

**Working Paper
453**

**CHANGING LEADERSHIP IN COMPUTER
AND INFORMATION SERVICES,
EMERGENCE OF INDIA AS THE CURRENT
WORLD LEADER IN COMPUTER AND
INFORMATION SERVICES**

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ABSTRACT

The paper analyses the changing leadership in Computer and Information Services (CIS). Leadership is measured in terms of export shares. The leadership appears to have changed from United States of America, United Kingdom and Germany to Ireland and subsequently to India. India has been trying to maintain her leadership through improvements in technological capability and in that process has also become a base for MNCs to set up software development centres. These MNCs have been increasing their innovative activities in India as revealed through increased patenting and domestic Indian enterprises has followed although very slowly in improving their technological capability. Two conclusions can be drawn. Leadership in CIS is basically a function of the availability of highly trained software engineers. But the sustainability of leadership depends whether the industry is domestically or foreign owned.

Key words: Computer software, CIS, outsourcing, moving up the value chain, innovation, patents, India, Ireland.

JEL Classification: L860; F600;O053;O057;O340

Introduction

An interesting aspect of modern times is the diffusion of computers in various activities that one does, ranging from the simplest of activities like making one's morning cup of tea to more complex operations in a nuclear plant or in a space station. For most of these operations, one has to employ custom made computer software that is written specifically for that purpose. The term computer software involves three types: (i) packaged software or software products; (ii) CIS that involve developing custom software applications that are turnkey solutions for a specific client; and (iii) embedded software is computer software written for machines that are not, first and foremost, computers. Companies from the United States continue to be the world leader in the first and third type of leadership, while it is in CIS one sees a successive change in international leadership. Our study is primarily concerned with tracking this changing leadership in CIS and then providing some explanations for this changing leadership. Before we proceed with the analysis, it will be very useful to reiterate two dimensions of our analysis. First, we are only concerned with changing leadership in CIS and second our unit of reference is a country and not companies within countries. This is because in a service industry such as CIS there are several companies that can justifiably be called a leader.

Rest of the paper is organised as follows. In section i, we analyse the change in leadership in CIS from the USA to Ireland and argue that the Irish leadership in CIS was not sustainable in view of the nature of its

organisation. Section ii presents an overview of India's CIS industry, followed by a critical review of existing studies on the growth performance of the industry and then identifies a set of seven features of the industry which increases the potential of it to become a world leader in CIS and maintain that position for a considerable length of time. Section iii undertakes a detailed review of the factors that has made India a world leader in CIS. In doing so, it steers clear from the usual debate of whether it has been achieved by the market or by the state as both the market and the state have had an important role in the achievement of this position. Section iv concludes the paper.

i. Changing leadership in CIS and emergence of Ireland as the leader

In this study, we measure leadership in terms of export market shares. This is because use of CIS in terms of custom software applications depends very much on the installation base of computers and also in the extent to which computers are used in critical areas of operation of a firm or an institution. On both these counts, the major markets for computers are in Western countries and Japan. So export market shares will give us a reasonable picture of the extent of international leadership of a country in CIS (Table 1).

The USA used to be the world leader in CIS services given its acknowledged supremacy in computer hardware. The USA has also a very large domestic market and a large set of venturesome consumers who are willing to try out new products and services. However, around the late 1980s given the high cost of developing these within the country, US companies began to outsource the production of computing software services to Ireland. This was accomplished by establishing their own subsidiaries and other forms of affiliates in that country as Ireland had a copious supply of well trained English-speaking engineers besides good physical infrastructure and favourable government policies. However, all these positive features which attracted MNCs to Ireland were not to

last long as India had most of these features at better prices. So by 2005 or so (Table 1 above), India had become the largest CIS providing country in the world and it has managed to maintain that position and even improve its market share from less than 50 per cent to almost 60 per cent now (c2012). Interestingly the ratio of India's exports to that of Ireland's kept on increasing all through the period and has been above unity since 2005 (Figure 1). India's CIS industry had become much more innovative now whether one measures innovations in terms of the number of patents granted or in terms of going up the value chain in being able to perform more sophisticated software services such as R&D services in a wide host of high technology industries such as R&D and engineering services. There are now many instances of reverse innovations where innovations are first developed in India and then transferred back to developed countries. Admittedly, the precise measurement of the increase in technological sophistication of the industry is fraught with much empirical problems, the availability of requisite data being one of the most important reasons.

In addition to using relative position of a country in exports of CIS as an indicator for measuring leadership, one could also use a summary measure of leadership as exemplified by the AT Kearney Global Services Location Index (GSLI). The index constructed for the first time in 2004, analyzes and ranks the top 50 countries worldwide as the best destinations for providing outsourcing activities, including CIS and support, contact centers and back-office support. The 2011 version of the GSLI has been computed for 50 countries¹. India has been consistently ranked as number one in the Index all through the years. See Table 2.

1. For details of the methodology involved in the computation of the GSLI, see, Peterson, Gott and King (2012).

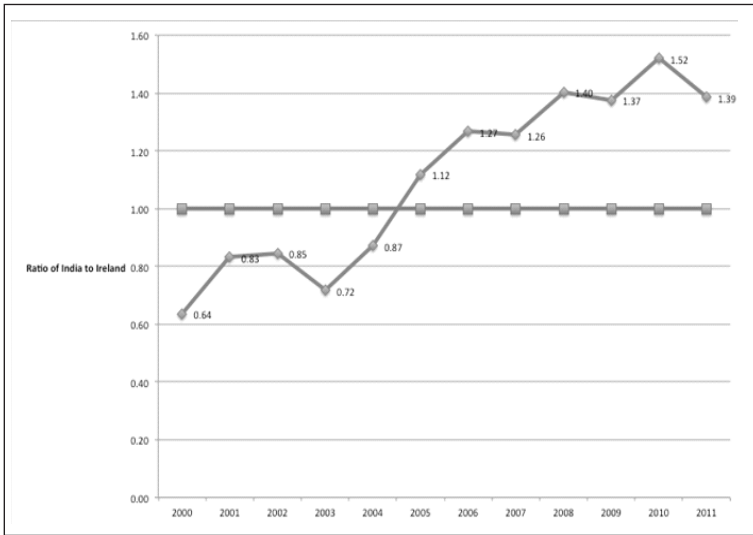


Figure 1: Ratio of India's exports of CIS to that of Ireland's

Source: Based on data provided in Table 1

There are two issues that may be highlighted. First, excepting for India and China, there appears to be very little correlation between the ranks in exports and ranks in GSLI. Second, Ireland does not appear to be a strong location for CIS according to the GSLI. In fact, her rank in 2011 is 49 out of 50 although it continues to be an important source of exports of software. This may actually raise some questions about the robustness of the GSLI.

Although much has been written on the software industry, one of the first comprehensive studies on the international computer software industry is by Mowery (1996). This study compares the growth and evolution of the industry across the United States, Western Europe and Japan and one emerging economy, namely Russia. The study highlighted for the first time that the software industry has received very little

Table 1. Table 1: Changing Leadership in CIS exports (Exports in billions of US \$)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011*
1 India	4.70	7.40	8.80	10.18	16.30	21.80	29.00	37.40	49.10	46.60	56.70	62.76
2 Ireland	7.40	8.90	10.40	14.20	18.70	19.50	22.90	29.80	35.00	33.90	37.30	45.29
3 Germany	3.80	4.80	5.53	6.70	8.09	8.39	9.99	12.75	15.40	14.82	16.33	21.55
4 United Kingdom	4.32	4.68	5.93	8.16	11.26	10.82	12.41	13.83	13.30	11.41	11.63	25.05
5 United States	5.62	5.42	5.39	6.25	6.70	7.32	10.08	11.99	13.12	13.48	13.77	28.15
6 Finland	0.02	0.30	0.50	0.50	0.70	1.50	1.50	1.80	8.19	7.00	6.18	6.46
7 Sweden	1.07	1.45	1.53	1.85	2.45	2.53	3.39	6.39	7.84	6.85	7.25	10.76
8 Israel	4.24	3.47	4.17	3.40	4.40	4.52	5.28	5.80	6.85	7.67	7.69	10.01
9 Netherlands	1.16	0.86	1.42	2.88	3.70	3.72	4.96	6.41	6.68	6.11	6.20	12.20
10 China, P.R.:												
Mainland	0.35	0.46	0.63	1.10	1.63	1.84	2.95	4.34	6.25	6.51	9.25	13.91

Note: * Data for 2011 alone refers to Telecom, computer and information services.

Source: IMF (2012).

