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**THE INFORMATION TECHNOLOGY (IT)
INDUSTRY IN BANGALORE: A CASE OF
URBAN COMPETITIVENESS IN INDIA?**

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Abstract

Bangalore is often referred to as the 'Silicon Valley of India' as it is home to the largest number of Information Technology (IT) firms in India. This paper aims to understand the reasons for Bangalore's success in attracting both foreign and domestic IT industries and investigates the extent to which the city can continue to be the preferred location for IT industry in the country. The analysis is conducted at the national level (which examines the global competitiveness of the IT industry in India), and at the city level, which provides a comparative analysis of the industry in Bangalore vis-à-vis other major metropolitan areas in India. On the conceptual ground, the paper endeavours to put forward a case of urban competitiveness of Bangalore. The theme of urban competitiveness is relatively new to the field of urban and regional economics, and is primarily found in the context of North American and European cities. Using a set of parameters which inter-alia include telecommunications infrastructure, government policies, availability of industrial/office space, skilled labour and specialised services, an appreciation of Bangalore's competitiveness is provided. The study found a strong link between the IT industry and the research institutes in Bangalore. Such links were especially strong in the R & D activities. Many of the interviewed firms felt that Bangalore would continue to be the preferred location for the IT industry in the country. However, they do not rule out the possibility that an impending infrastructure crisis in the city will undermine its competitiveness. The paper is based on my PhD dissertation completed at the end of 1997 at the Development Planning Unit, University College London, entitled *The Information Technology (It) Industry in Bangalore: A Case of Urban Competitiveness in India?*

Keywords

Information Technology

Software

Industry

Urban competitiveness

Bangalore, India

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THE INFORMATION TECHNOLOGY (IT) INDUSTRY IN BANGALORE: A CASE OF URBAN COMPETITIVENESS IN INDIA?

1. INTRODUCTION

Bangalore today has the largest concentration of Information Technology (IT)¹ industries in India. This paper examines the reasons for Bangalore's dominance in the IT industry in India. In doing so, it attempts to put forward a case of urban competitiveness of Bangalore in the IT industry in India. The paper begins with an attempt to understand the theme of urban competitiveness, and describes its relevance and importance in the context of developed and developing countries. The *Bangalore situation* (as it may be described), is a result of a spatial reorganisation of the global IT industry and the dynamics of growth offered to the global IT industry by India. Therefore, an understanding of what is happening in Bangalore cannot be seen in isolation of the recent developments taking place in the IT industry world wide, and the opportunities offered by India for any IT firm around the world. However, given the scope of the present paper, only a brief reference is made to the world IT industry and the IT industry in India.

This paper is organised under six sections: after the introduction, the second section provides an understanding of the theme of urban competitiveness. The third section provides a brief overview of the IT industry in the world and the fourth section provides a regional analysis of IT industry in India. Section five analyses causal factors behind Bangalore's growth as the premier centre for IT industry in India. Finally, the paper attempts to investigate if the Bangalore situation can be described within the hitherto available framework of urban competitiveness.

2. UNDERSTANDING THE THEME OF URBAN COMPETITIVENESS

Why does a city become the base for successful international competitors in an industry? Why is a city often home to so many of an industry's world leaders? And why is a particular city able to create and sustain competitive advantage against other cities or regions in a particular industry? These questions often come to the minds of present day urban managers. It is necessary to understand what it is in a city that is most crucial in determining its ability, or inability, to create and sustain its competitive advantage in national or international terms. The influence of the city on the pursuit of competitive advantage in a particular field is of central importance to the level and rate of productivity growth, the creation of local employment,

and improved levels of welfare for its inhabitants.

Studies related to urban competitiveness or territorial competition have largely been conducted in Western Europe and North America², and as such there is no empirical evidence on urban competitiveness available from the developing countries. In industrially advanced and rich regions (of North America and Western Europe) the recent emphasis on studying urban competitiveness emanates from the importance associated to major urban areas as a result of territorial integration of markets (NAFTA and EU). In such a situation, urban areas have gained significance both as economic actors and are more aware of the greater burden placed on them to strategically plan for their economic future.

