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Abstract

The Information Technology (IT) industry has played a major role in India's recent economic growth. However, the pattern of growth and cluster formation is not uniform across the country. While Bangalore emerged as a natural cluster, the governments in Hyderabad and Kolkata had to demonstrate entrepreneurial leadership qualities to create clusters there. This paper identifies the factors that contribute to the creation of clusters, particularly for locations that are late entrants such as Hyderabad and Kolkata. The paper concludes that quality of entrepreneurship of the state and pool of local entrepreneurship are equally important as industry attractiveness and factor availability for rapid cluster formation.

Key Words: Asia, India, Industrial Clusters, Government, Entrepreneurship, and Policy Implementation

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Introduction

Developing countries, eager to catch up on industrialization, have identified industries based on Information Technology (IT) as a major tool. It is in this context that the recent interest in industrial clusters as a means to accelerate regional development particularly after the boom in the IT industry in the Silicon Valley, has to be viewed (Sturgeon, 2003). At the same time, efforts by several states and countries to recreate Silicon Valleys have had mixed results. Why does it happen so? Are clusters human made? Is their growth a natural phenomenon or can it be catalysed? If so, how and how much? Knowledge drawn from manufacturing industries or other service industries provides only partial answers. This is true in the Indian context as well. Unfortunately, though many scholars have tried to explain why India could emerge as an IT super power, little has been said on how and why successful IT clusters have been formed in some cities such as Bangalore and what needs to be done to sustain and replicate the success. This paper attempts to provide some initial explanation to this complex process.

The paper, based both on primary and secondary data, discusses a theoretical model on cluster formation based on case studies of three cities in India; one already established (Bangalore), another in the early growth stage (Hyderabad) and third an established industrial and commercial city trying to revive its fortunes through IT (Kolkata). Our enquiries through these case studies bring out four sets of factors as key to the formation of IT clusters. While the role of industry attractiveness and factor conditions are well known, the role of a pool of local entrepreneurship is less discussed. We find that the extent to which the state plays the role of an entrepreneur in attracting and encouraging entrepreneurship is equally important, which is particularly elaborated in this paper.

Indian IT industry

Historically, technological revolutions have often played a strategic role in creating unexpected opportunities for countries. India, a relative laggard among developing countries in terms of economic growth, seems to have found such an opportunity in the information technology (IT) revolution as an increasingly favored location for customized software development. Unlike most developing nations India is demonstrating a high degree of competitiveness in knowledge intensive software development and IT enabled services. The Indian IT industry[1] has been experiencing rapid growth since the early 90s and has become a major player in the Indian economy. The World has also recognized the potential of Indian IT firms, which have become suppliers to a large number of the Fortune 500 firms. The software industry in India grossed annual revenue of Rs. 708 billion (US$ 15.6 billion) during 2003-04, up from Rs. 382 billion (US$ 8.4 billion) in 2000-01, registering an average growth of about 30% in

rupee terms. More than 8,000 firms, located in cities like Bangalore, Chennai, Hyderabad, Kolkata, New Delhi and Pune have been providing a range of software services, mostly targeted at foreign customers. The software exports from India grew from Rs. 283 billion (US$ 6.2 billion) in 2000-01 to Rs. 555 billion (US$ 12.2 billion) during 2003-04, registering an average growth of more than 30% in dollar terms.

Naturally, the Indian IT industry has generated a lot of interest among scholars and much has been written about the same in the past few years, especially after the industry's dazzling growth. However, very little research exist to explain why a large number of Indian IT firms located in a few city clusters have emerged globally competitive in the large spectrum of IT products and services. Existing literature, of course, recognizes the role and importance of IT clusters in shaping the evolution of the industry.

Industrial Clusters and Indian IT industry

The growth of the Indian IT industry has seen clear phases, with both Indian entrepreneurial firms and MNCs contributing significantly to developing the industry. The initial deregulation of the hardware industry encouraged many hardware firms to emerge in India. Later, majority of these hardware firms diversified into software business. The IT industry has responded to the various markets that have grown in different time spans and tried catering to those – in-house, software services, software exports and software products. The software capabilities were initially developed through import substitution and with a full-fledged orientation to the domestic IT market. However, gradually software exports started and became the buzzword of the industry in the 90s.

While the software industry has been growing rapidly in recent years, centers of excellence have already emerged in India, and the geographical spread of the industry in India has changed considerably in the last one decade. The share of Southern India in software exports increased from 25% in 1991-92 to more than 40% in 2003-2004. Though Chennai had emerged as a software centre early on, it was soon overtaken by Bangalore with Hyderabad, Pune and more recently Kolkata gaining ground to catch up. The Bangalore cluster is the largest in terms of sales and exports. It also houses the most sophisticated firms. Compared to Bangalore's software exports of Rs.146 billion in 2004, Hyderabad's and Kolkata's exports amounted to be Rs.56 billion and Rs. 22 billion respectively . However the number of firms in both Bangalore and Hyderabad were about the same (Business Standard, 2003). To promote rapid growth of IT industry, central as well as and many state governments have created software technology parks in which the necessary infrastructure is readily available. Notable examples include Bangalore's Electronic City and Hyderabad's HITEC City, which offer not only office space and communications links, but several social amenities, as well. The software parks located in these cities have also played an important role in allowing firms to develop clusters.