Table 2: Ranking of top 10 countries in the GSLI, 2004 and 2011

Rank	2004	2011
1	India	India
2	China	China
3	Malaysia	Malaysia
4	Czech Republic	Egypt
5	Singapore	Indonesia
6	Philippines	Mexico
7	Brazil	Thailand
8	Canada	Vietnam
9	Chile	Philippines
10	Poland	Chile

Source: AT Kearney, <http://www.atkearney.com/gbpc/global-services-location-index> (accessed on July 30, 2013).

attention despite “its size, rapid growth, and apparent importance to the development of a broadening array of high technology industries” (Mowery, 1996). A large number of studies are also available on the growth and evolution of the software industry in specific countries like India, Israel and Ireland².

Emergence of Ireland as a leader in CIS

In the literature on computer software industry across the globe, Ireland used to be perceived as a leader. As the data presented in Table 1 indicate, it certainly accounted for the largest share in software exports until 2004. It is not very clear as to who was the leader before that. Both United States of America, and Western Europe in general and Germany and United Kingdom within it, were important exporters of computer software. Most of the software services are consumed by MNCs. Given

2. See Arora et al (2001) and Arora and Gambardella (2005).

the high cost of producing them owing to significant increases in the cost and availability of software engineers, the leadership position moved to Ireland which was located in the developed world, but had pro active government policies and the availability of software engineers at the right prices.

One of the most comprehensive studies on the emergence of Ireland as a leader in CIS is by Sands (2005). According to her, “it was a case of fortune favouring the well prepared”. She identified a total of five factors that contributed to the software success story of Ireland. These are broadly divided into three domestic input factors and two external factors. The former consists of: (i) National vision, public policy and creating a pro business environment: Two specific issues stand out here. First, Irish corporate income tax rates were one of the lowest in the developed world: at least 30 per cent age points lesser than in other major developed countries³. Second, massive public investments in telecommunications infrastructure enabled Ireland to have a modern telecommunications infrastructure, which was ideal for the software industry. Thus these two changes, which were largely targeted at foreign enterprises, benefited domestic enterprises as well. (ii) Investing in education and human capital: Ireland had a demographic dividend of sorts compared to other European countries: 47 percent of the Irish population during the time was less than 29 years. Irish higher education policy responded to this by massively increasing the public expenditure on higher education. According to Sands (2005), “of particular significance was the decision to spend a larger proportion of structural funds received from the EU on human capital as opposed to physical infrastructure”. Other countries such as Greece and Spain, which too received similar structural funds, spent a larger proportion of it on building up physical infrastructure. (iii) Restructuring education system to meet the needs of the industry:

3. MNCs pay 10 percent corporate income tax on both manufacturing and export services in Ireland, which is considerable lower than in other countries not just in the developed world, but also in the developing world.

Engineering education was given a fillip with the establishment of a number of state run institutions. A number of degree programmes in computer science/software engineering was started during the time and as a result the total number of student enrolments in technology related disciplines consistently accounted for about 25 percent of total new entrants into the higher education sector. Higher enrolments also transliterated it into higher graduation rates. Many MNCs have cited the availability of educated labour force as the primary reason for their location in Ireland.

In addition to these domestic factors, there were two external factors. First, Ireland was a natural choice for US MNCs as the country was English speaking and historically through the Irish migration route to the USA, the two countries had much in common. This led to a large number of US MNCs locating their computer software production in Ireland. Second, was diaspora and international linkages. A significant number of Irish students who were trained in the US returned to take up positions back home. That coupled with a higher labour force participation of well trained Irish women made sure that the country had a copious supply of well trained labour force.

As a result of these favourable factors, Ireland become a major force to be reckoned with as far as the exports of CIS were concerned. However, almost 90 per cent of the exports of Irish software were affected by MNCs or their affiliates, which established software development, centres in that country. See Figure 2.

This was the case until mid 2000 or so. With increase in the salaries of Irish software engineers (although precise quantitative estimates of these are hard to come by), Ireland no longer appeared to be competitive to the MNCs and they moved business to a cheaper location such as India where availability of English speaking software engineers were in abundance. Practically all the researchers who have worked on the Indian software industry have stressed this point.

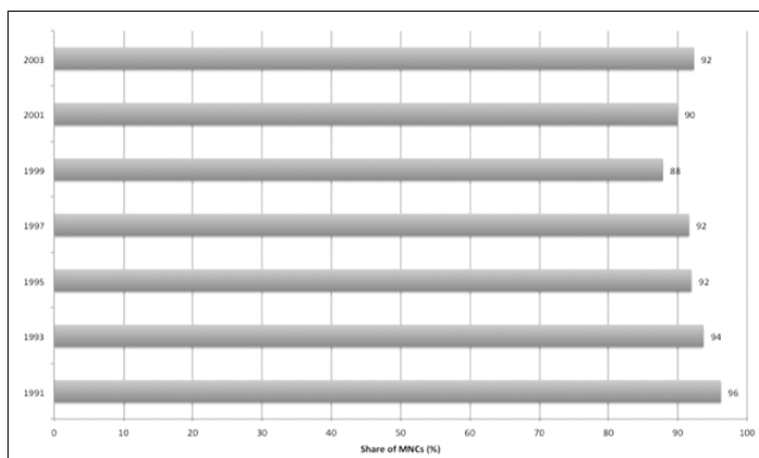


Figure 2: Share of MNCs in total exports of computer software from Ireland

Source: Based on Table 3.1 in Sands (2005).

Moynihan (2008) has gone into the growth and decline of the Irish software industry in some great detail. According to him the following three factors have been central to Ireland losing her leadership position as a base for export of software services. These are: (i) lack of software graduates; (ii) Over dependence on foreign companies; and (iii) Increase in personnel costs compared to other countries and therefore loss in competitiveness.

A proximate cause for this changing leadership is the availability and cost of the key factor input for providing this service, namely the computer programmers. A second cause is whether the country in question has fostered local entrepreneurship. For instance Ireland relied far too much on affiliates of MNCs. So when the cost of providing CIS increased in Ireland, the MNCs just moved on to other cheaper locations such as India. Since India had domestic CIS companies, she was able to assume this leadership and maintain it. Co-evolving government policies further supported the initiatives of the private sector firms.

ii. Overview of the Indian CIS Industry: The software industry is one of the fastest growing industries in India and its share in India's GDP has increased from 1.29 percent in 2000-01 to 3.29 percent in 2011-12 (See Table 3). The Gross Value Added of the sector has been growing at average annual rate of 18 per cent. It is largely an export oriented with exports accounting for a significant portion of its total output. Exports have increased from just about 2 billion dollars in 1997-98 to about 69 billion dollars in 2011-12. (Table 4). Although the

Table 3: Trends in GDP of computer related services⁴
(Values are in Rs Billions in constant 2004-05 prices)

Fiscal year ending	GDP at Factor Cost	GDP of computer related services	Share of computer related services(%)	Average annual percentage change (%)
2001	23218.68	298.21	1.28	
2002	24555.25	359.90	1.47	20.69
2003	25480.47	422.49	1.66	17.39
2004	27633.71	527.74	1.91	24.91
2005	29714.64	651.75	2.19	23.50
2006	32530.73	825.15	2.54	26.61
2007	35643.64	1014.67	2.85	22.97
2008	38966.36	1148.68	2.95	13.21
2009	41586.76	1392.51	3.35	21.23
2010	45076.37	1467.30	3.26	5.37
2011	48859.54	1535.68	3.14	4.66
2012	52435.82	1723.32	3.29	12.22

Source: Central Statistical Organisation (2013).

4. This is Division 72 according to National Industrial Classification (NIC) 204 or Division 62 according to the more recent NIC 2008. The activities listed under this are hardware consultancy, software consultancy, data processing, database activities, maintenance and repair of office/accounting/computing machinery and other computer related activities.

global financial crisis may have reduced the rate of growth of exports, it has continued to show an increase showing the resilience of the sector. According to successive surveys conducted by the Reserve Bank of India (RBI), the only official source of data on the IT sector, in 2011-12 (latest published RBI survey), the structure of the industry is such that CIS per se account for about 67 per cent of total exports (Figure 3). Of the remaining, Business Process Outsourcing (BPO) accounts for 21 percent, followed by software product development a mere 5 per cent and the remaining 5 per cent accounted for by engineering services. In short, prima facie, almost 90 per cent of the exports are supposed to be

Table 4: Trends in CIS exports from India, 1997-98 through 2012-13 (Millions of US \$)

	CIS Exports	CIS Exports as a per cent of service exports	CIS Exports as a per cent of total exports
1997-98	1760	18.67	3.90
1998-99	2626	19.92	5.53
1999-00	4015	25.56	7.54
2000-01	6341	38.98	10.27
2001-02	7556	44.08	12.22
2002-03	9600	46.24	12.88
2003-04	12800	47.64	13.74
2004-05	17700	40.93	13.78
2005-06	23600	40.93	14.50
2006-07	31300	42.42	15.44
2007-08	40300	44.61	15.71
2008-09	46300	45.54	15.93
2009-10	49705	53.00	18.01
2010-11	55460	42.13	14.51
2011-12	62212	43.71	13.76
2012-13	66080	45.36	14.61

Source: Reserve Bank of India Monthly Bulletins (various issues).

taking place in relatively low-tech services. However, this view is contested as both within CIS and in the BPO services there have been systematic efforts at moving up the value chain (NASSCOM, 2012). Systematic documentation of this moving up the value chain is yet to appear although there are case studies of it (Arun, 2013). Later on we will analyse the patenting behaviour of Indian CIS industry as this is a more objective indicator of moving up the value chain.

