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CHANGING SERVICE SECTOR INNOVATION SYSTEM OF INDIA

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Abstract: *Purpose* – The purpose of this study was to understand the changing service sector innovation system of India.
Design/methodology/approach – The study used secondary sources of data including reports, books and journals to gather information on what constitutes the National Innovation Systems (NIS) of a country. This paper has attempted to assess the performance of the service sector innovation system, which comprises investment, infrastructure, knowledge- and skill-generation, relations and linkages. The present paper made use of this conceptual framework broadly to make an assessment of the performance of the changing service sector innovation system in India. The study focused on three elements: Research and Development (R&D), Foreign Direct Investment (FDI) in services and the status of the higher education sector, in order to examine the performance of the NIS in India.
Findings and implications – The paper concludes that India has a well-functioning service sector innovation system, yet much needs to be done if India is to retain her ambition of becoming a knowledge powerhouse or an innovation superpower. Moreover, the private sector can play an important role in the improvement of the quality of education, as has been revealed by the example of The National Association of Software and Service Companies (NASSCOM).
Originality/value – While there is some research on the NIS of India, not much has been written about the service sector innovation system of India. This study attempts to fill this gap in the current literature to some extent.

Keywords: *Science, Technology, Innovation, Globalization, Internationalization of R&D, FDI, Service sector innovation system, National innovation system.*

Paper type Conceptual paper /General review

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INTRODUCTION

Science creates knowledge; technology is the application of that knowledge towards the welfare of mankind. Innovation is the complete process through which new ideas are created and implemented, particularly through the process of commercialization. The presence of innovation systems enables a country to harness the benefits of scientific and technological developments (Anand, 2008, CSSP). Freeman (1982) and Lundvall (1985) were pioneers of the modern version of the concept of National Innovation Systems (NIS). Freeman (1995) described NIS as "the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies". There are a number of studies on National Innovation Systems with a global perspective. However, studies relating to the Indian innovation system were quite scarce at the beginning of the decade (from 2000) but grew in number thereafter (Gupta and Dutta, 2005; Bound, 2007; CII, 2007; Dutz, 2007; Mitra, 2007; Mani, 2006, 2007; Arora, 2007; Nassif, 2007; Krishnan, n.d.).

Broadly, a national innovation system has the following four elements: (i) Investment (R&D Expenditure and Government R & D support, venture capital and Foreign Direct Investment [FDI]); (ii) Infrastructure (Science and Technology institutions, intellectual property rights [IPR]), Government Policy, ICT and Culture; (iii) Knowledge and skill generation (education and human resources development, and labour flexibility); (iv) Relations and linkages (university-industry linkages, public R&D and industry, globalization of multi-national corporations [MNC] R&D, Transnational networks) { Baskaran and Muchie, 2007). The present paper will make use of this conceptual framework broadly to make an assessment of the performance of the changing service sector innovation system in India. We will be focusing on three elements: R&D, FDI in services and the status of the higher education sector to examine the performance of the service sector innovation system in India. It is important to mention that R&D services and higher education are a part of other service components of the services sector in India. Therefore it will be interesting and relevant to find out how the growth of these sectors is bringing about changes in the service sector innovation system. Studies on the NIS of India have been carried out, but studies on the service sector innovation system in India are far fewer in number. The present study is an attempt to fill this gap.

SNAPSHOT OF THE CHANGING SCIENTIFIC AND TECHNOLOGICAL LANDSCAPE IN INDIA

After independence, India invested in science and technology (S&T) infrastructure and spent significantly on R&D expenditure**.** This has totally changed the scientific and technological landscape of India. At present, India has a vast network of S&T institutions and a critical mass of scientists, engineers and technical persons. India is home to dynamic hubs of innovation, such as Bangalore, Chennai, Delhi, Hyderabad, Mumbai and Pune (Desai, 2011).