The dynamism and economic success of numerous clusters operating in countries such as Italy, Germany, and Japan in diverse industries such as automobile, leather, textile, jewelry and optical frames has been well documented. In spite of some inter-firm variability, the firms in a cluster show striking similarities in the way they are structured, behave and perform as they are more or less governed by the same policy, institutional, competitive, technology, and socio-

economic environment (Porter, 1990). The constellation of these forces together creates an environment that becomes the source of constraints, contingencies, problems and opportunities that affect the terms on which a firm transacts business and derives and sustains competitiveness. It is, however, obvious that mere concentration of IT enterprises is no guarantee of successful cluster formation, since advantages associated with clustering do not always emerge automatically and spontaneously. In India agglomeration of firms is quite a widespread phenomenon. In many a city significant number of small and medium sized enterprises often operate close to one another and produce similar goods. Ironically, although working and living in close proximity, cooperation, sharing of information and joint activities among these firms are limited to specific value links. Therefore, it is important to understand why successful IT clusters have been formed in some cities such as Bangalore and what needs to be done to sustain and replicate the success. Many scholars have tried to explain why India could emerge as an IT super power, largely on grounds of demand conditions and factor supply arguments. That leaves a fundamental question: how these IT clusters emerge and what role the entrepreneurial leadership of government can play in IT cluster formation in a country like India?

In this paper, we discuss how IT clusters have been formed in select Indian cities. We have also highlighted the significant contribution state level governments make in shaping the formation of IT clusters by presenting the case studies of three capital cities of three major states in India namely Karnataka, Andhra Pradesh and West Bengal. Karnataka houses Bangalore, which has emerged as the 'Silicon Valley' of India. Hyderabad in the neighboring Andhra Pradesh is fast catching up, and is rated as the next 'Silicon Valley' (Zwingle, National Geographic, 2002). Kolkata (erstwhile Calcutta), the British Capital of Indian subcontinent, which was once the most industrially and commercially developed city in India, has been trying to revive its fortune by aggressively attracting investment in IT and ITES industry.

Formation of IT Cluster in Bangalore

Bangalore, the Silicon Valley of Asia, houses the most prominent cluster in India. From a mere 13 software firms in 1991-92, the city now has a pool of over 1,200 software firms working in areas such as computer chip design, systems software and communication software, employing over 100,000 IT professionals. Compared to other locations in India, Bangalore has high-end technology/industry concentration such as VLSI and telecom services and higher degree of MNC presence with over 200 foreign firms in operation. It is ranked fourth as a global hub of technological innovation, behind San Francisco and Austin of US, and the Taiwanese capital Taipei. But why and how did Bangalore emerge as the leading hub of Indian IT industry?

Early Factor Advantage

There are several factors – historical, geographical, economic, cultural, and political factors that have contributed to the emergence of Bangalore as the dominant cluster in India. Bangalore has been fortunate to be rich in the supply of both economic and non-economic factors that make a place a preferred choice of business location (Ramachandran, 1986).

Among the advanced factors, highly skilled labor plays a very important role in the development of any industry (Hanna, 1994; Porter, 1990). As software makes intensive use of

human capital, availability of highly skilled technical and managerial manpower becomes the key location factor. Bangalore has a large, highly skilled IT talent pool available at a relatively low cost, which it owes to historical development of the city's educational, research and industrial infrastructure. There has been early localization of science and technology related research and training institutions, as Bangalore has been considered an ideal place in terms of climate and infrastructure to conduct scientific research in sensitive areas like defence and electronics. The seed was sown with the establishment of the elite Indian Institute of Science, a number of the largest and most prestigious public sector enterprises in fields such as electronics, aeronautics, earth moving equipment and machine tools, and research organizations such as Indian Space Research Organization and Defence Research and Development Organization. Going a step behind, these got established partly for climatic reasons and partly for technical and economic reasons. These enterprises created a good pool of technical manpower in Bangalore, an important condition to develop IT industry anywhere.

A large and sophisticated network of educational institutions supplies the human capital required by the software industry. Karnataka has one of the strongest educational infrastructures with thousands of schools and colleges adding to the talent pool every year. Of the 66 engineering colleges, 26 are located in and around Bangalore. The Indian Institute of Information Technology, the Indian Institute of Science, a network of engineering schools, and the Indian Institute of Management contribute to the knowledge pool through their graduates and research activities. Many of the graduates who migrated to the United States for higher education and jobs form part of the social network that nurtures the local software industry. Investments made by government and other public institutions for specialized infrastructure such as technological and management institutions, and educational programs and investments by companies - in training programs, infrastructure, centers of excellence, testing laboratories, and so on – have contributed to the development.

Bangalore has been identified as an ideal place to live with abundance of rich social infrastructure. This includes moderate climate, housing, parks and educational facilities. Over a period of time, the social infrastructure got strengthened further with all modern day attractions around.

Multinational Firms Driving Growth of Local Entrepreneurship

Since Texas Instruments located their 100% export oriented unit in Bangalore in 1984, many more blue chip multinationals like Digital Equipment, Hewlett Packard, and IBM have followed suit leading to a cumulative investment of US $ 1.3 billion by 2001. Bangalore continues to remain the most favored location for a number of multinationals. During 2001-2002 Bangalore attracted about 40 percent of the 112 FDI ventures established in India. Further, the emergence of entrepreneurial and managerial *Brahmins* who are better suited to the knowledge intensive industries like that of software and IT enabled services is an important socio-cultural and ethnic factor explaining the formation of this industry in India and particularly in Bangalore (Taeube, 2002). Over the years, Bangalore has become one of the most important locations for most Indian IT majors both home grown firms like Infosys, Wipro, and Microland and others like TCS and Satyam, who came later. While the promoters of Infosys hails from Karnataka, that of Wipro

obtained technology for computer manufacturing from the Indian Institute of Science in Bangalore and decided to make it its home.