The growing importance of the CIS industry can be seen from not only its growing share in the country's GDP, but also its growing share in both total exports and services exports. In fact, the software exports have become such an important component of the country's current account that excluding it would have widened our current account deficit by almost 2.5 times than the situation when it is included (Figure 3).

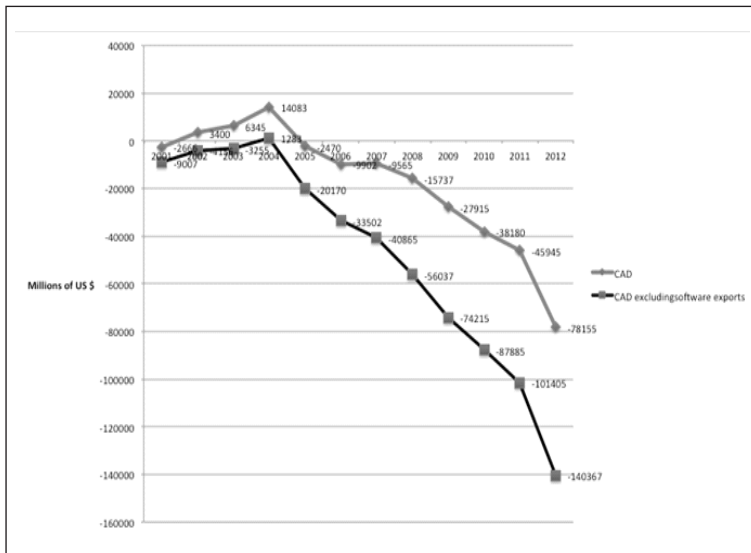


Figure 3: Trends in India's current account deficit with and without software exports

Source: Reserve Bank of India (2013).

It is also important at this juncture to understand the computer software industry in India in terms of the range of services actually performed (Figure 4). As can be seen from the figure, the structure of the industry has remained almost stable over the last five years, with IT services accounting for the largest share. Within the BPO/ITES sectors, the two types of services that have grown in importance are finance and

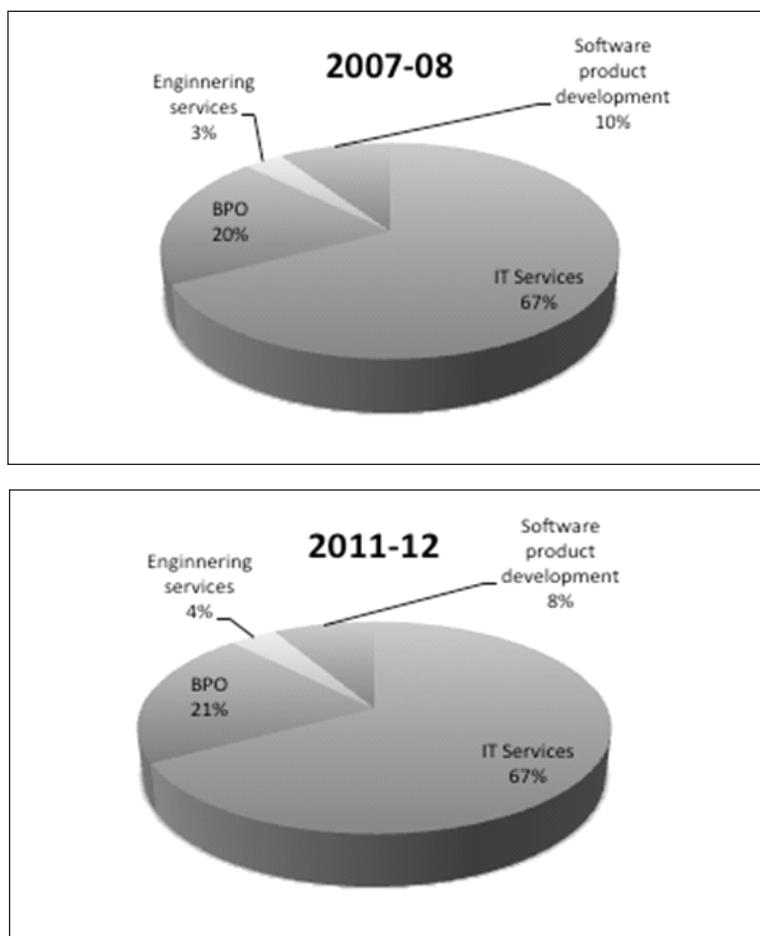


Figure 4: Structure of the CIS exporting industry in India

Source: Reserve Bank of India (2009 and 2013).

account related and engineering services. These former has increased from 9 per cent in 2007-08 to 23.5 percent (of the total BPO/ITES exports) in 2011-12 and the latter has increased from 13.7 per cent to 15.3 per cent during the same period (Reserve Bank of India, 2009 and 2013).

According to the UN *Manual on Statistics of International Trade in Services* (MSITS)⁵, service exports from one country to another falls into four modes: Mode 1: refers to cross border trade; Mode 2 refers to consumption abroad; Mode 3 refers to commercial presence abroad and Mode 4 refers to presence of natural persons. Employing this definition of service exports, RBI has provided us with the break up of CIS exports into these four modes (Table 5). It shows that majority of the exports take place through Mode 1. Mode 4 which involves Indian software engineers travelling to the clients premises and rendering services has increasingly been affected by visa related issues in some of the leading importing countries, such as the USA for instance.

Table 5: Distribution of CIS exports from India according to the four modes of service exports (percentage shares)

	Mode 1	Mode 2	Mode 3	Mode 4
2002-03	40.08	0.00	45.14	14.78
2007-08	60.4	0.60	13.90	25.10
2008-09	56.30	0.10	16.80	26.00
2009-10	64.60	0.00	17.60	17.80
2010-11	67.40	0.10	14.80	17.70
2011-12	69	0.50	15.40	15.10

Source: Compiled from Reserve Bank of India (2005, 2009, 2010, 2011, 2012 and 2013).

5. See United Nations, Department of Economic and Social Affairs (2011), pp. 112-3.

Although CIS is an important industry for India its database is rather weak. According to registration data with Ministry of Corporate Affairs, as on October 31, 2011, a total of 52, 577 firms are registered as CIS companies in the country, the majority of them being in Delhi, Maharashtra, Andhra Pradesh, Karnatka and Tamil Nadu⁶. Another important issue is the size distribution of firms in the CIS industry. None of the published sources of data allow us to construct one. Even the NASSCOM has been publishing on their website⁷ only a list of the top 20 exporters, annually since 2007-08, but it does not include prominent MNCs such as IBM, Accenture etc which have operations from the industry. The general feeling is of course that the sales of the industry is dominated by domestic companies. But foreign companies have been increasing their presence in India and an indirect statistic for measuring this is the fact that the computer software and hardware industry has received almost 6 percent of the cumulative FDI inflows to India during 2000 through 2013 (Department of Industrial Policy and Performance, 2013), making the sector the fourth most important FDI receiving sector in the country. Almost all the major IT majors have started operations in the country. And this increased competition from foreign companies have increased the possibility of technology spillovers from the foreign to the domestic companies.

Review of research issues

A review of the vast amount of written material, both by Indian and foreign scholars, reveal the following ten issues wrt the phenomenal growth of this sector. We confront each of these propositions with newly available quantitative evidence.

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6. The source of this data is unstarred question number 254 answered in the Lok Sabha on 23/11/2001. See <http://164.100.47.132/Annexture/lsq15/9/au254.htm> (accessed on August 16, 2013).
 7. See NASSCOM, Industry Ranking, <http://www.nasscom.in/industry-ranking> (accessed on August 12, 2013).