In 2006, there were 3960 R&D institutes in India, the maximum number of which were located in Maharashtra. The national expenditure on R&D increased from Rs.18088.16 crores in 2002–03 to Rs. 28776.65 crores in 2005–06. R&D expenditure as a percentage of GNP stood at 0.89 per cent. India's per capita R&D expenditure increased from Rs. 169.38 in 2002–03 to Rs. 260.20 in 2005–06.

A large proportion of R&D (76 per cent) in India was performed by the central and state governments, including the public sector industrial sector. The private sector accounted for 20 per cent and four per cent was accounted for by the higher education sector (Department of Science and Technology, 2007). However, this trend is in sharp contrast with the developed countries, where an overwhelming portion of R&D is performed by private enterprise and the universities have strong linkages with the corporate world.

Internationalization of R&D also took place at a faster rate after the introduction of the economic reforms of 1991. Transformation is now taking place from global production networks to global innovation networks. Companies are off-shoring, outsourcing and subcontracting various R&D activities to other regions (in addition to their home country) in order to gain access to a broader knowledge base, S&T resources and markets. Generally, three modes are used by MNCs to expand their domain of R&D: joint venture, greenfield, mergers and acquisitions. In the case of India, R&D investment is flowing in various sectors, such as IT, drugs and pharmaceuticals, biotechnology and automotive. Approximately 100 foreign organizations (mainly MNCs) and 16 countries established their R&D centres in India over the last decade (TIFAC, 2005). The US is leading in terms of numbers of these

centres and employment in them. Bangalore is the favourite hub of global MNCs[2].

India's innovative performance improved from 3.65 to 3.93 during the period 1995–2007. A small but positive change of +0.28 was observed despite the fact that India's R&D expenditure during 1990–2007 has hovered around only 0.8 per cent of its GDP. Another noticeable point is that there is an increasing trend in the number of patents granted to companies by the Indian Patent Office, indicating greater awareness of the importance of knowledge[3] (Ministry of Commerce and Industry, 2008). In 2009, 5314 residents of India and 23,626 non-residents filed patent applications (World Bank, 2011, p.315).

Having examined the changes in India's scientific and technological landscape, let us try to find out the extent of FDI inflows in India, as these are considered to be important contributors to the efficiency of NSI.

B GROWING FDI IN SERVICES

"As part of overall investment in the economy and as the mechanism that facilitates the flow of technology, FDI can contribute significantly towards the efficient performance of an NSI. A steady and growing market size, abundant availability of natural resources for manufacturing, cost attractiveness, reliable business community, high levels of intellectual manpower, engineering expertise and a reform process that has brought about economic liberalization appear to have made India an attractive destination for foreign investment" (Baskharan and Muchie, 2007, p. 15). India has been trying to tap the growing stock of global knowledge through channels such as FDI. FDI has become an important source of private foreign capital and plays an important role in economic transformation and accelerating economic growth. In addition, it is a means for the transfer of production technology, innovative capacity and organizational and managerial practices between locations.

[2]file:///C:/Documents%20and%20Settings/Home/Desktop/Higher%20eductaion/NIS-India/FDI%20in%20R&D%20in%20India.htm, FDI in R&D in India, A.K. Bharadwaj and Rammi (2008) Kapoor, India: Science and Technology, 2008. http://www.nistads.res.in/indiasnt2008/t4industry/t4ind5.htmwebsite :

[3]Desai (2009).

The FDI inflows into India increased from US $ 4029 in FY 2000–2001 to US $ 27,024 FY 2010–11. The cumulative total for FDI for the above refereed period was $ 197,935 from April 2000 to April 2011[4]. The services sector (financial and non-financial) attracted highest equity inflows followed by computer software and hardware and telecom (radio paging, cellular mobile, basic cell phone services).

Studies (Joshi, 2010) point out a perceptible increase in foreign investment in the tertiary sector after 1991. FDI, varying between 26 and 100 per cent, has been permitted in various sub-sectors of the services sectors. FDI Markets recorded a total of 3188 investment projects in the services sector from 1633 companies between January 2003 and May 2011. The average number of jobs created per project was 274. The leading sector was software and IT services, which accounted for 36 per cent of projects. The leading business activity was sales, marketing and support, which accounted for 20 per cent of projects. The top ten companies accounted for eight per cent of all investment projects, with IBM (United States), Deutsche Post (Germany) and General Electric (GE) (United States) among the top ten companies. The top three source markets for outward investment were the US, the UK and Germany, providing 48 per cent, 12 per cent and 5 per cent of investment projects respectively (FDI Intelligence, 2011).