Attractive Industry: Tapping the Export Market

The success of most Indian software firms comes from serving foreign customers, especially in the U.S. (Kapur and Ramamurti, 2001). Given the small size of the domestic market, Indian firms had to be export oriented and were dependent on the growth of the export market (Chakraborty and Dutta, 2002). Since the 1970s, outsourcing of software development activity by firms in developed economies became a trend due to the huge increase in software costs, increasing demand for complex information systems applications, the rapid obsolescence rates of the information technology infrastructure and the inadequate supply of IT personnel. As a result, today IT work is distributed globally on the basis of cost, location of customer sites, and expertise, largely independent of the IT Company's country of origin (Salzman, 2000). As a result, many large and medium-sized US firms focused their attention on more valuable and creative projects (Arora et al., 2000). Differences in time zones allow work to be carried on by Indian teams on a 24-hour basis, shortening cycle times and improving productivity and service quality. The social network connecting people of Indian origin in the U.S. often working in Silicon Valley, with engineers and managers in India has also played an important role in exploiting this advantage (Kapur and Ramamurti, 2001). Being members of a vibrant cluster Bangalore based firms could tap on the network and capitalize on the US demand more than others.

This is clearly visible from the fact that Bangalore remained the most favored destination for both Indians setting up ventures based in India or working for the Indian subsidiaries of foreign multinationals (Heeks, 1999; Taeube, 2002). 71 of the 75 multinationals located in Bangalore had executives of Indian origin returning from abroad as heads in 2000 (Ghemwat, 2000). Overseas Indians, who returned to start new companies or supply venture capital, have fuelled new venture formation. Besides, overseas companies opened software centers in India to strengthen interaction between their organizations and Indian suppliers. By 2001, several MNCs had R&D subsidiaries too, in Bangalore.

Benefiting from Cluster Advantage

The basic principles of clustering that gets involved applies to IT too, the major differences being the virtual nature of the activity. In terms of spatial concentration, traditional manufacturing firms and knowledge based firms follow same pattern. Success of a cluster depends on the attractiveness of the specific location for firms in the related industries and the eco system that gets evolved. A cluster of independent and informally linked software firms and institutions located in the same city has definitely allowed firms to exploit advantages in efficiency, effectiveness, and flexibility (Porter 1998 and 2000, Nicholas, Purcell and Gray, 2001) This is fine with Bangalore that has witnessed close relationship between local industry and major research universities / institutions of the area, reasonably active venture capital industry, some degree of interfirm cooperation, tolerance for spin offs, and nurturing of the firms largely outside the purview of the large, ponderous, bureaucratic firms and financial institutions.

The process of synergy building is steady and its speed depends on the growth of the industry and benefits individual firms can derive from the cluster.

The cluster based in Bangalore has affected the development of software firms in three broad ways as argued by Porter (1998). First, by increasing the productivity of companies based in the area; second, by driving the direction and pace of innovation, which underpins future productivity growth; and third, by stimulating the formation of new businesses, which expands and strengthens the cluster itself. Companies have been able to operate more productively in sourcing hardware and software, accessing information, technology, and local institutions, coordinating with related companies, and measuring and motivating improvement. Software firms have been able to tap into an existing pool of specialized and experienced employees, thereby lowering their search and transaction costs in recruiting. It has been easier to attract talented people from other locations because the cluster of firms signal opportunity and reduces the risk of relocation for employees. However, there is not enough evidence available to suggest that formal inter-firm kiretsu type linkages (Tyrini, 1994) exist among IT firms in Bangalore, whereby they gain from disintegration of value chain and use of efficient networks of market transactions (Scott, 1988 and Storper, 1997).

Naturally, there has been an accumulation of extensive market, technical, and competitive information within the cluster, and the local firms have preferred access to it. In addition, personal and professional relationships, old boys' networks built in technical colleges / universities and community ties have fostered trust and facilitated the flow of information. The cluster has also developed an unmatched reputation of Bangalore as an industrial location, which in turn has been benefiting the firms located in the city to deal with the global buyers and suppliers. Beyond reputation, the city-based firms have often been profiting from a variety of joint marketing mechanisms, such as company referrals, trade fairs, trade magazines, and marketing delegations.

Bangalore as a cluster of high quality IT companies has made it easy for overseas companies to meet many potential vendors in a single trip; That allowed them to multi-source or switch vendors, if the need arose. This also led to high degree of local rivalry, which was very motivating. Peer pressure amplified competitive pressure among other Bangalore based firms, even among non-competing or indirectly competing companies. Pride and the desire to look good in the local community had spurred professionals to attempt to outdo one another. The state government that promoted IT in a big way during the latter half of nineties also fuelled rivalry. As a result, there has been a rapid increase in the number of IT companies in Bangalore, thereby intensifying rivalry.

The diffusion of technology, facilitated by the entry of multinational firms from the US has been helping firms move up the value curve. At the same time, Indian software firms like Infosys and Wipro opened offices in the U.S., or acquired U.S. companies, to better serve their clients on high-end projects and to have listening posts in Silicon Valley. Thus, physical distance was bridged by the strengthening of cross-national, intra-firm networks and by inter-firm social networks among Indians and overseas Indians.