- **Growth performance is exaggerated as the data on IT exports is collected and presented only by the Industry Association-the NASSCOM:** Although the IT industry has been growing rapidly there is a lack of official data on this industry. The most comprehensive source of data on Indian industries, namely the *Annual Survey of Industries* (ASI) does not have data on the output of computer software industry as ASI deals with only manufacturing industries. However, the *National Accounts Statistics* published annually by the CSO has time series data on the value added of the computer related services since 2000-01 (Central Statistical Organisation, 2013) and according to this, during the period 2000-01 through 2011-12 the real GDP of computer related services have grown at an average annual rate of 17.52 per cent compared to 7.7 percent for real overall GDP of the economy (Table 3). Reserve Bank of India (RBI) has been reporting computer software exports as a miscellaneous item in the invisibles in the current account of India's balance of payments. As a result, exports of computer software are available from India's official balance of payments statistics since 1997-98 and these data on exports reported by the RBI corresponds to those reported by the NASSCOM. Further, the RBI has been conducting an annual survey of computer software and CIS exports since 2007-8, where in a reconciliation of the data on exports as obtained through these surveys and the NASSCOM data has been achieved (Reserve Bank of India, 2009, 2010, 2011, 2012, and 2013).
- **The contribution of the IT industry to India's overall growth performance:** As seen earlier, the sector contributes about 3 per cent of India's GDP and about 15 per cent of India's total exports. In this sense it is an important industry, very highly productive etc. Recent data on the Gross Value Added of computer related services (Central Statistical Organisation, 2013) allows one to

precisely measure the contribution of the CIS sector to the macroeconomic performance of India's economy. Although, still an important contributor to overall economic growth, the actual estimates are still less than what is claimed in the literature.

- **The difference between Gross IT exports and Net IT exports has been widening** implying that IT exporters, very often, fail to repatriate their full export proceeds: During the early periods, namely up to the mid 1990s or so, net exports of Software was only something like 70 per cent on an average of gross exports. This has since improved to 96 per cent or so by 2012-13. We argue that the difference, gross and net exports, is directly proportional to offshore vs. on-site type of assignments in the total number of assignments secured by Indian IT companies. In the earlier period the share of on-site assignments were higher and therefore considerable costs were incurred in traveling abroad etc., in terms of executing these projects these projects at the customer's premises. Nowadays the situation has changed in favour of offshore assignments and as expected the share of net exports in gross exports have actually increased: the share of offshore services account for as much as 82 per cent of total exports (Reserve Bank of India, 2013, Table 6). In other words, the ratio of net to gross exports of CIS is positively correlated with the ratio of offshore to on-site assignments.
- **The relative roles of government and private sector in explaining the superior growth performance of the IT industry in India:** It is seen that both the private sector and the government can justifiably claim to have contributed to the phenomenal growth of IT exports from India. The industry itself is almost entirely composed of private sector firms. However, the IT firms have received a variety of tax incentives and other forms of subsidies, which have been very helpful for the industry to

increase its exports. So it is not state vs. the market, but state and the market working together in terms of explaining the growth of the industry. The initial success may have been shown by the industry on its own through sheer dint of hard work⁸. But once the success was achieved especially in terms of growth in exports the government has actually stepped in to nurture the industry through a variety of support mechanisms, which included both financial and physical as well.

- **The Indian IT industry relies rather too excessively on export sales and therefore has become very vulnerable to external shocks:** It is a fact that India's IT industry is very largely export oriented in the sense that much of its sales are done abroad. This is in turn due to the small market for computer software services within the country. Governments actually play an important role in enlarging the size of this domestic market. The argument runs as follows. Given the fact that the installation base of personal computers are largely within the government and educational institutions, which are in most cases owned by the government, governments hold the key to enlarging the domestic market for computer software by increasing its consumption through let us say e-governance initiatives. In this way, the industry can reduce its dependence on exports.
- **Use of IT and its effect on productivity enhancement:** Use of IT can actually enhance productivity of those firms using it provided the firms use it in their critical areas of operation such as enterprise resource planning. Mere deployment of IT may not necessarily have any productivity enhancing effects. Most of the empirical

8. In fact, the business press during the 1980s had highlighted very many instances where existing government policies ranging from the amount of foreign exchange that can be obtained for legitimate business trips abroad to restriction and customs duties on the imports of personal computers by the industry.

studies that are done in this context, both in India and abroad, have used data on IT deployment and productivity improvement. The results of such studies are, of course, not that straight forward to interpret as IT use leading to productivity improvements. We have a dearth of studies analysing the impact of IT deployment on productivity improvement as data on IT deployment are not that easily available.

· **Extreme regional concentration in the production of CIS within the country:** It is a fact that much of CIS production is concentrated in the south and within the south, Karnataka and Bangalore accounts for the largest share. The industry is one, which has a natural tendency to cluster in a small unit area for a variety of reasons. Physical infrastructural constraints in Bangalore have diffused the industry, somewhat, to other parts of the country.

· **The IT industry provides very little direct employment:** Although the total direct employment by the IT industry is only about 2 million or so⁹, it has also an indirect employment effect¹⁰. Further, being a very highly productive sector, these two million employment contributes approximately about 3.35 per cent of India's GDP¹¹.

9. The empirical basis of these figures are in some doubt. See also f.14.

10. But there are no systematic estimates of these indirect employment effects. There have of course been a recent attempt at estimating the indirect employment effects of the Chennai branch of the largest CIS firm, TCS. According to this study, while TCS had a direct employment of 14, 000 its indirect employment was at best not more than 1000 workers. See Vijayabaskar and Suresh Babu (2013).

11. The figure refers to 2011-12 and it is the share of GDP of computer related service in GDP at Factor Cost. See Central Statistical Organisation (2013), Statements 1 and 70.

- **India's IT industry focuses much more on CIS and not products.** This is also a fact, as there are very few India software products that are available in the market. Most of these products are in the banking and financial services segments. There are two reasons as to why Indian firms are not very active in IT products. First, the IT software product market is characterised by very high levels of concentration with just one firm alone accounting for a significant portion of the world market. Efforts made by antitrust agencies of both the USA and the European Union have not been successful in reducing the market power of this large monopolist. Second, according to the industry the rate of profitability in software services is much higher than software products. Hence, for these two reasons, the software industry in India has tended to focus much more on services than on products.
- **India's IT industry is not very innovative:** If one employs the conventional indicators of measuring innovation such as R&D expenditure and patents, the domestic software industry may not rank at all in terms of innovation. This of course does not mean that the domestic firms are not innovative as they may be employing different forms of IPR mechanisms such as trade secrets for instance. Being essentially service related firms, they have introduced a number of innovations such as reducing the time spent in executing projects. Further, increasingly the industry has been taking up a number of technologically speaking more sophisticated contracts in the form of R&D services, architectural, engineering and technical services. Together these sorts of contracts are referred to as Knowledge Process Outsourcing (KPO) as compared to less sophisticated, Business Process Outsourcing (BPO). The ratio of KPO to BPO has been increasing over time and now stands at around 0.63. This shows that although may not be that innovative the technological sophistication of the

industry is increasing. Further, of late, the industry has also been taking out patents abroad at the USPTO.¹²

Distinct features of the Indian CIS industry

The issue-specific survey of research issues help us to identify seven features that are characteristic of the CIS industry. They are:

- **Highly export oriented:** Over three-quarters of the total sales of CIS are in the international market. Export rivalry between firms have encouraged all firms to constantly improve their productivity and service offerings. Although exports are to about 150 countries in the world, over three quarters of these are to just two countries, USA and the UK. As noted before, such heavy concentration in a finite number of markets have had its deleterious consequences especially when these markets suffer a downturn as has been the case recently with recession gripping both the US and UK markets.
- **Extremely high rate of growth over a long period of time- 31 per cent per annum over the last 15 years or so.** No other Indian industry, whether in services or in manufacturing has grown at such high rates for a long period of time. However, in the more recent period and specifically since 2005-06, the growth rates of software services has been on a downward spiral (Figure 5). This is almost entirely due to recessionary conditions in its main export market, namely the US market.

12. The India Patents Act does not allow patents for computer programmes.

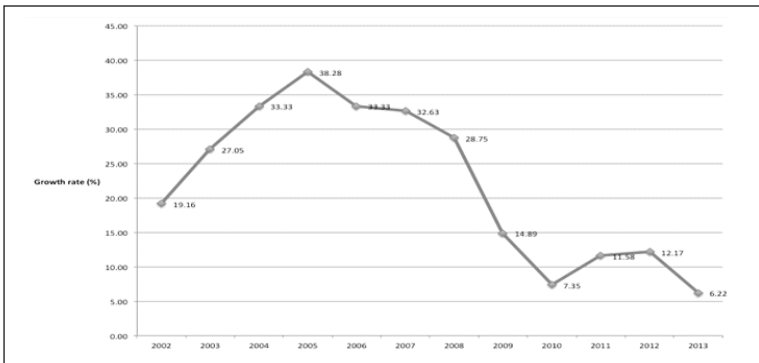


Figure 5: Annual average rate of growth of CIS exports from India 2001-02 through 2012-13

Source: Computed from overall BoP data presented Reserve Bank of India, (2009, 2010, 2011, 2012, and 2013).

