India, when IPR was becoming a major issue in the Indo-US relations. It took up the campaign against software piracy and conducted a number of well-publicised raids[11].

Given the manpower constraint confronted by the industry especially since 2000, NASSCOM has undertaken varied initiatives to enhance the supply of manpower and improve their employability at all the levels. In a context wherein high income earning opportunities were provided by the IT industry for the graduates, there has been a decline in the number of students entering for post graduate courses and Ph D. In this context, NASSCOM has been working with Ministry of Human Resource Development to create highly specialized professionals with skill sets in emerging, "on-the-horizon" technologies that are not yet mainstream. In 2007 NASSCOM, in partnership with the Ministry of Human Resource Development, began the "Finishing Schools for Engineering Students" program, with a view to enable young technical graduates to become industry-ready.

NASSCOM also has initiated the IT Workforce Development (ITWD) program, keeping the issues and concerns of the industry at one end and challenges of the academia at the other. As part of this initiative, NASSCOM has been nurturing the IT industry-academia interface through workshops and conferences, faculty sabbaticals, training programs and mentorship initiatives to ensure better synchronization between IT education and the industry requirements.

[11] For a detailed account of the NASSCOM activities in promoting IT and role played by late Mr Dewang Metha, see " Power Lobbying", *Business India*, February 19 to March 4, 2001.

5. Towards a Perspective: Lessons for developing countries and an agenda for S-S cooperation

In the light of the foregoing discussion, two issues of immense policy relevance arise: Are there any lessons from Indian experience for other developing countries? Is there scope for South-south Co-operation in Software and ICT?

5.1 Lessons for other developing countries

It has been argued that the National System of Innovation evolved overtime as an outcome of the policies initiated by the government, has been instrumental in facilitating India's IT success (Kumar and Joseph 2006). The present study also underlined the role of a system of innovation that involved the development of higher education system in engineering and technical disciplines, creation of an institutional infrastructure for S&T policy making and implementation, building centres of excellence and numerous other institutions for technology development along with a vibrant private sector. In addition, the institutional interventions like the setting up of the software technology parks were highly helpful for software exports. The different regional governments and the industry associations also played their role. The patterns of clustering of the software development activity in and around Bangalore provides a further evidence to the contention that public funded technological infrastructure has crowded in the investments from private sector in skill intensive activities such as software development (Kumar and Joseph 2006)

The first and foremost lesson from India is that, the development of software sector and building up of capabilities cannot be accomplished by the magic of market forces – the state has a key role to play. In making efforts towards developing a software production base, the strategy might be to make available a large pool of skilled manpower at different levels such that the primary condition for the establishment of software production base is satisfied. Here the strategy needs to be one of pooling together the resources of different actors like Civil Society Organizations, private sector and other stakeholders. Also, the strategy should be not one of spreading thinly the resources across the country, instead the investment needs to be undertaken in such a way as to take advantage of the agglomeration economies. This might be possible through the setting up of

Technology Parks wherein, built up space, communication infrastructure and others, which are beyond the reach of an individual entrepreneur is provided along with a "single window clearance" system so that the prospective investors need to have only limited interaction with the bureaucracy. Secondly, such technology parks needs to be close to and have constant interaction with the centers of learning such that mutual learning and domestic technological capability is built up in the long run. Thirdly, since the software sector consists of different activities that call for varying levels of skill intensity, the developing countries with skill deficit could make their entry point with ITES or software services. But there is the need for conscious efforts towards skill empowerment such that the sector does not get locked up in low technology activity and an upward movement along the value chain is facilitated. In a less developed economy it might be possible that the business may not be ready to have large domestic demand. While is possible to develop a software industrial base using the export market, a domestic market is definitely an advantage as we have see from the experience of China. Hence an appropriate policy framework that creates a vibrant domestic market base is likely to help development of a vibrant software industry.

5.2 South-South Cooperation in ICT and Software

Paradoxically, during 1970s and 1980s when the developing countries had only their poverty to share, South-South cooperation has been much debated among the developing countries[12]. The issue seems to have taken a back seat during the last decade as the developing countries were increasingly experimenting with trade and investment liberalization under Globalization. But today, with increasing disenchantment among developing countries with globalization and creation of substantial technological capabilities in the South which in turn has contributed to southern development solutions, the South-South Cooperation is gaining momentum (Joseph 2006).