The top three destination cities for inward investment were Bangalore, Mumbai and Chennai, providing 19 per cent, 12 per cent and 9 per cent of investment projects respectively. Between 2003 and 2011, FDI Markets recorded a total of 3188 investment projects in the selected services sector, as shown in Table 1. Software and IT services accounted for the highest number of projects, with a total of 1158, representing 36 per cent of the investment projects. The average project size was 274 jobs per project. The total number of jobs created during 2003–2011 stood at 870,165.

It is important to emphasize that the formation of human capital is vital for the continued growth of FDI inflows, for building up a human base for R&D and also in order to maintain a well-functioning and efficient NIS. Herein comes the role of education. The next section therefore focuses on the role of the higher education system in India in the NIS, regarding its size and the challenges it faces.

[4]http://dipp.nic.in/fdi_statistics/india_FDI_April2011.pdf

Year	No of Projects	Percentage Growth
2003	263	
2004	419	59.3%
2005	343	-18.1%
2006	538	56.9%
2007	363	-32.5%
2008	498	37.2%
2009	367	-26.3%
2010	308	-16.1%
2011	89	n/a
Total	3,188	
Average	354	

Source: FDI Intelligence from Financial Times Ltd.
Note: Service sector here comprises software & IT services, business services, financial services, communications, transportation, real estate, hotels and tourism, leisure and entertainment, warehousing and storage and other sectors. Although electronic components are a part of the manufacturing sector, they have been included in the service sector.

Table 1. Investment projects in selected services sector

THE ROLE OF UNIVERSITIES

It is evident from the foregoing that knowledge and skill generation and also university-industry linkages are an important part of NIS. "The role of education in facilitating social and economic progress is well recognized" **(**Government of India**,** 2008, p.1). This current era of globalization has offered immense opportunities. However, people must have the necessary knowledge, skills, capacities and capabilities to seize those opportunities (Joshi, 2004). Herein lies the role of education, and especially higher education in building up and improving human capital. In India, elementary education has received a major push through Sarva Shiksha Abhiyan during the Tenth Five Year Plan (2002–07). However, higher education remained neglected until the Eleventh Five Year Plan (2007–12)[5]. In 2004–2005 as per revised estimates, just 3.68 per cent of GDP was spent on education and 0.66 per cent of GDP on higher education (Kapur and Mehta, 2007, p.50). It is important to note that knowledge is critical for promoting economic growth. The growth potential of any knowledge economy will depend on its capacity to

[5]See Joshi (2012).

produce knowledge. The universities of the twenty-first century have to become producers of knowledge. The university system is an integrated element in a broader national innovation system, as universities are the suppliers of higher education and research in innovation systems in developing countries (Brundenius, *et al.*, 2009). How rightly it has been observed by Beteille that, "An institution will scarcely deserve to be called a university if it undertakes only teaching and no research, or only research and no teaching" (Beteille 2010, p.193). Universities are important institutions in the knowledge society. They can serve industry through direct flows of information from ongoing research. Moreover, university-industry relationships can promote innovation (Brundenius *et al*, 2009). Therefore, there is a need to lay greater emphasis on research and development in higher education.

The economic growth of India in recent years is driven primarily by the services sector and within the services sector by information technology (IT) and information technology enabled services (ITES). Therefore, to keep India's ambition of becoming a knowledge powerhouse alive, the sustainable development of higher education is not an option; it is imperative. Without the expansion of the higher education system and improvement in its quality, India will not be able to sustain overall growth (Joshi, 2012).