- Close interaction with discerning users.** The main customers of India's CIS are the leading firms in their respective fields. It is generally held that majority of the Fortune 500 companies deal with Indian CIS vendors for their custom made software requirements. This interaction with discernible customers have made Indian IT firms learn about new technology and ways of doing business and above all improving their delivery mechanisms and project planning skills.
- Regionally concentrated in clusters:** Five clusters account for a significant portion of CIS production and exports. This clustering has the potential of the firms constituting the cluster to learn and benefit from best practices employed by their peers. This happens essentially through movement of IT personnel from one firm to another as the industry has high attrition rates¹³. Further, most of

13 There are no official estimation of attrition rates in the labour market for CIS. A survey conducted by Deloitte (2012) puts the attrition at ranging from 17 percent to 8 percent at the junior management to top management levels in the case of CIS firms. Similar rates in the case of ITES firms range from a higher rate of 34 percent to just 1 percent. See Deloitte (2012), p.17.

the dominant clusters like Bangalore, Mumbai-Pune, Gurgaon-Noida-Delhi, Hyderabad and Chennai are organic or historically driven clusters and are dominant in the sense that as much as 90 per cent of the exports of CIS emanate from these clusters (Figure 6). Research elsewhere has shown that historically driven clusters are far more innovative than those created through public policy action.

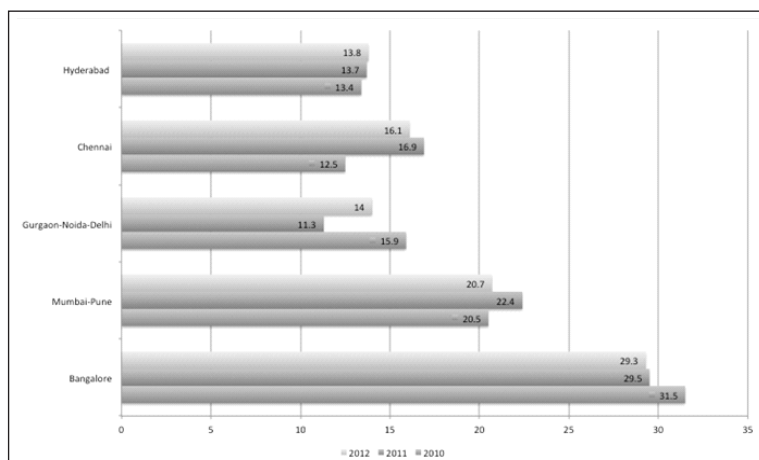


Figure 6: Five dominant CIS clusters in India, 2010-2012

Source: Electronics and Computer Software Export Promotion Council

- **Employs a small number of highly skilled personnel:** According to official sources (Central Statistical Organisation, 2010), the CIS industry directly employ only about 0.5 million people¹⁴.

14 These numbers are actually based on Central Statistical Organisation (2013), Table 6.1 on p.18 which itself is based the 63rd round of NSSO{(National Sample Survey Organization (2009) Table 33, p. 375)}. However, these numbers are considerably lower than those estimated by Department of Electronics and Information Technology (2013, p. 25) that the total direct employment of the sector as on 2012-13 is 2.96 million. The recently released study by the Science Advisory Council to the Prime Minister reports a direct employment figure of 2.5 million and indirect employment of 10 million. See Karnik(2013).

However, the value added per worker in the CIS kept increasing from Rs 0.52 million in 2001 to Rs 2.5 million in 2008¹⁵. See Figure 7. Most of these are engineering degree holders in various disciplines. Such a high density of highly skilled workers enable the industry to keep pace with technological changes in the service delivery and even enabling the firms to go up the value chain.

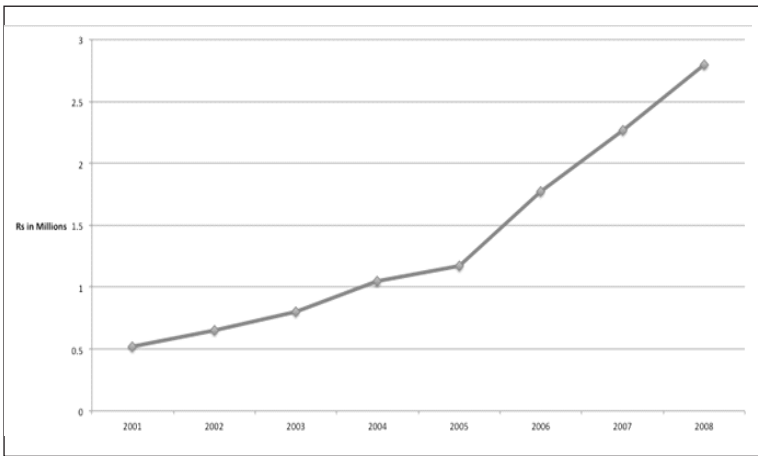


Figure 7: Trends in labour productivity in CIS industry, 2001-2008

Source: Computed from Central Statistical Organisation (2010).

- Most of the firms are new and started by technology-based entrepreneurs:** Majority of the leading domestic IT enterprises are new and have been set up by technology-based entrepreneurs over the last twenty years or so. To be very specific they have

15 This corroborates the study by Das, Banga and Kumar (2011), wherein they estimated the total factor productivity growth of CIS firms (sample consisted of 18 firms) during the period 1995-96 through 2007-08. The study estimated the TFP growth during the period to have increased by 33 per cent per annum and much (74 %) of it was contributed by technological change. See Das, Banga, Kumar (2011), pp. 24-5.

been established after 1991 or in other words most of the leading firms can justifiably be referred to as the product of economic liberalisation. These 'entrepreneurial' firms are different from the conventional enterprises on a number of parameters. On three traits in particular the 'entrepreneurial firms' stand out from 'conventional firms'. They are (i) corporate governance: the entrepreneurial firms although established by a specific, very often, technically trained entrepreneur, are listed public limited companies with a wide shareholding. Having been listed in both Indian and foreign stock exchanges they are subject to more transparent disclosure practices regarding their operations and performance; (ii) technology-intensive industries: almost all the entrepreneurial firms operate in technology-intensive industries and mostly in service industries where the entry/barriers are low; and (iii): extent of globalisation: most of the entrepreneurial firms are highly integrated with the global economy. Exports of these enterprises typically range between 30 to 95 per cent of its total sales. A combination of all the three has made these firms to be potentially more innovative rather than the rest.

- **A coevolving sectoral system of innovation:** The relative roles of government and the private sector in explaining the 'success' of the CIS industry, as noted earlier, is a hotly debated issue. However, a closer examination of the sectoral system of innovation of the industry shows that many of the institutional support systems, which manifest itself in the form of a range of policy instruments, and infrastructural support systems have co-evolved with the success of the industry. So the argument here is that the industry first achieved some successes and the government came forward to support it even further primarily in terms of improving the physical infrastructure and secondly in terms of providing the industry with a whole host of fiscal incentives. One must particularly emphasize the nature of the interface between the

industry association, NASSCOM, and the government in charting the growth trajectory of this sector. This is analysed in some more depth below.

iii. India as a world leader in CIS

In this section we undertake a detailed review of the factors that has made India a world leader in CIS. In doing so, it steers clear from the usual debate of whether it has been achieved by the market or by the state as both the market and the state have had an important role. The study identifies many features of this industry. First of all, the very high growth rate in value added - almost 31 per cent per annum over its entire growth period from 1988 through 2012 or so. This high growth rate has enabled it to maintain its leadership position. The industry is also very innovative and this has been achieved through its existence in, largely, historically evolved clusters. This clustering has enabled the industry to benefit from spillovers and other agglomeration economies. It's highly export oriented with exports making up over 90 per cent of the industry's turnover during any particular year. This high export orientation has put into contact with highly discerning customers abroad and this producer-customer interaction has enabled the firms to learn from state-of-the art techniques required by these discerning customers. The fact that technology-based entrepreneurs have started most of the firms has enabled the firms to keep abreast of latest techniques in software production and this was further aided by its employment of small number of highly skilled workforce. Further, the industry has benefited a lot from Indian diaspora based essentially in the Silicon Valley and pro active government which has given a number of fiscal and non fiscal incentives to main its high growth rate in exports. All this has contributed to the industry having a rather tightly knit sectoral system of innovation.