The study of urban competitiveness in the developing part of the world has its own purpose. Whereas in the developed world, it assumes greater significance as a result of blurring of national boundaries, it becomes important in the developing world as a result of economic dominance of some of the large cities in these countries. Equally important is the large share of a country's urban population that lives in these cities of the developing world. For example, in India, over two-thirds of the total urban population is concentrated in just 23 metropolitan (or million plus) cities. The economic liberalisation that is now taking place in many developing countries, not excluding India has increased the importance of the urban areas as recipients of foreign direct investment (FDI), and as a result, the study of urban competitiveness in the developing world has its own significance.

Competition in the context of urban areas is not very easy to understand. Cities are more complex entities than firms, and cannot always be easily divided into strong and weak competitors. The same urban location may emerge in both forms. The coexistence of locationally enduring corporate headquarters, Research and Development (R&D) and skilled production locations along with more mobile back offices and assembly work bear testimony to this. The "strong" or "weak" distinction itself needs to be handled with care.

Often, the reason why cities should compete with each other is not clear because competition is mostly associated with contention between rivals. The Latin language suggests a different interpretation: the word derives from *cum petere*, which means searching together. Thus the Latin meaning quite vividly

¹ For the purpose of the present paper, IT is defined as a group of information and electronics based technologies that include computers and computer software.

² Research has focused on different issues like territorial competition (Cheshire and Gordon, 1995), competitive advantage of inner cities (Porter, 1995), and urban competition (Singh and Kresl, 1994; Kresl, 1995; and Bramezza, 1996).

expresses the logic of competition. Due to increased interdependencies and the growing complexity of urban areas, Bramezza states that competing is better conceived of as searching together the best solution to specific problems, 'in a strategic way, at the right time and in the right place' (Bramezza, 1996:21).

Consequently, cities are competitive if they are able to cope with the negative consequences of economic success, such as exploding land prices, traffic congestion, environmental degradation and social exclusion. Thus 'a balance between the global dimension (the ability to exploit and profit from local resources and diversity) must be struck' (*op. cit.* p.22). Therefore, the search for urban competitiveness should ultimately aim at sustaining and enhancing the welfare of the actors that are already operating and living within the city's boundaries and others that are likely to be attracted to the city by its success.

Implicitly, urban competitiveness operates in different spatial scales: local, regional, supra- and intra-regional scales. There is competition among large cities, among smaller cities and between large and small cities, depending on the target, for instance to attract residents, visitors, specific sectors, head offices of international firms, and manufacturing sites.

Each city, more or less, specialises in one or more functions (Henderson, 1988; Porter, 1995). This could be in trade, financial business, tourism, or manufacturing. Such a specialisation develops when goods or services related to it are an important part of the urban economy and its products are consumed not only by local actors, for instance the inhabitants, but also external actors. These specialisation have been defined as "urban functions" (e.g. Berg et al., 1995; Benoit, 1995). For some of these authors, the concept of 'urban function expresses the need for a more integral strategy referring to the city as incubator and performer of urban functions, an approach that guarantees the integrality of the overall urban development better' (Bramezza, 1996: 22). Some of the locational factors in a city are skilled labour force, and an efficient transport and communication infrastructure. Thus the cumulative effect of the locational factors present in a city determines the city's potential to become an attractive location for specific sectors of economic activity.

Locational factors can be grouped in two categories: basic and non-basic factors. Basic factors may be viewed as a necessary but not a sufficient condition for a city's competitiveness. They are the primary condition a city has to meet if it is to be competitive. Basic locational factors include: an efficient infrastructure system, an adequate supply of strategic urban services³, a living and business environment of

high quality and efficient and adequate urban management. Non basic factors largely include all other factors that relate to the type of urban function. Thus some authors argue that urban competitiveness cannot be created without the above mentioned basic locational factors (Cheshire & Gordon, 1995; Berg et al., 1995, Bramezza, 1996; Benoit, 1995).