A. EXPANSION OF THE HIGHER EDUCATION SYSTEM

At the time of independence, India had 20 universities and approximately 500 colleges, and total enrollment was 0.2 million. By December 2011, there were 43 central universities, 129 deemed universities, 297 state universities, 65 institutes of national importance and other university-level institutions, 100 private universities and 33,023 colleges. Not only has the number of institutions in India expanded, but tertiary student's enrollments have also increased. Student enrolment by stages in higher education was highest at graduation level (86 per cent of the total) followed by post-graduation level (12 per cent of the total). Research and diploma/certificate courses accounted for just 1-1 per cent share in total student's enrolment by stages in higher education.[6]

Overall enrollment in India has increased during the period 1950–51 from 43000 to 16,975,000 by 2010–11 (provisional estimates), an increase

[6]http://www.ugc.ac.in/pub/HEglance2012.pdf last accessed May 22, 2012.

of 393.767 per cent, yet the gross enrollment ratio of India compares poorly with that of developed countries such as the US and the UK. Even Brazil, the Philippines and Malaysia had a higher gross enrollment ratio (GER) compared to India. The tertiary enrollments are highest in the arts, followed by science and commerce or management. Enrollment in science disciplines was just 18.42 per cent, which is a cause for concern.

It is important to note that in spite of India's mammoth higher education system, demand for higher education outstrips its supply. The Indian higher education system is grappling with several problems including accessibility, affordability, the uneven distribution of private institutes, participation and low R&D output.

The decade 2010–20 has been declared the Decade of Innovation. Hopes have been expressed that India will become an innovation superpower by 2030. However, Krishnan points out that there is "… a lack of dynamism of the government R&D system, poor research output of higher education system, absence of a vibrant high-technology sector, limited scope and impact of government support programmes for R&D, a science-technology divide, and inadequate spillover of foreign direct investment in R&D".

There is a need to reform the higher education sector if India wants to become the knowledge powerhouse of the world. Education, training and ICT are three pillars of the knowledge economy. In fact, the government is aiming at strengthening these three pillars as is evident from the Eleventh Five Year Plan documents (Vol. I and Vol. II), which emphasise the need for massive expansion of the university system and also the creation of competitive world-class institutions of higher education. There is a need for a regulatory and accreditation mechanism to ensure the quality of the higher education system. In addition, there is a need for public-private initiatives and strengthening of university-industry linkages to counter the growing demand of tertiary education and the subsequent lack of resources. The next section deals with the role of private initiatives in India's higher education sector.

THE ROLE OF PRIVATE INITIATIVES IN HIGHER EDUCATION IN INDIA

According to NSS data, the government's share in overall education expenditure has been declining steadily, from 80 per cent in 1983 to 67 per cent in 1999. For states like Kerala, the decline is steep, from

75 to 48 per cent, while for Madhya Pradesh it is from 84 to 68 per cent. Indeed, while private expenditure on education rose 10.8 times between 1988 and 2004, it rose even faster for the poor, increasing by 12.4 times. Many students who formally enroll in publicly funded colleges and universities barely attend classes there. Instead, they pay considerable sums to the burgeoning private sector vocational IT training firms such as NIIT and the Aptech, or to new professions such as the "Aviation University" that are being set up by the UB group.

Privatisation of higher education is a highly debatable issue. There are people like Professor Yash Pal, who take a cynical view of privatization. However, economists such as Kausik Basu feel that privatization is a reality. Basu says, "Those that are interested in profit would not be interested in good education is a fallacy. We should allow private investment in education, and if it becomes a success, it will attract infusion of funds into our higher education system".

Biswanath Pattanayak, the founder-Director of the Asian School of Business Management, Bhubneswar, notes, "Most of the US centers of excellence are private initiatives, be it Wharton or Harvard (EDU TECH, 2009)".

It is important to note that even the Eleventh Five Year Plan document recognizes the role played by the private mechanism in setting up of some first rate institutions, including the Indian Institute of Science, Bangalore, the Tata Institute of Fundamental Research, Mumbai, the Xavier Labour Relations Institute, Jamshedpur, the Tata Institute of Social Sciences, the International Institute of Information Technology, Hyderabad, Vidyanagari in Baramati.