Clustering in Bangalore has played a vital role in innovation and value upgradation in the same manner as envisaged by Porter (1998). Because most sophisticated buyers in the world were part of this cluster, local firms usually had a better window of the market than isolated competitors do. Small and mid size companies continued to get opportunities to grow as the bigger companies moved into larger projects vacating space for the smaller ones. Being located in the same place and being part of the network, these players got the first crack at the outsourcing orders vacated by the big ones. The ongoing relationships with other entities within the cluster have also helped companies learn early about evolving technology, hardware and software availability, service and marketing concepts, and so on. Such learning was facilitated by the ease of making site visits and frequent face-to-face contact. Besides, serial entrepreneurs tend to choose their familiar and comfortable location for their subsequent ventures too, as was found in Cambridge by Vyakarnam and Myint (2005).

Cluster formation in Bangalore has greatly facilitated new business formation too by start up entrepreneurs. The environment in Bangalore has provided the context for local IT firms to take birth, be nurtured during their infancy, organize resources, acquire capabilities, and compete in the foreign markets. Professionals working within the cluster have been able to identify gaps in products or services around which they can build new businesses. For them the barriers to entry are lower in the business, and the skills, technology, and staff needed are often readily available from within the cluster itself. Local financial institutions and investors, already familiar with the cluster, have fixed a lower risk premium on capital. In addition, entrepreneurs have been benefiting from established relationships.

The case of Mind Tree Consulting is interesting; it is a high value adding software-consulting firm promoted by ten IT professionals with top management experience in global firms such as Wipro Technologies. The founders brought not only experience and expertise in IT and management, developed over a long period of time, but also their rich contact network into the business. The high level of quality of the start up team helped the company in several ways. Team members' experience and contact network helped it build a strong brand from the beginning. Their take off was smooth and quick, with outside resources pooled largely from the Bangalore cluster itself. (Ramachandran and Ray 2002).

Local Government – Indifference to Intermittent Active Facilitation

The role of the state and the local governments, albeit small, was also important in developing the industry. The 1971 policy of the government attracted substantial investments to locations around Bangalore. In 1997, Karnataka became the first state to come out with a specific policy for the promotion of IT, which included a number of tax concessions and other benefits to IT investors.

In recent years, like most fast movers, Bangalore started facing the pinch on two counts. On one hand, the rapid growth of population rising on the wave of IT success impaired the livability of Bangalore with dramatically escalated real-estate prices, congestion, poor road conditions and other overloads on the local infrastructure. On the other hand, many other state governments have started aggressively promoting IT and providing better infrastructure and policy support to attract

investments. This has been providing alternative locational choices for software firms looking for new investment opportunities in India.

In the absence of government initiatives, the leading software firms had started early on to invest heavily to overcome the bottlenecks in physical infrastructure. For example, Infosys had to install its own telecommunication system, stock 11 ton of back up batteries to keep the computers running, 4000 gallons of diesel fuel to power its generators during power cut, operate own sewage treatment plant to reuse water as a remedy to erratic water supply, run a fleet of buses to transport its employees (Ghemwat, 2000). Shortage of public infrastructure has forced several Bangalore based firms to start moving to these new locations for expansion of operations. With the rapid erosion of the relative factor advantage, the role of local government has increasingly become critical to sustain the prominence of Bangalore based IT cluster. The recent initiatives by the state government have started paying dividend again, with several new IT based investment of high quality flowing in. For instance, the state government has set up a new university with excellent facilities exclusively for engineering education.

Overall, it is observed that factors such as historically and accidentally created human resources, proactive policies to attract and allow multinational firms to exploit the human resources, technology leverage by local firms, emergence of a new class of entrepreneurs and their linkages with the epicenter of IT in Silicon Valley, and to some extent facilitating role of the state government have played crucial roles in the emergence of the Bangalore cluster. This cluster, the first of its kind in India has enjoyed the benefits and suffered the pangs of a typical fast mover in a highly dynamic industry.

Formation of Cluster as a Late Mover - Case of Hyderabad

Our second case study is Hyderabad which marked its beginning with the establishment of the Software Technology Park of India (STPI) in the year 1991-92. Since then it has grown rapidly to harbor 1154 firms with software exports of Rs. 51 billion in 2002-03 (NASSCOM 2005) and exports . The top ten firms contributed more than 58% of the exports from Hyderabad with 7 firms having exports of more than one billion rupees. The industry has grown particularly rapidly in the last three years. About one third of the registered units are foreign companies contributing about 40% of the total investments. More than 500 firms registered with STPI, Hyderabad are in the process of starting their operation. Once these firms become operational, formation of IT cluster in the city will get a major boost. In the past few years, the AP government has been able to attract a number of leading foreign multinational firms and Indian firms to set up operations in Hyderabad by providing better infrastructure, concessions, hidden subsidies and local demand through e-governance projects of the state government. It has simultaneously backed local IT firms such as Satyam Computers and InfoTech Enterprise to grow and flourish. As a result, Satyam has emerged as the biggest exporter from the city, and one of the largest 'big four' in IT industry in the country.