Singh and Kresl use a number of elements to work out the competitive ranking of forty US cities. Their study focused on three indicators of urban competitiveness. According to them, each of these variables 'captures an important aspect of the performance of a city's economy' (Singh & Kresl, 1994:429). The variables chosen by Singh and Kresl and their role in indicating competitiveness are as follows:

- *The growth of retail sales.* Relatively rapid growth of retail sales will be a function of growth of the city's population, of rising income of its inhabitants and of the degree to which it is an attractive location for non-inhabitants to come to for shopping, recreation, cultural events and dining. Each of these components will be indicative of competitiveness.
- *The growth of manufacturing value added.* Relatively rapid growth of value added in manufacturing will be reflective of investments in plant and equipment, in human capital and in infrastructure. It will give an indication of the overall competitiveness of the city's manufacturing sector.
- *The growth of business services.* While services as a category include several items, such as amusement, auto repair, and personal services, which have little or nothing to do with economic competitiveness, business services are essential to any expansion of economic activity and of any transformation of economic activity (*ibid.*).

Similar to the point made by Singh and Kresl, regarding the role of services, Senn argues that the role of service activities in territorial or urban competition may be seen in terms of a cumulative growth process which is at its strongest in large cities (Senn, 1995:122). He further adds that it is the role of the services that has enhanced the competitive position of Milan within the European hierarchy of cities vying for investment.

Thus, it can be stated that the specific mix of locational factors determines the city's attractiveness for specific sectors. The relation between those sectors determines the type of urban function potentially supplied by that city.

'The concept of urban function is essential for urban competitiveness because urban functions are indeed the object of competition between cities' (Bramezza, 1996:25). In an increasingly globalised national economies, most of the larger cities seek to perform

³ Strategic urban services are those which create a comparative advantage that are not shared by many other cities, such as advanced telecommunications, transport facilities, and appealing tourist

attractions.

specific urban functions: they aim at becoming financial centres or logistic nodes, or centres of research, and so on. Thus cities vie with one another for new urban functions and to strengthen those already existing but not yet fully exploited.

What is Urban Competitiveness?

In the previous section of the paper it was demonstrated that the strength of urban function is closely related to the presence and quality of locational factors for investment and employment. Therefore, the competitiveness of cities in terms of functions is directly linked to the existence of locational factors that are relevant to those functions. Thus, a city where locational factors are available for the fulfilment of a specific function, and more so than in other cities, is likely to be more competitive than other cities in performing that particular function at a certain point of time. Thus urban competition is essentially a dynamic process, and the 'level of competitiveness of a region is always liable to change, both because of the development of new locational potentials in other regions and because of the changing needs of established companies in the region' (Berg, et al., 1995:61).

Cheshire and Gordon define urban competition as 'locally based efforts to promote the development of a locality in competition with other localities' (Cheshire & Gordon, 1995: ix). According to them these take many forms - place marketing, assisting local businesses, constructing infrastructure designed to make the area more locationally attractive, or simply information provision and networking- and serve a range of goals, but its distinctive characteristic is that it originates from local interests. Thus urban competition seeks to influence the spatial distribution of economic activities from the bottom-up rather than from the top-down and perceives the urban area, the economic performance of which is the object of the policy, as in competition with other cities, regions and localities. There are, however, conceptual difficulties in understanding urban competition as 'it involves both collective actors, including local public bodies and private firms/households, and individual firms looking for a location or seeking to improve their competitive position' (Benoit, 1995:222)

Thus based on the studies mentioned above, for the purpose of the present paper, urban competitiveness can be defined as the capacity of an urban area to attract and sustain a particular economic activity or a set of economic activities in a given point of time. As suggested by Humphrey and Schmitz, competitiveness, therefore, has to be necessarily viewed as a dynamic process. 'Being competitive is not a state, it is a process of remaining competitive through improvement. The objective of policy intervention at the micro (*or the city*) level should be to develop the capability of groups

of firms to generate processes of improvement deriving from inter-firm linkages and contact with the market' (Humphrey & Schmitz, 1996:1860). Thus competitiveness is a dynamic phenomenon, that will constantly change with changing economic, political, sociological, and technological conditions

The relative competitive position of a city always refers to specific urban functions. This is a result of a gap between (1) the supply of locational factors in that city and the level of supply of those factors required by the sectors related to that function (the level of absolute attractiveness of a city for one urban function), and (2) the supply of locational factors in that city for those sectors relevant to that function and the supply of the same factors in all other cities performing the same function (the relative competitive position of a city for one urban function, with respect to other cities). Further more, as stressed earlier, four basic locational factors (efficient infrastructure, strategic services, high quality of living environment and of urban management) constitute the primary condition for a city to perform any competitive urban function.