It seems obvious that with the increase in per capita income, the growing middle-income class of India is willing to pay to educate its children and the private institutes can help to fill this gap provided proper standards are maintained (Kaul, 2006).

There is an IT boom in India. The IT ITES industry in India accounted for a 5.2 per cent share of GDP in the FY 2007, earned $40 billion through exports and absorbed 2.0 million by the end of FY2008. A study done by The National Association of Software and Service Companies (NASSCOM) (Deloitte, 2008) revealed that the supply of IT professionals outstripped their demand until 2004, but there is

now a shortfall of 62,697. The demand for IT professional is expected to increase to 430,000 by 2011–12. Since the public higher education system is not able to supply the requisite number of trained people required for the industry and their curriculum has been unable to keep pace with the changing trends in technology, the top five companies, including Infosys, Wipro[7], TCS, HCL technologies and Satyam came forward and invested close to $430 million in 2007–08 to train around 1,00,000 engineers hired during this period. On average, companies conduct 163 training programmes annually and spend 80 per cent of the budget on training entry level hires.

NASSCOM has undertaken various initiatives targeting three levels of talent requirement.

The example of initiatives taken by NASSCOM (as shown in Table 2) point out how the private sector can help in improving the quality of engineering education in the following ways:

1. "Developing a de facto certification exam to test the competence of graduates
2. Working directly with the universities to reform and update the curriculum

For the entry level employees	NASSCOM Assessment of Competence launched in 2006
	Working with universities and colleges to align their curriculum with the needs of the ITES –BPO sector
For the middle level employees	NAC-Tech Test
	Finishing School for Engineering Students Programme
	IT workforce Development programme aiming at improving the interaction between industry and academia
For the top level	Working with MHRD to develop highly specialized professionals in "on the horizon" technologies that are not yet mainstream
	Collaboration on the establishment of five new IIITs based on PPP model by the end of 2008

Table 2. Initiatives undertaken by NASSCOM

[7]Wipro's trust Mission 10 xs has teamed up with the National Association of Software and Services Companies (Nasscom) to enhance skills of engineering graduates in IT and related sectors.

3. Training faculty in new technologies and pedagogies
4. Putting new entrants through a rigorous boot camp to improve standards." (Dahlman, 2010).

The demand from the market is growing for IT professionals and the system is under stress to provide an adequate number of skilled professionals who are equipped with the required knowledge and technical skills to fill this demand-supply gap. Recognising this urgent need, the Eleventh Plan envisages setting up 30 CUs, eight new IITs, new IIMs, ten new NITs, three IISERs, 20 IIIITs and two new SPAs. With the past wonderful experience with private institutes in India and the resource crunch facing the higher education sector, the government is likely to explore the scope for public-private partnership (PPPs) in the establishment of the new institutes to cash in on India's advantage in technology and knowledge. But here is a note of caution from Beteille (2010), who said that "the challenge before them [universities] today is to become socially more inclusive without relaxing standards of teaching and research".

CONCLUSIONS

In the decades of the 1950s and 1960s, the supremacy of the United States in science and technology and innovation is well known. With increasing globalization, many new players have come to the forefront, including India. India is making its presence felt by undergoing a transition from an imitator to an innovator. The scientific and technological landscape in India stands changed with the internationalization of R&D and services. India has a large number of R&D institutes and a large pool of scientists, engineers and R&D manpower. FDI is growing and the size and scale of higher education has also expanded over a period of time. The spectacular dynamism shown by the Indian economy in the decade of the 1990s has raised visions of India becoming a knowledge and innovation superpower. It is with this background that this paper has made an attempt to assess the performance of India's innovation system which comprises investment, infrastructure, knowledge and skill generation and relations and linkages. The paper concludes that India has a well-functioning NIS, yet much needs to be done if the country wishes to fulfil her ambition of becoming a knowledge powerhouse. The sustainable development of scientific and technological institutions with higher education is not an option; it is imperative.

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