In identifying the more proximate factors that has contributed to this success the paper identifies the following six factors. All these six factors have been identified in the literature as well (Heeks, 1996,

Joseph and Harilal, 2001, Athreye, 2005, Desai, 2005). Balakrishnan (2006), who examined the source of competitiveness of the software industry is of the view that this was achieved in two stages. First, via long-term investment by the state in technical education and science and technology, with neither necessarily directed at the production of software. Subsequently, an incipient software industry with recognisably high export potential has been targeted via fiscal incentives and the provision of export-enabling infrastructure. The emergence of a globally competitive Indian software industry serves as an interesting example of successful state intervention at a time when the model is largely out of fashion. However, our argument is slightly different. The industry has on its own, often enough working under severe constraints of physical infrastructural bottlenecks and bureaucratic red tapism, first achieved some success through their own efforts. Once the success has been achieved and demonstrated the state has responded through a variety of support measures.

1. **Availability of a large quantity of especially English-speaking engineers:** India's higher education system especially at the tertiary level is offered, by and large, in English only. Although the system was biased in favour of science-based subjects, over the last twenty years or so engineering education has expanded, most of them through privately run engineering colleges (Mani, 2002). The graduates of these colleges became natural candidates for appointment by IT companies. Encouraged by the success enrolments increased in subjects like Computer Science and Information Technology. The industry has sometimes expressed doubts about the quality of these engineers, but given the low level of technical skills required for the initial set of projects, the quality available appears to have been adequate. Moreover, all the leading companies have their own in-house training capability for bringing the recently recruited engineers to the standards required by them. In fact, the ability of the higher education system

to outturn qualitatively improved graduates will be the crucial factor that will determine the future competitiveness of the industry. Fortunately, various qualitative improvement plans are underway (Mani, 2010). An important point to be noted here is that in the initial period the firms recruited engineers from across the different branches of engineering. The literature on CIS has taken an exception to this practice that CIS companies recruiting engineers of all hues with higher incentive packages has very often crowded out the supply of engineers for especially the manufacturing industry. But no empirical estimation of this so called crowding out phenomena exists, however. In actuality, the congregation of engineers of different disciplines in CIS companies have actually enabled these companies to develop domain specific expertise and this has become very useful to these firms at the moment to offer consultancies in various domains.

2. **Role of the state:** As has been argued by Balakrishnan (2006) and indeed by a number of scholars who wrote about the industry, the state has played an important role in encouraging the growth of this industry. These support systems can be grouped under three broad categories: (i) Fiscal incentives for export promotion, establishment of Special Economic Zones¹⁶; (ii) Improvement of physical infrastructure (establishment of software technology parks, improvement in telecommunications infrastructure; and (iii) development of domestic market through essentially the diffusion of e-governance initiatives). Of these three, it is interesting to note that the industry enjoys a tax subsidy with respect to corporate income tax rates even now (Table 6) although

16. Section 10AA of the Income Tax Act provides for a deduction from the total income of hundred percent of profits and gains derived by a unit located in a Special Economic Zone (SEZ) from the export of articles or things or from services for the first 5 consecutive assessment years, of fifty percent for further 5 assessment years and thereafter, of fifty percent of the ploughed back export profit for next 5 years.

the tax subsidy has progressively been brought down. Regarding physical infrastructure, state intervention has been in the form of establishing Software Technology Parks of India (STPI). Established in 1991, there are now (2012-13) 53 STPIs covering the whole country and provides the much-needed physical infrastructure that is needed for software production and exports. In fact, its importance could be gauged from the fact that almost 80 per cent of the software exports from India emanates from the units located in the STPIs. Recent attempts at E-governance (the 2006 initiated National E-governance Plan, NeGP being the most important), although still at a very rudimentary stage, are giving a fillip to the domestic market for CIS. Finally, despite privatisation, much of the higher education in general and engineering education in particular is still in government owned colleges and universities. Finally, the 2012 announced National Information Technology Policy aims to make India a global hub for IT and IT enabled services by 2020. Further, the policy also, inter alia, aims to: (i) increase revenues of IT and ITES industry from 100 billion dollars currently to 300 billion dollars and expand exports from 69 billion dollars currently to 200 billion dollars by 2020; (ii) gain significant global market-share in emerging technologies and services; and promote innovation and R&D in cutting edge technologies and development of applications and solutions in areas like localisation, location based services, mobile value added services, Cloud Computing, Social Media and utility models. Further, in addition to the central government individual state governments are also providing a variety of incentives for CIS firms¹⁷. One must also mention the attractive incentives for NRIs to back ventures in India and also the recent efforts to establish standards for skill development through close working with the

17 In fact IT and Bio Technology are two industries in which most of the state governments have clearly articulated policies.

IT industry. In short, as argued by Mani (2006), the computer software industry is an excellent example of an industry where the state and the private sector enterprises have worked together to achieve some desirable results. Further to these three roles, there is also a new role which government has assumed recently, namely the prevention of firm collapse due to mismanagement and fraud¹⁸. So it is not state or markets, but state and markets working together that has produced this leadership position.

3. **Role of the Industry Association-NASSCOM:** The NASSCOM was established in 1988. Currently (c2013) it has a membership of 1400 companies, which account for 95 per cent of industry revenues. Right through its inception, the association has been relentlessly working to improve the brand image of Indian software industry. This perhaps is its most important contribution. It also serves as a broker of ideas and market by promoting networking, exchange of best practices, placing buyers and sellers in contact with each other etc. No other industry association in India has been NASSCOM-like in being very proactive¹⁹. A specific area where NASSCOM has been successful has been enabling Indian

18 The rapidity and firmness with which Government of India stepped in to deal with a major instance of fraud at one of the leading CIS companies, Satyam, is an illustration of this rather unconventional role of the state. See Securities and Exchange Commission, <http://www.sec.gov/news/press/2011/2011-82.htm> (accessed on August 24, 2013).

19 In the liberalised economic regime, many industry-specific associations have become more important in charting the course of direction of their respective members and helping to put in place common facilities and support for improving quality of production and in the rendering of services. However, there exists no studies on their real role or contributions to their respective industries. The role played by NASSCOM to place the Indian CIS industry on the world map is fairly well understood.

CIS to secure the necessary quality certifications so that they can improve their interface with potential customers abroad²⁰. Another important contribution is brand and image building. Karnik (2012) provides an insider view of the story of the role of NASSCOM in the emergence and leadership position of India's IT industry.

Table 6: Extent of corporate income tax subsidy to Indian CIS firms

	Software development agencies		ITES/BPO	
	Effective tax rate (%)	Extent of tax subsidy (%)*	Effective tax rate (%)	Extent of tax subsidy (%)*
2007	6.38	27.61	7.36	26.63
2008	12.00	21.99	15.00	18.99
2009	11.80	22.99	13.10	20.89
2010	18.00	15.99	15.10	18.89
2011	19.05	13.39	21.34	11.10
2012	22.94	9.51	24.38	8.07

Note: * The extent of tax subsidy is computed by taking the difference between the statutory corporate income tax rate for domestic companies and the effective tax rate.

Source: Ministry of Finance, Government of India (various issues) and KPMG, <http://www.kpmg.com/global/en/services/tax/tax-tools-and-resources/pages/corporate-tax-rates-table.aspx> (accessed on July 28, 2013).

20 India is supposed to be having the largest number of CMMi Level 5 certified CIS firms in the world. This is the highest quality certification that a company can get for software development in this world. This certification is given by Software Engineering Institute in Carnegie Mellon University, USA. Only about a 100 companies around the world have this certification. This certification ensures that all software developed in the company has been created using highly analyzed statistical processes which go through rigorous refinements leading to continuous improvements.

4. **Availability of new generation of entrepreneurs with a clear focus on corporate strategy:** As seen earlier, the fact the industry is led by new generation entrepreneurial firms is an important factor explaining the leadership position. The entrepreneurs themselves are well trained having gone to some of the best engineering schools in the country and therefore had the right skills and ideas to take the industry along a growth path. This strong internal capacity for decision-making and strategic vision has been very helpful in achieving the leadership position²¹.
5. **Role of the diaspora in securing knowledge about markets abroad, venture capital:** Saxenian (2006) was one of the first to emphasise this aspect. Nanda and Khanna (2010) has also explored the importance of cross-border social networks for entrepreneurs in India's CIS industry for getting leads to new business and accession finance and especially venture capital. Large number of India expatriates has done extremely well in some of the leading centres for IT in the world like Silicon Valley. Many of these entrepreneurs have been a source of new ideas and markets for friends and relatives back home. Later on they have also become a source for venture capital these VCs have financed a number of IT-based ventures in India (Mani and Bartzokas, 2004). Needless to add, these VC financiers were also able to provide the crucial strategic thinking for these new ventures, securing the right kind of markets abroad etc.
6. **Interaction with discerning foreign customers:** Being a service-oriented industry, the seller is merely executing specific CIS requirements of the buyers. Most of these buyers, as noted earlier, are leading firms in the world in their own respective fields. So

21. In fact, one of the leading CIS companies, when faced with decline in its ranking among the top CIS companies have gone on to the extend of inviting back one of the founder entrepreneurs as a way of reversing this fall in ranking.

this buyer-seller interaction, which is deeply embedded, has been a great source of new ideas, technologies and practices to the sellers. In fact, this has given rise to a number of small and medium sized companies, which are leaders in their respective domains²². Recent research by Kite (2013) too has emphasised this point, but in an indirect manner of non-IT firms in India improving their productivity through the use of CIS from the Indian CIS industry.