Equally important as the definition of the concept of urban competitiveness are the elements that can actually be used to explain the concept of urban competitiveness itself. These elements could well be used to assess the relative degree of competitiveness of an individual city and to identify both its strengths and weaknesses at a particular point of time. This latter aspect will be of crucial importance in suggesting a specific strategy for enhancing competitiveness of the individual city.

Whereas the definition of the term explains what urban competitiveness is, the determinants are the variables through which urban competitiveness can actually be measured or assessed. According to Kresl and Singh, urban competitiveness is a function of economic and strategic determinants. Economic determinants can further be divided into factors of production, infrastructure, location, economic structure and urban amenities. The strategic determinants are mainly governmental effectiveness, urban strategy, institutional flexibility, and private-public sector co-operation. Kresl and Singh opine that any determinant that can be represented by statistical data will be an economic determinant, and strategic determinants are always qualitative in nature (Kresl & Singh, 1994:434).

Based on various studies, Kresl concludes that 'a healthy and dynamic manufacturing sector is essential for international competitiveness of any region or urban economy' (Kresl, 1995:48). Quoting studies by Scott et al., Kresl states that 'manufacturing remains the core for US competitiveness because it provides higher wages and output per employee, 70 percent of exports (in 1980), and more than 50 percent of imports (in 1980). This is however not so true at least for most US

and Western European urban areas in recent years, as the overall economic output of these areas over the recent past has shown that services or the tertiary sector has over taken manufacturing in output and employment terms (Knight 1995:225).

Thus competitiveness is not 'just a question of promoting more growth but rather a process of economic evolution that will generate specific results that are considered especially desirable' (Kresl, 1995:50). A competitive urban economy will depend more on the quality of jobs rather than on mere numbers, in terms of providing employment to people.

The foregoing discussion on the determinants of competitiveness highlighted how various economic activities and industries tend to get concentrated in a particular urban location. A number of studies⁴ have highlighted how new high technology firms get concentrated in certain urban locations. Almost all of these studies have been carried in the industrially advanced economies. Nevertheless, there are certain crucial aspects related to urban development that can be learnt from these studies.

The foregoing discussion on the determinants of competitiveness highlighted how various economic activities and industries tend to get concentrated in a particular urban location. A number of studies⁵ have highlighted how high technology firms get concentrated in certain urban location. Almost all of these studies have been carried in the industrially advanced economies.

How far any of these are relevant to the Indian context or happening in India? The technology available to the vast majority of the population is nowhere near that compared to the ones in the western world. Nor is the infrastructure in the country anywhere near that of international standards. In such a circumstance, why are the IT companies making a beeline to India, and more so prominently to Bangalore? Empirical evidence suggest that Bangalore has the highest proportion of the IT industry in the country. Is it matter of just chance that the IT industry concentrate in Bangalore? For that matter, is it just fortuitous that Silicon Valley, Route 128, Austin in Texas, Silicon Glen, or Cambridgeshire all have a high concentration of high technology industries? It is even more interesting to note that all of these locations are in the industrially advanced countries, so why do firms choose Bangalore? Why do so many of the recent journalistic literature (both within and outside India) address Bangalore as the Silicon Valley of India? Limited literature available on the IT industry suggests that IT and other high

technology firms concentrate in regions that offer high quality work force, interaction with research laboratories, availability of state of art infrastructure, and favourable state or federal laws to promote such industries. Hence, based on the literature and from limited empirical evidence, the research was executed to gain an in-depth study of the processes that have led to the growth of IT industries in Bangalore, and to examine if such growth patterns can be sustained in the future as well. Before proceeding on to examine the IT industry in Bangalore, a brief review of the IT industry in the world, and in India is provided in the ensuing section.