Entrepreneurial Leadership of State

In this section we present an analysis of how the Andhra Pradesh state government led by Chandrababu Naidu has been able to make a giant stride to shape an IT cluster in and around

Hyderabad. The entrepreneurial vision and the clarity of the strategy are evident from the number of initiatives the Chief Minister has taken to position Hyderabad as the knowledge hub of India. This includes not only upgrading economic and social infrastructure, but also providing pioneering leadership in e-governance in India. This not only pushed up IT-orientation in the society, but also opened up business opportunities for several companies including Microsoft. The state government partnered with private companies to promote IT literacy too. This includes campaigning and facilitating the setting up of a number of pioneering international quality institutions in the area of IT, biotechnology, life sciences, business management and insurance, all in emerging growth areas. All of them are designed to be of international repute. Creation of a finance district to house a number of institutions and agencies is expected to lead to a cluster of financial organizations in Hyderabad. The entrepreneurial leadership is as much reflected in these initiatives as much in brand building around them. A number of foreign delegations and dignitaries were invited to the HITEC city in the last few years and several road shows and seminars were held in various countries including the US, the UK, and Germany to give visibility and build image for the city. Naidu, as the Chief Minister (1996-2004) took personal interest in negotiating with a number of multinational firms. All these formed the building blocks of a grand strategy to catch up with the development process, which is knowledge driven in the emerging context. These steps are far superior to anything happening in any other Indian state.

The entrepreneurial leadership of the state is reflected in a number of ways. For instance, AP was one of the first states in India to formulate an IT policy in 1999. Recognizing the emerging global opportunity in the IT Enabled Services sector (ITES), AP formulated a separate ITES policy in 2002. The Chief Minister demonstrated superior entrepreneurial leadership compared to his counterparts in other states. For instance, when the Indian School of Business (ISB) start up team was deciding which location to choose for the prestigious institution among Karnataka, Tamil Nadu and Maharashtra, the Chief Minister personally persuaded the high powered team to visit Hyderabad and give him a chance to make a presentation, though his state was not in the shortlist. The visiting team's experience in Hyderabad contrasted with those in other cities. While one Chief Minister (CM) wanted a quota of seats reserved for applicants from there, another CM made them wait for 45 minutes and showed indifference at the meeting. In Hyderabad, the CM not only individually greeted by garlanding the members of the team, but also made a power point presentation, and personally handed out plates at dinner. Many investors have experienced the same pattern of behaviour from him both before and after making investments. Interestingly, three years after the setting up of ISB, the entire area, lying on the outskirts of the city, has suddenly become an IT hub.

The current strategy of Hyderabad to encourage setting up of a number of high quality private schools for primary and secondary education is relevant in this context. Some of the other initiatives that make sense in this context include creation of a number of parks, botanical gardens and other eco-tourism centers, major urban afforestation program all over the city, promotion of tourism in a big and concerted way and building the image of Hyderabad as the first choice to live. These are all strategic variables forming part of a grand strategy based on the emerging industrial location factors. These strategies are synergistic with the current efforts to promote tourism in the whole of AP, including Hyderabad. There is a definite and conscious effort to make Hyderabad and surroundings and the state as a whole attractive for the knowledge and service driven industries to grow. It is such qualities of entrepreneurial leadership that

provide the necessary fuel to push the state to a higher production function and enter a new and higher paradigm, as explained by Schumpeter (1949).

The initiatives have started paying off as can be seen from a recent survey conducted by Nasscom (2002) on city competitiveness. Hyderabad is Ranked 1 ahead of Chennai (Rank 3) and Bangalore (Rank 6). The competitiveness assessment was done based on three parameters, availability and quality of infrastructure, availability and cost effectiveness of manpower and policy support.

In essence, the Hyderabad case proves that it is possible for a late mover to catch up if it follows, principles of identifying entrepreneurial opportunities (Ramachandran 2003, Shane 2005) and successfully execute them (Bossidy and Charan 2002). It is not easy for a sleepy government system to wake up and act like this suddenly.

Formation of Cluster as a Late Mover - Case of Kolkata

During the mid 1980s the first set of software firms were set up in Kolkata, the capital of West Bengal, a state ruled by the communist government for about last three decades. At the peak of trade unionism in the state and amidst large scale opposition to computerization, IT companies in Kolkata received virtually no government support; instead, they faced very hostile environment in the early years. Though the state government set up the first Software Technology Park of Kolkata (STPK) in the year 1992-93 soon after economic liberalization, it did not pay enough attention to it for the next several years. As a result, the progress made during the major part of 90s was abysmally slow with only 39 registered units and 30 operating firms and Rs. 2 billion exports in 1999.

During the last five years, Kolkata has emerged as an important IT cluster in India with more than 400 registered units and 215 operating firms employing over 25,000 professionals and exports of Rs. 22 billion in 2004. The STPK has grown particularly rapidly in the last three years (growing at the rate of 70%) earning the distinction of the fastest growing STP in India. Unlike many other Indian cities Kolkata has always had an inherent advantage in areas such as talent pool, reliable supply of power, quality and cost of living which are among the key enablers of knowledge based industries like IT. The bottlenecks used to be in the areas of civic infrastructure, work culture, hostile industrial climate, investor unfriendly image of the local government and absence of policy and investor support. However, in the last three years, the state government has been able to attract a number of leading foreign and Indian IT firms to invest in Kolkata by laying the red carpet, removing all the regulatory hurdles with alarming speed and presenting an IT investment friendly face to the investors. The government has also initiated a project to set up by 2007 India's largest IT hub having all the facilities of becoming a most modern IT hub not only in India but in the whole south east Asia in 500 acres of land near Kolkata airport. Besides, more than 150 firms registered with STPK are expected to start their operation in 2005. Once these firms become operational and the new electronic city project is complete formation of IT cluster in the city will get a major boost.