In a sense, the potential of IT in general and software in particular to contribute to the socio-economic transformation of the developing world through South-south cooperation emanate from the fact that while the western world held monopoly over the earlier GPTs, in case of software, the capabilities are more diffused with capabilities in the South. While Japan and South East Asian countries (Ernst 1993) used to hold leading position in the manufacture of ICT goods, China of late has joined the league. In the field of ICT software and services while India has emerged as a major player in the world market going by the evidence presented in this study, China also has

[12] See in this context among others, RIS (1987) and South Commission (1990)

established a sound software development base. Though there has been apprehensions about Indian software firms focusing on low end of the software value chain, the present study presented evidence to suggest that India's software sector has been moving up the value chain. Further there are a number of ICT innovations from India addressing issues specific to developing country like affordability, illiteracy and last mile connectivity (see box 2). Therefore, unlike the developing countries of 1950s and 1960s that had to resort to

Box 2

CorDECT: An Answer to Last mile Connectivity at Affordable Cost?

Despite living in this Information Age, people in most developing countries can not afford to spend much on telecom. In a country like India, where over 65% of the billion plus population hails from the rural hinterland with low income and affordability levels the key issue in the provision of telecom services remains that of affordability. To be precise, the income levels of most rural households hover around $40-$60 and the amount that they can spend on communications can be no more than $2-$3 in a month. This calls for the development of a technology that has a very low capital expenditure, one such technology being the WiLL (wireless in local loop).

CorDECT WiLL, developed by the TeNeT Group of IIT Madras and Midas Communications in Chennai, (a company incubated at IIT Madras in India). DECT stands for "Digital Enhanced Cordless Telecommunications", a radio technology suited for voice data and networking applications. It is a low-cost fixed wireless access technology aimed at connecting primarily homes and small offices in rural areas and small towns. CorDECT provides two lines to each subscriber, a voice line and a 35 kbps dedicated Always-ON Internet connection (a premium rate at 70 kbps). Capable of being used in both rural and urban areas, its cost effectiveness is highlighted better in the rural case where using the Relay Base stations it can serve users in a radius of 25-30 km. Such rural deployment costs less than $300 per line, making CorDECT the lowest cost connectivity solution.

Apart from India Apart from India, CorDECT is already being used in over 10 other countries including Egypt, Tunisia, Brazil, Argentina, South Africa, and Iran. However the usage in these countries may be more in urban areas

Source: Joseph (2005)

the difficult task of importing and adapting technologies from the North, for today's developing countries that are lagging behind in the sphere of ICT, there are many a "ready to use"

innovations from the ICT technology shelves of emerging countries in the South. Hence these countries have the less risky and less costly option of transferring technologies from other countries in the south to hasten their catching up process.

While China is known for its hardware production capabilities, we have provided evidence to suggest that China is also emerging as a major producer of software and much of it has been used domestically which in turn could have been instrumental in increasing the efficiency and competitiveness of other sectors of the economy. India and China are not isolated success stories in the South. A number of non-G7 countries have developed capabilities in the field IT and software (Arora and Gambardella 2004 Ojo et al 2008) and a new generation of countries like Philippines, Morocco, Costa Rica and others have joined the bandwagon (UNCTAD 2003).

Thus ways and means by which these countries have managed building up software capabilities and ways in which it has been harnessed for addressing various development issues might offer very valid lessons for other developing countries. This becomes all the more relevant when we consider the fact that the elements and priorities of national ICT strategies are shown to vary between developed and developing countries. While issues like basic telecommunication, affordability, local content, human capital and other related issues are the central concerns of developing countries, the developed countries are preoccupied with issues relating to IT security, privacy, cross-border certification and other related issues (UNCTAD 2003, Koanantakol 2002).

The e-strategies in general underscore the need to promote the use (diffusion) of ICT across different sectors of the economy. Towards this end the establishment of a liberalized trade regime has been given importance as is manifested in the Information Technology Agreement under WTO. While the diffusion of ICT is crucial to the socio-economic transformation and building of competitiveness in the developing world, the present approach appears to consider the developing countries as passive adopters (Mytelka and Ohiorhenuan 2000). The often suggested lop-sided approach towards ICT use without due attention to ICT production seems to have the potential threat of perpetuating the technological dependence of the less developed countries. Such an approach also has the danger of forgoing the new income, employment and export earning opportunities offered by ICT, which some of the developing countries have reaped to their benefit.