3. A BRIEF REVIEW OF THE IT INDUSTRY IN THE WORLD AND IN INDIA

A brief analysis of the world IT industry, especially the computer hardware reveals that there has been a constant fall in the prices of computer hardware progressively over the years. This has been largely possible due to the down sizing of the computers, and increased processing capacities of the latest computers. Consequent to the fall in the computer hardware prices, which has increased the user base, there is a rise in the demand for computer software also. This allows software suppliers to lower prices by amortising development costs over larger unit sales. According to Schware (1992), 'although the demand for software is increasing at an annual rate of approximately 12 percent (in the last ten years), yet the number of software professionals grew at only about 4 percent annually (in the same period)' (Schware, 1992:8). At the same time, according to him 'productivity in developing software has increased slowly- perhaps 5 percent per year - leaving a significant annual shortfall of software developers' (Schware, 1992 : 8). This has been significant to the development of the global software industry, and its geographic spread,⁶ in the last ten years as companies (especially in the developed world) bore in mind the backlogs in the turnover of the professionals, and planned their investments in regions/countries which offered increased availability of good quality software professionals.

The backlog of software professionals in the developed world has, according to Schware (1992) resulted in a software productivity bottleneck and has forced the software companies to focus their attention on worldwide productivity in the generation of software. In addition, according to Nolan et al (1988), software and software related activities such as training, documentation, and maintenance now account for a far greater percentage of total system costs than in earlier years. It is here that countries like India can offer very competitive location for software and support activities (Dataquest, 1995). Nolan et al (1988) estimate that

⁴ For examples see Segal and Quince (1985); Moulart, et al., (1991); Shachar and Felsenstein (1992); Castells and Hall (1994); Saxenian (1996); and Graham and Marvin (1996).

⁵ For examples see Saxenian (1995), Castells and Hall (1994), and Segal, Quince et al. (1985).

⁶ Especially to countries like India, and Brazil.

'more than 50 percent of personal computing direct costs are consumed by such support activities'. The increasing demand for software, and increasing shortfall of trained professionals in many parts of the developed countries have led the firms to look for suitably trained professionals overseas, or start off-shore activities. In many cases, software professionals are invited from another country to work on a client site (which has been very commonly referred to as *body shopping*⁷). Table 1 shows the difference in monthly wages between software professionals in India and US in US dollar terms. As evident from Table 1, companies looking for good quality software professionals can save enormous sums of money by hiring Indian professionals instead of the ones professionals in the developing countries, and continued from the US. An understanding of wages of software backlog of software professionals in the developed countries (Table 2) is very crucial to the understanding of the geography of world software industry, and to the present context on Bangalore.

A major trend in today's software industry is to offer clients an integrated system, which involves integrating a number of different products from software vendors which are designed to work together as a single system. Now system integration services have begun to bring together different types of software and hardware and integrate them to provide a unique configuration more or less bespoke to end users' requirements.

The ever decreasing prices of computer hardware has enabled firms to take on system integration, 'or the progressive assembling of system components into the whole information system' (IBM, 1994). A systems integrator combines standard hardware components with custom software- or certain standard software packages modified appropriately- in a unique configuration more or less tailor-made to end users' requirements. This is a common trend all over the world. Even in India, the erstwhile PC manufacturers like Wipro, Tata-IBM, and Digital are providing system integration, rather than PC manufacturing. According to the Association of Data Processing Service Organisations (ADAPSO), 'systems integration is the process of identifying and bringing together various technologies in order to define and deliver a complete information package that will fulfil specific design, operational and management objectives' (ADAPSO, 1987).

Today such integrated systems are possible, largely due to efficient and latest satellite communication, modern networking technologies, and the growing use of multi-user, multi-tasking operating systems. Even a decade

back, it was not economically feasible and technologically possible to cater to large number of users from a single operating system. But now it is possible to integrate the hither to disparate components of a system: large and small computers from different manufacturers, packaged and custom-designed software. This is significant, because the greatest gains from the use of IT, in principle, come when components are integrated into a single networking entity.

⁷ Body shopping is very cost effective for companies, as well trained software professionals can be hired at almost a fraction of the cost one would have paid the local software professional. But since 1994 countries like the United States have imposed stricter work permit rules to reduce body shopping, but still the trade of body shopping continues unabated.