Entrepreneurial Leadership of State

In this section we present an analysis of how the West Bengal state government led by the Chief Minister Buddhadeb Bhattacharya along with his colleagues in IT department has been able to make a giant stride to shape an IT cluster in and around Kolkata. The state was a late starter in promoting itself among the IT players. West Bengal's share in the country's IT services export was only 3-4 percent in 2002. The state hired the services of McKinsey & Company to draw up the IT vision and road map for the state. Accordingly, the state government envisioned to put the state among the top three IT states in the country by 2010, contributing 15-20 percent of the country's total IT revenue. The focus on the long term would be on high value-added IT work, developed through a combination of corporate leadership, intellectual leadership and government leadership.

Since then the government has been adopting a three-pronged approach towards achieving the target and have made significant progress in the last three years. It has providedlegal, administrative and physical infrastructure to potential players who wanted to set up shop in the state. Following Naidu's strategy in Hyderabad, the government has taken up several active e-governance initiatives to spread the use of IT in departments with maximum citizen interface.

The entrepreneurial vision and the clarity of the strategy are evident from the number of initiatives the state government has taken to effect resurgence of Kolkata as the intellectual capital of India. The city has been having a number of pioneering high quality institutions of excellence for decades in the areas of engineering, science and technology, statistics, management, medicine and insurance. However, these institutions started declining a few decades ago and almost lost their preeminent positions. The entrepreneurial leadership of the state is reflected in reviving these institutions and also encouraging new institutions to be set up by private initiatives. The government has promoted a new university under which 65 private engineering colleges and business schools have been established. It has started promoting industry academic meet to bridge the gap between the supply of talent and recruitment.

Further, one of main issues that needed to be tackled to place Kolkata firmly on the IT and ITES map was the image of the city. To convert Kolkata as a destination for IT and ITES firms, the state government has taken up a slew of steps to erase the negative image about the city, and have been doing a lot of promotional efforts, including road shows abroad.

The Chief Minister has taken personal interest in wooing big Indian industrial houses and multinational firms. A seasoned politician in India's communist party, Buddhadeb Bhattacharjee became chief minister (CM) of West Bengal in 2000. Since then, he has been on a mission to win investment and change perceptions of the state and its capital, Kolkata. After a late start, the state government has been actively wooing technology companies and discouraging unions from striking. In an interview with Review (2004), he said, "It's a very competitive world. …………Therefore I have to perform or perish. We must get rid of 'red-tape-ism' and bureaucratic bungling. In the past, we committed certain mistakes in the trade unions. Sometimes their behaviour was beyond our control. Now we say, look, we won't allow this sort of agitation

or intimidation. Labourers have to share it, otherwise the industry will collapse and you'll lose jobs. We won't allow any irresponsible behaviour or activities in the name of trade unions".

Though WB faced a different set of challenges in setting up an IT cluster in Kolkata, many of the steps resemble that AP government did a few years ago. For instance, WB government formulated an IT policy in 2001. Recognizing the emerging global opportunity in the IT Enabled Services sector (ITES), it announced a separate ITES policy in 2002. Similarly quite like the AP government, WB government has given major emphasis on E-governance projects which would not only help improve administration, but also create business opportunities for the IT companies. The state has created a single window system to facilitate IT investments and separate organization serves as an interface between the private sector and the government on e-governance projects.

Both Hyderabad and Kolkata have seen the local governments playing an active and direct role in shaping the IT cluster; still there are some differences in approaches adopted by WB government *vis a vis* AP government as Kolkata has been facing a different set of challenges compared to those faced by Hyderabad. Kolkata has been carrying a legacy of over hundred years of rapid idustrialisation punctuated by recent decades of labour unrest, industrial disputes, flight of capital and talent. While over 20 percent of top IT talents in India have their origin in West Bengal, only handful of them is based out of Kolkata. The WB government faces a dual challenge not only to win the confidence of investors but also to woo the migrants Bengali IT professionals working elsewhere to return to the state. These two are highly interconnected - success in one will rub into another. No doubt a lot of resources have been deployed to invite existing national and international IT and ITES players to set up their operations in the state, and successfully so. However, Kolkata's biggest challenge perhaps lies in establishing a few large IT players developed from local entrepreneurship. Some of the home grown entrepreneurs need to capitalise on the entry of big players and push themselves adequately to catapult themselves into the big league as happened in Bangalore earlier and more recently in Hyderabad.

Discussion

The detailed analysis of how Bangalore, an early entrant and Hyderabad and Kolkata, two late entrants in creating IT clusters show some interesting patterns. We notice that competitiveness of a location for cluster formation depends on a number of variables as shown in Figure 1. The State plays the role of a facilitator in the process.