Maintenance of leadership position

Central to maintaining their respective leadership positions, leading CIS firms have been having strategies for moving up the value chain rather than being stuck at the lower end. One manifestation of this effort is the slow increase in the exports of software products from India although as a share of total exports (as can be seen from Figure 3 a and b) it does not show a rising trend²³. See Figure 8. Indian software firms have developed some world class products used extensively even abroad. See Table 7.

Considering the highly oligopolistic market for software products, breaking into that market by relatively speaking small sized Indian CIS firms is not that easy. Further, there are also other reasons as to why Indian IT companies have shied away from developing software product²⁴. First, they did not have domain expertise to create products. Secondly, they did not want to take risks. Thirdly, at the time India itself was not a big market for IT products. Now the first three requirements are necessary even to continue as services companies. Therefore, the blueprints for building product companies are forming by default as India's software industry continues to grow.

22. iYogi, TutorVista, GetFriday and Plexion are illustrations of this.

23. See also Joseph (2007).

24. These arguments are based on Asian Technology Information Program (2004).

Table 7: Instances of software product development from Indian CIS industry

Name of product	Name of company which introduced the product	Domain and popularity
Flexcube	i-Flex now taken over by Oracle	<ul style="list-style-type: none"> • Universal banking solution· • Preferred by more than 450 financial institutions in over 125 countries· • Ranked # 1 by IBS in the 2011 annual sales league table
Ranger	Subex Ltd	<ul style="list-style-type: none"> • Fraud management systems· • Product launched in 2000- has 7 per cent of the world market in tough competition against similar products by MNCs
July Meta Service System (JMSS)	July Systems	Universal messaging platform for mobile phones
Strawbera	Sasken Communication Technologies	<ul style="list-style-type: none"> • Suite of applications for mobile phones and Personal Digital Assistants
ebizframe	Eastern Software Systems	<ul style="list-style-type: none"> • Internet based ERP software· More than 800 customers in 20 different industries spread over 25 countries

Source: Compiled from Asian Technology Information Program (2004) and company websites.

A recent study by Lee, Park and Krishnan (2013) discusses the catching up of Indian CIS firms in great detail. The most distinguishing aspect of this study is that its unit of reference is specific CIS firms and not the industry as a whole. Their findings are: 1) the catching-up process by the Indian CIS firms can be classified as a three-stage model of “body shopping–offshoring–global delivery model,” comparable with the three steps in manufacturing, namely, original equipment manufacturing (OEM)–own design manufacturing (ODM)–own brand manufacturing (OBM); the window of opportunity for Indian CIS firms was primarily the techno-economic paradigm shift, and secondarily the regulation and support in the IT industry of the government; and 3) Indian CIS firms initially partially re-invented their own path with offshoring and created their own global delivery model, gradually moving to higher value-added services.

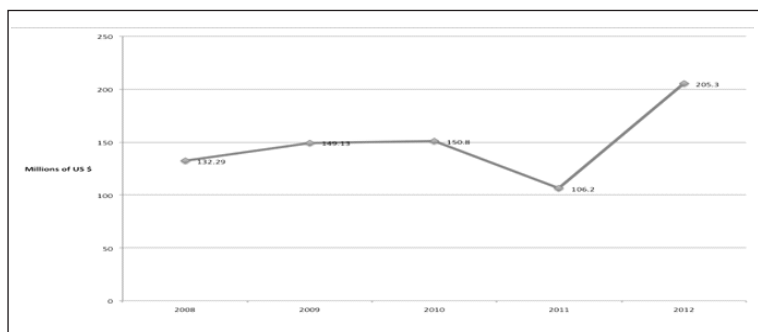


Figure 8: Exports of computer software products from India

Source: Reserve Bank of India (2009 through 2013).

According to Nasscom- AT Kearney (2012), innovations in the computer software industry can be broadly classified into three: (i) Product innovations: This involves new products for both the global and domestic markets, based on either new or existing technologies and for both B2B and B2C segments; (ii) Process innovation: New processes to improve efficiency and technology-enablement of existing processes. The main

priority is to improve the firm's or client's bottom-line, to be able to retain clients once secured; (iii) Business model innovation: This includes partnerships, target markets, pricing models, cost structures and delivery networks. Such innovations can have significant impact on the bottom-line or quality compared to incremental process innovations. There are several instances of these three types of innovations and a sample of these are presented in Table 8.

Table 8: Examples of the three types of innovations in the Indian IT industry

Type of innovation	Examples
Product	<ul style="list-style-type: none"> • Adobe India developing the latest version of PageMaker. • Texas Instrument's low-cost solar lanterns targeting a rural customer base
Process	<ul style="list-style-type: none"> • CSC's new process to facilitate knowledge transfer at end of each client engagement. • IBM's real time staff utilisation and productivity tackling platform
Business model	<ul style="list-style-type: none"> • Aditya Birla Minacs offering end-to-end packaged solutions in specific retails like retail • TCS and IBM using cloud computing to target small and medium enterprises. • Infosys's software assisted services model which lowers upfront investments. • Rural shores unique rural centre-based BPO delivery model with lower costs. • WIPRO's combination of offshore and onshore delivery centres.

Source: Nasscom- AT Kearney (2012), p. 55.

A more standard way of analysing the increasing technological capability of India's CIS industry is to analyse some of the innovation indicators such as patents. Since India's patent regime does not allow for software patents²⁵ we rely on the patenting of computer implemented inventions (software patents are known by this technical term)²⁶ by India based inventors at the USPTO. See Table 9. It is interesting to note that software patents from India now accounts for about a third of all patents from Indian inventors and much of it is accounted for by foreign companies operating from India through their own affiliates. Although the number of patents secured by Indian CIS firms have increased very much even during this short period, as a share it has been declining. Many foreign IT majors such as IBM, Texas instruments, Honeywell, Microsoft, Symantec, Microsoft, Cisco, Adobe, Oracle, SAP etc., does a fair amount of their IT related R&D in India. In fact, for some of them, patents secured from R&D done in India increasingly are an important contribution to their total world-wide patent portfolio.

Domestic CIS have been new to the issue of patenting and most of them have set up IPR divisions only in the post TRIPS period (ie., since 2005). Nevertheless, if one breaks the domestic software patents firm-wide, one of the leading performers, Infosys, now account for almost half of all domestic software patents. See Table 10.

25 According to section 3(k) of India's Patent Act 1970 (amended in 1999, 2002 and 2005), "a mathematical or business method or a computer programme per se or algorithms are not patentable in the country".

26 The definition of computer implemented invention that we employ here includes US Patent Classes 700-707, 709, 715-725.

Table 9: Trends in software patents granted to Indian inventors at the USPTO

	Domestic (Number)	Foreign CIS companies based in India (Number)	Total software patents (Number)	Total patents from India (Number)	Share of Domestic companies in total software patents (%)	Share of software patents in total patents from India (%)
2008	17	97	114	634	14.91	17.98
2009	21	129	150	679	14.00	22.09
2010	51	245	296	1098	17.23	26.96
2011	38	352	390	1234	9.74	31.60
2012	54	461	515	1691	10.49	30.46

Source: Compiled from the USPTO.

Table 10: Distribution of software patents granted to domestic computer software companies at the USPTO, 2008-2012 (Number of patents)

	Infosys	TCS	WIPRO	Ittiam Systems	Satyam	Sasken	Ramco	L&T	Total domestic
2008	0	4	2	3	2	6	0	0	17
2009	1	1	1	7	5	2	4	0	21
2010	12	4	6	16	4	4	4	1	51
2011	14	2	7	3	5	3	0	4	38
2012	29	4	8	3	6	2	2	0	54

Source: Compiled from USPTO, http://www.uspto.gov/web/offices/ac/ido/oeip/taf/stcag/inx_stcorg.htm (accessed on July 27, 2013).

Although there are about 26 different areas (or classes) where a patent for software can be secured at the USPTO, India based inventors are active in 15 of these. Among these 15, almost 60 per cent of the total number of software patents are in three different classes, namely, 707, 709 and 717²⁷. In all the three, India is one of the leading inventors and comes within the top 5 countries in each of these classes.