TABLE 1**USA and India: Difference in the annual salaries of software professionals (1995) in US \$ and in PPP terms**

Professional Category	USA (US \$)	India (US \$)	Annual salary in India at PPP ¹
Programmer	72,000-84,000	3,480-3,600	22,968-23,760
Programmer with 2-4 Years Experience	84,000-96,000	4,560-5,160	30,096-34,056
Systems Analyst	120,000-150,000	7,320-8,640	48,312-57,024
Project Manager	150,000 +	9,000+	59,000+

Source : Originally from Heeks (1996:115 and 117), PPP equivalent calculated by the author

¹ The adjustment for research purposes of data on the money incomes of workers to reflect the actual power of a unit of local currency to buy goods and services in its country of issue, which may be more or less than what a unit of the same currency will buy of equivalent goods and services in foreign countries at current market exchange rates. PPP-adjusted incomes are useful for comparing the living standards of workers in different countries. 'In 1995, 1 US\$ = \$ 6.6 PPP in India' (World Bank, 1995).

TABLE 2**UK, USA, and Japan : Estimated Backlog of Software Professionals (1989-1993)**

Country	Backlog of Software Professionals
UK	16,000 (1989)
USA	87, 000 (1992)
Japan	400,000 (1993)

Source : Heeks, 1996 : 108

The current software development situation is such that the demand for computer applications is outstripping the ability of the principal software suppliers to supply programmes in a timely and cost-effective manner. According to Schware (1992), the mainframe users waited an average of 16 months for software system development, mini computer users 12 months, and personal computer users held steady at six months. Increasing demand for software coupled with the shortage of resources for providing it will give good opportunities, to the emerging software firms. Already software backlogs and personnel shortages are forcing certain European, American and Japanese companies to look offshore. Most of these firms have resorted to outsourcing to avoid any serious delay in their projects.

The software industry is growing very rapidly, with an annual growth rate of 48 percent, which is faster than for the US industry during its "boom" period between 1981 and 1983. Custom software production accounted for nearly a third of total revenues in 1986, followed by sales of services in data processing (30 percent), turnkey system development (20 percent), and software packages (17 percent). The future market for packaged

software for micro computers is promising. Over half of the software companies are engaged in packaged software development. 'As more small and medium businesses begin to use micro computers, software packages for these enterprises will be needed' (Schware,1992 : 34).

For a long time it has been argued that the only niche Indian software companies enjoy is cost. But there have been increasing evidence to suggest that it is not the whole truth. The average wage of Indian software professional in US dollars has actually at least doubled between 1990 and 1996. By 1996, the World Bank study projected that India's revenue productivity would be the same as Ireland and Singapore (IBRD, 1992). To stay competitive in the software industry, country and companies have to move beyond cost factors alone and emphasis has to be laid on the quality of the product and the level of skills involved in software development.

4. BANGALORE AS A PREMIER CENTRE FOR IT INDUSTRY IN INDIA: SOME EVIDENCE

There are very limited official statistics to show the spatial spread of the IT industry in India. The Annual Survey of Industries (ASI) primarily provides a brief

state level analysis of a set of industries, of which the IT industry is merely a component. Therefore, year wise information of the IT industry for all the locations in India was collated from the various volumes of the IT Magazine -Dataquest (published from India), for

two time periods to offer a temporal analysis. The results presented in this section are mainly based on the analysis of data of firms from 1993 and 1996.