Indeed, industry attractiveness is a critical factor that creates the necessary customer pull and momentum for any firm to flourish, and consequently any location to grow rich. Industry structure determines the relative bargaining power of the forces operating on a player in the industry. This logic applies to both industrial firms and clusters (Porter 1980, 1990, 1998). In a growing industry such as IT, attractive demand conditions very often facilitate entry of new players, that too when entry barriers are not very strong. It would not have been possible for a late entrant like Hyderabad or Kolkata to make the place attractive for IT investment, had the IT industry been showing signs of maturity by now.
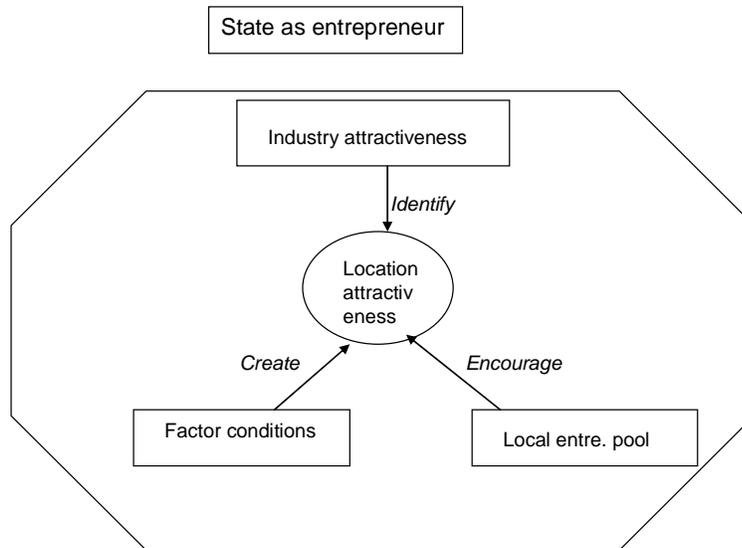
Figure 1: Dynamics of Formation of Industry Cluster

We found that availability of relevant factors, primarily driven by economic infrastructure and manpower of high quality is a necessary condition for the location to facilitate growth of the cluster. Knowledge based industries are influenced by a different set of location factors compared to traditional manufacturing based industries (Saxenian, 2000, Ramachandran, 1986). Regional development indeed depends on the development of economic activities and income generated in the region. Ramachandran (1986, 1989) has shown a shift in the mix of location factors from economic to social as a region develops its economic infrastructure, on lines with the Maslowian (1954) hierarchy of needs argument. According to Ramachandran, as the supply of physical infrastructure reaches a reasonable level, the need of entrepreneurs and managers to have fairly high quality social infrastructure would go up. This is particularly so in knowledge driven industries, where employees, the key source of value addition, is highly mobile. The kind of economic infrastructure would not be the same for manufacturing and non-manufacturing industries. For instance, the quantity and quality of communication infrastructure of IT industry is much higher compared to manufacturing.

The lessons from the experience of regional development in a number of countries, including relocation strategies of firms in mature industries to low wage zones such as Malaysia and Thailand, provide insight into the continuing attractiveness of Bangalore. Entrepreneurs and managers look for a combination of factors while choosing their location. As noticed by Ramachandran (1986), the role of non-economic, social factors is tilting the location choice to a

place, which is better to live, is also found very high. Hyderabad's recent efforts in creating attractive social infrastructure have to be viewed from this angle.

The need to have a local pool of entrepreneurs is very important; both at the early stages to kick start the growth of the cluster and at a later stage to sustain the momentum. For entrepreneurs, 'home proximity' is the most important location factor (Ramachandran, 1986), particularly in societies such as India with strong cultural bonding among family and community members. In case the relative factor advantage of the cluster goes down temporarily, a capital flight is bound to happen. However, the local entrepreneurs are more likely to continue and work for the revival of the cluster advantage because of their greater stickiness to the location (Stuart and Sorenson, 2000). Besides, in dealing with a turbulent industry such as IT, location of business in a place where one's social and professional networks are present, becomes important (Johannisson, 1998). This is particularly so for start ups with limited internal resources (Siegel, Siegel and MacMillan, 1993), but with the need to have growing pool of resources (Barney, 2002). This is evident in the case of Bangalore cluster where companies like Infosys and Wipro have taken very active role in supporting the Karnataka government to revive the factor condition and to some extent arresting the flight of capital to other location such as Chennai and Hyderabad. Firms such as Satyam Computers and InfoTech Enterprises reaffirm this assumption in the ease of Hyderabad and so do to some extent by a group of IT companies promoted by Purnendu Chatterjee in Kolkata.

The role of the state as an entrepreneur and strategist in shaping the formation of IT clusters for late starters has been the most important revelation of the case studies of Hyderbad and Kolkata. In an organizational context, whether it is a firm or a government, building and sustaining competitive advantage revolves around the quality of leadership it has. For innovations to occur, that too in a tradition-bound, bureaucratic, mature organization such as a government in this context, the leadership has to possess additional qualities. The leader must have entrepreneurial leadership qualities. Entrepreneurial leadership has two basic components (McGrath and MacMillan, 2000). The first is entrepreneurship, which is defined in terms of innovations based on market opportunities. The other is leadership, which is reflected in terms of the ability to motivate the team and carrying it along to accomplish the innovation objectives, with the help of appropriate people, systems and processes. Not only has the leader to create a work climate for innovative practices to flourish, but also to orchestrate seeking and realizing opportunities to grow the business (McGrath and MacMillan, 2000). The leader has to support and encourage hands on practices that involve problem solving with people at work. Besides, an entrepreneurial leader has to allocate resources, attention and talent *disproportionately* (emphasis added), and build counter pressure to fight inertial forces. The team should share a common vision to build competitive advantage though innovations.