Recent studies tend to suggest that the primary commodity producing countries in the South have not benefited from globalization. Hence, there is the need for giving a renewed impetus to

considerations of “commodity problematique”, and at the same time searching for new avenues of income and employment. In this process IT enabled services and Business Process Outsourcing offer opportunities for countries in the South. Some of the countries already have made significant progress in reaping this new opportunity. Hence what is called for is cooperation among the Southern countries to avoid wasteful competition and to address the restrictive practices currently being adopted by the developed world such that outsourcing finally does not end up with the fate that labour faces today with respect to cross boarder movement.

Thus the need for South-South cooperation is obvious because of the existence of IT capabilities in the South and marked divergence in the IT interests of developing and developed countries. Going by the available evidence cooperation in the sphere of ICT has emerged as a major agenda in many of the regional cooperation agreement starting the e-ASEAN framework agreement. India is very active in South-South cooperation in ICTs (Joseph 2005; Joseph and Parayil 2009). Some of the existing cooperation agreements involving CIBS as reported by Ojo et al (2008) include:

- India’s bilateral agreements with over 30 countries in the area of e-government, computerization of government offices, and FDI in software industries of countries such as Sri Lanka, Mauritius, Vietnam, and Senegal. India has also been involved in trilateral relationships with Mexico and Venezuela.
- South Africa plays a prominent role in a few major regional economic frameworks such as the Southern African Development Community (SADC), Common Market for Eastern and Southern Africa (COMESA) and the African Information Society Initiative (AISI). These regional initiatives involve cooperation in the area of e-applications (such as e-learning and e-government).
- China has supported several developing countries through its technology cooperation programme, largely in the form of training. China also has some 130 technical cooperation agreements including SSC in science and technology with major players in the north, particularly the EU and the US.
- Brazil, as a member of Economic Commission of Latin America and the Caribbean, is involved in the development of regional information systems with other members.
- The India-Brazil-South Africa (IBSA) Economic Cooperation agreement includes: (i) facilitation of trade among the three countries, (ii) sharing of experience in the field of e-governance and (iii) mutually strengthening capabilities in free and open source software.

But, what is at present missing is an institutional arrangement for promoting the same with research backed by theory and empirics to sustain it. In this context there is the need for initiatives to make the ball rolling by bringing together the countries in the South under the umbrella of an e-South Framework. The Agreement shall aim at bridging the digital divide, developing software

capabilities and harnessing ICT for development through an integrated development of ICT Sector in the developing countries. Towards achieving this objective, the Agreement, in tune with the Information Technology Agreement of WTO should facilitate free trade in ICT goods and services. At the same time, drawing from the e-ASEAN Framework Agreement the e-South Agreement should be instrumental in building capacity both for production and use. Given the paramount importance of human capital in developing ICT production and promoting ICT use, special focus may be given to developing IT manpower wherein there is the need for relaxing the restrictions on the mobility of skilled manpower across the developing world. In general the Agreement should facilitate an integrated development of the ICT sector wherein both production and use are promoted instead of the ongoing lop-sided approach towards making many a developing countries passive adopters of technology. South-south cooperation, however, should not be construed as a substitute for the ongoing initiatives at promoting North-South, bilateral and regional cooperation or country-specific policies.

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Annexure 1
E-Choupal: Harnessing ICT for Rural Development

The e-Choupal is a success story of private participation for rural development in India at the instance ITC, one of India's largest corporate entities is into the business of tobacco, hotels, paperboards, specialty papers, packaging, agri-business, branded apparel, packaged foods and other fast moving consumer goods. The ITC's endeavor to use ICT for supply chain management in agro-products market for processing, marketing and delivery has created a win-win situation for both the corporate and the farmers in rural areas. While the ITC has gained in terms of efficiency the rural farmers have gained in terms of higher income. Moreover, the gains from ICT use have also generated positive spillovers in the economy. The success of this mission of ITC had secured ITC the Development Gateway Award for the year 2005, given for the exemplary use of ICT, the inaugural 'World Business Award' instituted in support of the United Nations' Millennium Development Goals and the Wharton-Infosys 'Enterprise Business Transformation Award 2004' for the Asia-Pacific region.