TABLE 3

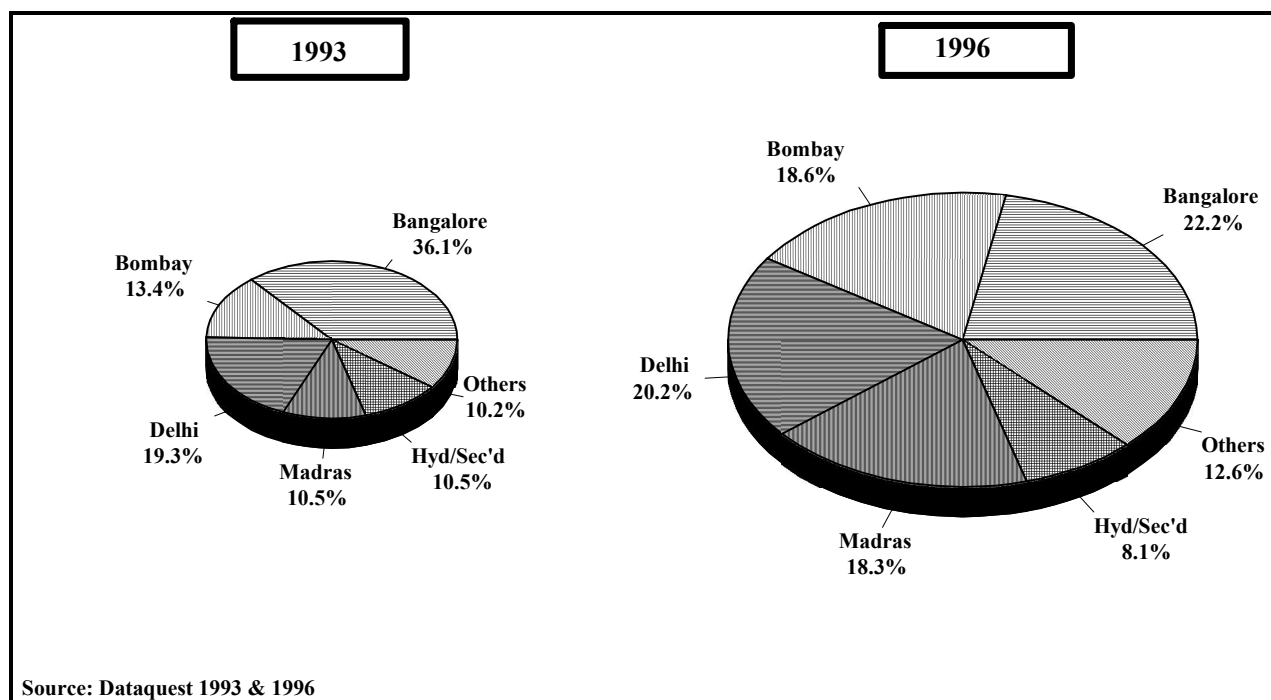
India: Location of IT Firms in Major Urban Areas (1996)

Urban Area	Number of Firms	Percent of India Total
Bangalore	205	22.2
Bombay	172	18.6
Calcutta	28	20.2
Delhi	187	20.2
Hyderabad-Secundrabad	75	8.1
Madras	169	18.3
Pune	28	3.0
Others	61	6.6
Total	925	100.0

Source: Compiled from Dataquest 1996

FIGURE 1

India: IT Firms in Major Urban Areas- 1993 and 1996 (Share of the National Total, %)



In 1993, more than a third of the IT firms in India were based in Bangalore. Although this proportion fell to 22 percent by 1996 (Fig. 1), the city still has the largest concentration of IT firms in the country. Table 3 reveals that Delhi, Bombay and Madras have emerged as the strongest competitors to Bangalore for the location of the IT industries in India.