A late entrant has to have a clear innovative approach to build competitiveness as argued in relevant literature in entrepreneurship and strategic management. Possibilities of sustaining competitive advantage are greater when the entrepreneurial initiatives are based on a strategic intent (Burgelman, 1983; Hamel and Prahalad, 1989; McGrath, MacMillan and Venkatraman, 1995). The spirit of entrepreneurship should flow through the whole administrative system to become competitive. This is particularly so when the mission is to catch up with the development

and overtake existing players. Hyderabad and Kolkata have very clear strategic intents that the Chief Ministers and other top level administrators have shared at every conceivable avenue.

State governments as organizations that are striving to build competitiveness need to possess qualities similar to those of firms competing in market place to build and sustain competitive advantage. This is particularly so in fast changing liberalized and globalised economies where states are competing with each other. It is under such situations that we need high quality entrepreneurial leaders, who can envision the future growth trajectory and build resources not only in terms of infrastructure, but also in terms of creating an attractive, confidence boosting environment through brand (image) building. Time is one of the most crucial variables and is traded at a very high premium for a late comer intending to develop an IT cluster. While the late comer may benchmark and learn from the early movers and need not reinvent the wheel, everything has to be done at a rapid pace to out pace the other competing locations. Moreover, unlike firms in many other industries, IT firms have a rapid decision cycle on most strategic decisions including the choice of investment destinations. Therefore fast response, short lead time, quick decisions and single window clearances by the government provide a decisive edge over other locations. It is here that the role of the entrepreneurial leader and the deftness of the team become all the more crucial.

The Ex-Chief Minister of AP, Chandrababu Naidu and the current Chief Minister of WB, Buddhadeb Bhattacharya are persons who exhibit many of the qualities of an entrepreneurial leader. Though no quantitative comparison is attempted here, a number of anecdotal evidences support this argument. This includes the list of new policy initiatives adopted, strategy to create appropriate infrastructure, creation of local demand through innovative e-governance projects, image building, creating capabilities and deftness in the team and so on. Continuity of entrepreneurial policies and leadership over a sufficiently long period is yet another dimension.

Implications and Conclusions

We observe that at least three local level critical factors - relative factor conditions, entrepreneurial leadership of the state government and a pool of entrepreneurs are needed for the successful evolution of a location into an industrial cluster as a late mover, provided the overall attractiveness of industry is high. For an early mover like Bangalore, these location factors evolved over a long period of time, on most occasions not by design, but by chance. Therefore, the role that the local government there had in the past and has even now, to maintain the supremacy of Bangalore cluster, is qualitatively different from that of other state governments, which have to take a more direct role in shaping the formation of IT clusters as late movers.

The roles of industry attractiveness and factor conditions as two ingredients for cluster formation have been well documented. However, the role of the state as an entrepreneurial leader and the pool of local entrepreneurs, and the synergistic effect provided by these factors have not been given due attention in extant literature so far. We believe the major contribution of this paper is that it highlights the importance of these factors among others in the formation of IT and other knowledge based clusters in an emerging market. This paper also brings into sharp focus the

differences that exist in the developmental models followed by the first movers as compared to the late entrants.

Many alternative models of development have been identified based on research in different country contexts. It is argued that the developmental approaches adopted by pioneering industrial nations differ substantially for nations that are in catch up mode (Abramovitz, 1986). Many studies (e.g., Tyson, 1988; Vogel, 1988) on successful Newly Industrialized Countries (NICs) such as Japan, South Korea, Singapore and Taiwan highlight the role of the government in either directly or indirectly influencing the quality and quantity of human resource, capital, technology and information to foster technological innovation and its diffusion. Though discounted in the purest capitalist sense, the role of government in leading the development process, particularly in poor countries is very high (Meir and Stiglitz, 2001). The purpose of government intervention is to move the economy from one level (lethargical equilibrium) to a higher level (prospects equilibrium). It is when the government is led by entrepreneurial leaders that such paradigm shift takes place on lines with the innovation arguments of Schumpeter (1949). Adelman (2001) has argued for hyperactive government to accelerate the process of development in such situation.

This means, the process of cluster formation can be directed and to a great extent planned with the inclusion of the two additional drivers discussed in this paper. While industry attractiveness and factor conditions make a location attractive for investment, it is the quality of entrepreneurial leadership of the state that determines the possibilities of a late entrant location becoming the leader. We believe that a detailed study of the strategic growth followed by Bangalore, Hyderabad and Kolkata provide valuable lessons for other locations trying to develop a number of knowledge intensive industry. For any other IT cluster to emerge in India as a late mover, the cluster formation process can be better planned and expedited. Any state government in India and similar emerging economies trying to emulate IT cluster in Bangalore has to use the catch up and leap frog models by choosing any combination of vehicles of technology leverage. It has to play a crucial role in shaping the cluster by developing and promoting educational and research institutions, attracting investments in high technology areas by providing better factor condition and creating local demand.

It is clear from the three case studies that knowledge clusters require a pool of entrepreneurs to get the building blocks laid. This pool of entrepreneurs may be locally bred or outsiders who are attracted by the competitiveness of the location. These entrepreneurs become the initial face of the industry, and the location's ambassadors. Two entrepreneurial forces (government and local entrepreneur) can create synergistic effects to attract new investments and facilitate the take off process of a cluster.

Endnotes
1) We tend to equate the IT industry and the software industry in our current study and assume that both mean the same, as has been done by majority of the authors while studying the industry.

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