At this point, it is interesting to compare India's patenting record in software with that of Ireland's. See Figure 9. Ratio of Indian patenting to that of Ireland has increased from 3.8 to almost 7 during the period under consideration. Further, all the MNCs which operate from both countries such as IBM, HP, Microsoft has far more patents from India rather than their counterpart R&D in Ireland²⁸. Given the fact that in both countries much of the patenting is done by MNCs affiliates (almost entirely in Ireland), India has undoubtedly a better and increasing record. In others words, if a patented technology signify a high end technological activity, Indian IT industry, led by the MNCs, is moving towards increasingly more technologically sophisticated activities. Success will lie if domestic CIS firms are able to follow the lead given by MNCs in improving their technological capability.

Apart from these standard indicators, one may also consider the following non-conventional indicators to measure the leadership position of India²⁹.

-
- 27 707 refers to Database and File Management or Data Structures, 709 is in Multicomputer Data Transferring (Electrical Computers and Digital Processing Systems) and 717 refers to Software Development, Installation, and Management.
- 28 During the five year period, 2008 through 2012, IBM had 437 patents from research done in India, while it had 77 from Ireland. Similar figures for HP is 145 from India, while only 15 from Ireland. Microsoft had 113 from India and 12 from Ireland.
- 29 The source of this information is India Brand Equity Foundation (2013).

- India was once again rated as the most attractive location for global sourcing by the AT Kearney Global Services Location Index, 2011.
- The country is one of the most preferred locations for engineering offshoring according to a customer poll conducted by Booz and Co.

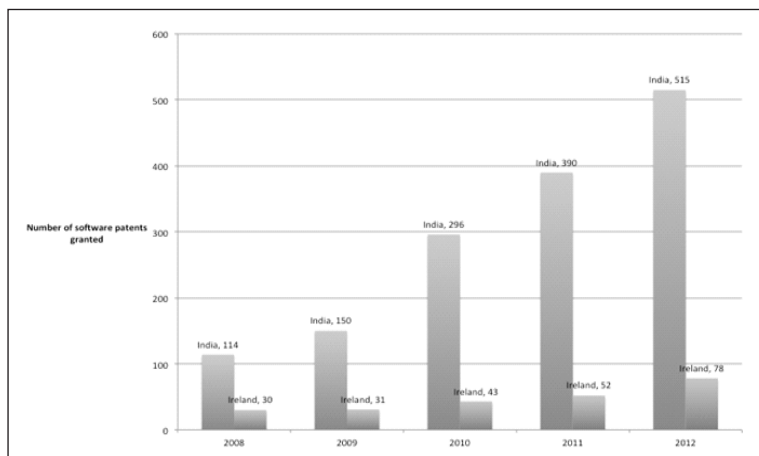


Figure 9: Comparison between India and Ireland in software patents at the USPTO

Source: Compiled from USPTO.

The emergence of the Bioinformatics industry

Another indicator of India's leadership position in CIS is its role in the emergence of a new industry, the bioinformatics industry (Mani, 2006). The industry is also clustered in Bangalore, where most of the IT majors are located. The products of the bioinformatics industry are very useful for drug discovery etc. The industry which has been growing extremely fast, propelled largely by exports until 2008-09 seem to have been adversely affected by the global financial crisis (Figure 10). Thereafter, the industry is more dependent on the domestic market for its growth.

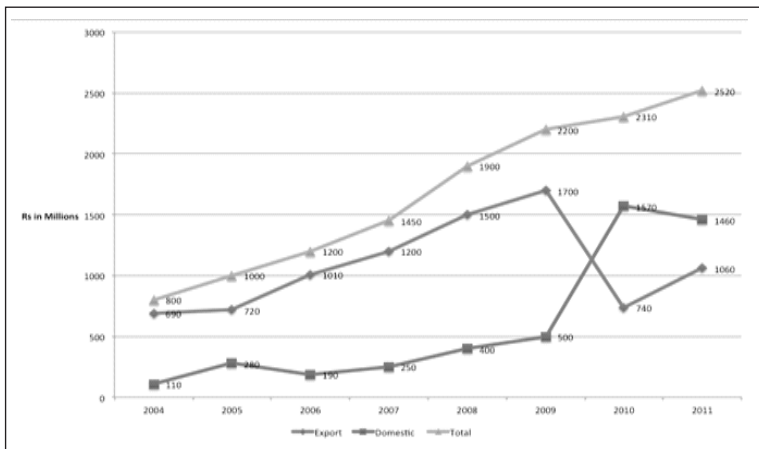


Figure 10: Growth of the Bioinformatics industry in India, 2004-2011

Source: Compiled from Annual Surveys conducted by Association of Biotech-Led Enterprises, http://ableindia.in_able_biospectrum_surveys.php (accessed on August 12, 2013).

New strategies for maintaining leadership

The domestic software companies have attempted to remain very competitive by adopting a variety of strategies:

- First, the leading companies have adopted a global delivery model. This could be gauged from the fact that as of 2011, the number of global delivery centres of Indian IT firms has reached 580 spread across 75 countries (2012-13). By setting up this global delivery centres they can quickly serve their customers and also overcome restrictive regulatory policy regimes which limits outsourcing of CIS to foreign locations.
- Second, the firms are consciously moving away from a few large size deals to multiple small size deals.

- Third, the firms are also enlarging their skill sets so that they can offer a full range of services (ranging from infrastructure services to consultancy and from low end application development to high-end integrated IT solutions) to their potential clients thus reducing the search and transaction costs of their customers. This is because management consultancy industry has been growing very rapidly over the last few years and especially since the global financial crisis of 2008 (Economist, 2013). Traditional management consultancy firms which were more focused on drawing out strategies for long term growth of their clients are these days also into offering a complete package including IT solutions. So potential customers can reduce their transaction costs of multiple consultancy contracts with just one. So CIS firms which also possess skill sets in traditional management consultancy area are likely to be more successful. Ireland has such CIS firms which also have strong consultancy capabilities (eg., Accenture). Major Indian domestic CIS firms are now in the process of toning up their consultancy capabilities.
- Fourth, easy scalability in the sense that firms can enter and exit from industry very fast and existing firms can increase their scale of operations quite fast.
- Fifth, Indian CIS firms have used cross border M&A as a way of enlarging the scope of their markets abroad, in dealing with protectionist tendencies especially in the USA, and in acquiring skill sets that they do not possess and which are difficult to be built up in the short run (Saxena and Sen, 2013). For instance, the 2008 acquisition of Axon by HCL Technologies have made the latter possess an increased technological capability: Axon's strong business consulting and implementation capabilities and HCL's robust global delivery-based application and infrastructure management capabilities have been combined.

- Finally, the firms are also using the newer technologies of cloud computing, social media and data analytics especially in Big Data³⁰ to their advantage. Also is the ability to tap into new business models such as Software as a Service (SaaS). Given the existence of extremely skilled manpower at their disposal, which at the beginning looked over qualified for the nature of low skilled operations in now proving to the advantage of the firms in moving up the value chain.

iv. Concluding remark

India has emerged as a leader in CIS in 2005 and she has been maintaining her leadership ever since that year. It is not immediately clear as to who was the first leader in CIS. Both United States and Germany and the United Kingdom are obvious candidates. However, since the mid 1990s, Ireland has emerged as a clear leader if leadership is measured in terms of exports of CIS. She maintained that position for very nearly ten years. Availability of high quality software engineers and a favourable incentive policy towards MNCs were two of the important factors, which lead to the country becoming a leader. So production of CIS was almost entirely in the hands of foreign companies. Once these favourable factors reversed and other locations like India become more attractive production moved to those locations. India, which had a copious supply of the key factor input, soon started assuming this leadership in 2005 onwards. A key difference between India and Ireland is the fact production of CIS in India is concentrated in domestically owned companies as against MNCs in the case of Ireland. Although it must be added that the share of MNCs in the production of

30 Big data refers to a collection of data sets or chunks of information too large and complex to be processed using traditional software tools. By applying big data solutions, enterprises are looking to sift through massive amounts of information about users, analyse usage patterns on a real-time basis, and prepare personalised campaigns that can potentially increase revenue per user. Apart from this, firms can make use of big data insights to cut costs and boost profit.

IT related services is clearly on the rise although quantitative estimates of it are hard to come by. The initial factors that were favourable to the growth of CIS are now slowly disappearing with the increase in the salary levels of software engineers. Therefore the only way for the country to maintain her leadership is to be very innovative and go up the value chain. Fortunately, one can see that the firms are beginning to take innovation seriously and are putting in place strategies to achieve it; low but increasing levels of software patenting by domestic companies is one such indicator. If this strategy of innovation based growth is carried forward, India is likely to maintain its leadership in CIS for a very long time to come.

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