The e-choupal is an alternative to the Mandi system of marketing. The operation of the Mandi consists of a number of different stages, from the logistics of transporting grain to the market to quality inspection, auction, bagging and weighing, and payment. Various forms of inefficiencies burden the mandi system. Firstly, the farmers have no means to know the price trends of their product and since the sale of their product is by auction, there is little possibility of choosing another Mandi, in case of price differences. This apart, there is no scientific ways of quality testing of the crops. Most often they are by way of opinion of the commission agents or the direct buyer that the quality is determined. There are also costs related to bagging and weighing the crops, often leading to higher spillage and inaccurate weighing by the weighers. For the trading company the Mandi system posed another set of problems. The presence of agents meant that there was no direct interaction between the farmers and the trading company. This led to price and quality distortion of the product.

ITC has conceived Echoupal as a farm centre with an Internet connected computer in the village. The e-choupal is run from a local farmer's house, who is named the *Sanchalak*. Along with the *Sanchalak* there is also the *Samyojak*, a local commission agent, who provide the logistical support. The *Sanchalak* and the *Samyojak* are the two important interfaces between the trading company and the farmers. The Echoupal provides the farmer with some vital services. Firstly, the company provides the fair average price for the day based on the price in the *Mandi* , which is made available to the farmers through the e-choupal portal. The farmer can subject his product for quality assessment with the *sanchalak*, and choose to sell the product at the echoupal. The *sanchalak* issues a report of quality of the product and identity of the farmer. The farmer takes the note from the *sanchalak* and proceeds with his crop to the nearest ITC procurement hub, ITC's

point for collection of produce and distribution of inputs sold into rural areas, where proper weighing is done in the presence of the farmer and payments are made immediately. Thus the e-choupal provides the farmer with an alternative from the inefficient *Mandi* for selling, quality checking and receiving fare and timely payments for the products.

The e-choupal has become very popular among the farmers and its network reaches more than a million farmers in nearly 11,000 villages through 2,000 e-Choupals in four states (Madhya Pradesh, Karnataka, Andhra Pradesh, and Uttar Pradesh. The average usage is about 600 farmers per e-Choupal in the soya cropping area, with fewer in wheat, coffee, and shrimp.

The incremental income from a more efficient marketing process is about US$6 per ton, or an increase of about 2.5% over the *mandi* system. For the company also the echoupal system brought in many gains. The cost of intermediation reduced from 2.5 to 3% in the Mandi system to less than 0.5% in the echoupal system[13]. Similarly, the payments made for transportation by the company directly to the farmer is only half of what ist used to pay to the intermediary. Removal of intermediary manipulation of quality and the ability to directly educate and reward quality in the customer base results in higher levels of quality in e- Choupal procurement. In the *mandi* system, there was a mark up of 7-8% on the price of soybean from the farm gate to the factory gate. Of this mark up, 2.5% was borne by the farmer while 5% was borne by ITC. With e- Choupal, ITC's costs are now down to 2.5%. In absolute numbers, both the farmers and ITC save about US$6 (Rs 270) per metric ton[14].

There are also other vital information that are available for the farmers from the echoupal- the most important is the prevailing price of the crop in the local market as well as in neighboring markets. This critical information empowers the farmer with the choice of when and where to sell. It also facilitates the farmers to communicate among them and discuss on a range of issues relating to quality, price and innovations in cropping methods. One of the important ways in which e-Choupals have become successful is the presence of the *sanchalaks* , who are part of the local farming community. Their presence and local expertise help in converting many of the ideas in the Internet to the local farm. The website also provides local weather information and agricultural best practices on specific crops. . The ITC does lab test for the samples collected and provides with customized feedbacks on improving the quality and yield of the crop. Another major impact is the power of information through the computers in transforming the rural life, be it for education, health, or entertainment.

[13] Annamalai, Kuttayan and Sachin Rao (2003)p14
[14] Annamalai, Kuttayan and Sachin Rao (2003) p15