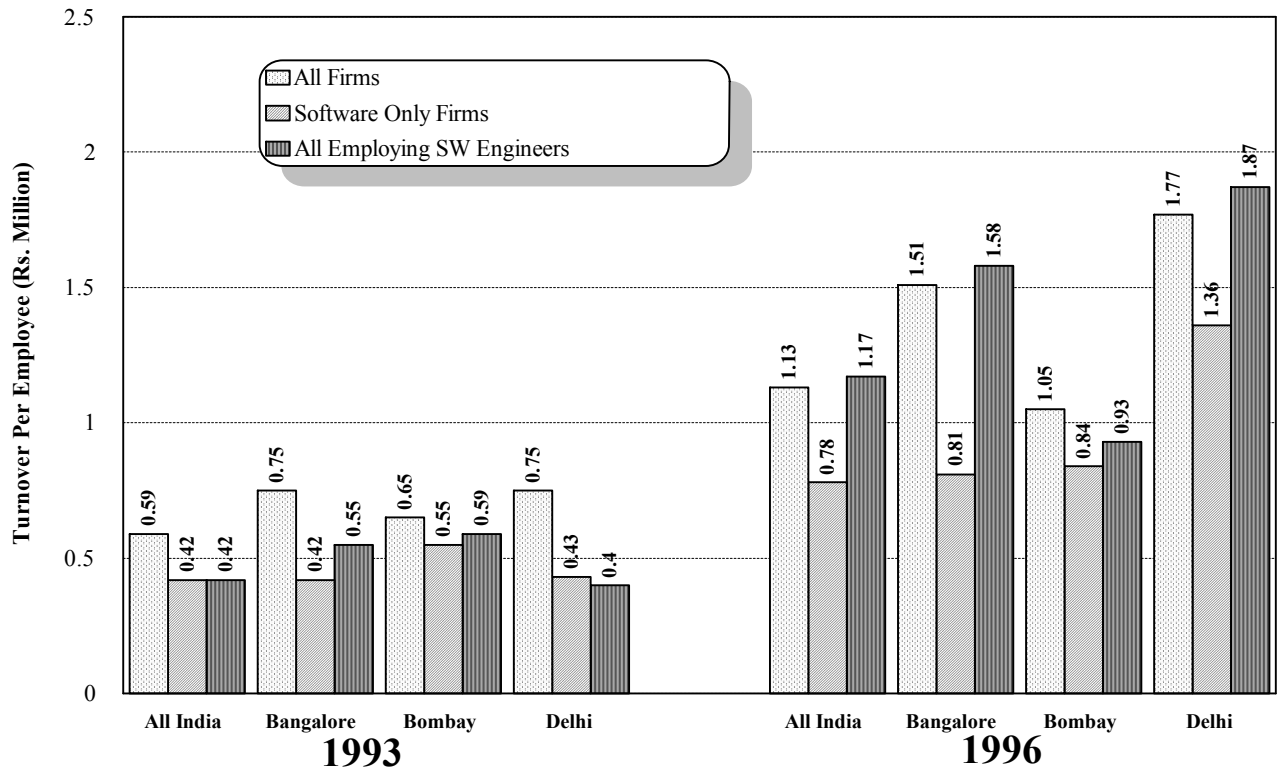
In terms of number of firms, Bangalore does enjoy a premier position among the Indian cities. How does it rate in terms of productivity vis-à-vis other cities? One way of understanding the productivity of an industry is to analyse the Net Value Added (NVA)⁸ per employee in that industry category. Owing to the nature of data

collection methods adopted by the Dataquest Magazine, the NVA (Net value Added) per employee cannot be calculated. Instead, the Turnover per Employee (TOE) for each category and for each location has been calculated for the 1993-1996 time period. The TOE is used as a proxy variable for NVA per employee. The Turnover Per Employee (TOE) in Bangalore is one of the highest in the country. Bangalore's TOE for all firms in 1996 was 30 percent more than that of Bombay, and 16 percent higher than the all- India aggregate. However, Delhi's TOE is 30 percent higher in all firms category than Bangalore (Table 4 and Fig. 2). Thus it well established that the IT industry in Bangalore not only excels in quantitative terms, but even quality wise it is one of the best in the country.

⁸ The NVA needs to be interpreted carefully. High NVA per worker can be found in sectors that have high ratios of capital to labour. This is mainly because capital intensive industries must earn a normal return on large investments, they must charge prices that are larger markup over labour costs than labour-intensive industries, which means that they have high value added per worker.

FIGURE 2

Turnover Per Employee in IT Firms (1993 and 1996 Current Prices)



Source: Dataquest, 1993 & 1996

Source: Dataquest, 1993 & 1996

TABLE 4

India: Change in the growth, output and turnover per employee for major cities (1993-96)

Year	Bangalore			Bombay			Delhi			All Locations		
1993	All Firms	Software Only Firms	All Firms Employing Software Engineers	All Firms	Software Only Firms	All Firms Employing Software Engineers	All Firms	Software Only Firms	All Firms Employing Software Engineers	All Firms	Software Only Firms	All Firms Employing Software Engineers
Total Firms	127	69	88	47	20	30	68	28	41	352	173	233
Total Employees	8,896	3,641	5,263	14,793	5,932	9,998	10,818	3,654	5,619	48,880	16,365	29,343
Total Turnover (Rs Billion)	6.698	1.466	2.926	9.752	3.269	5.951	8.199	1.573	2.300	28.999	7.013	12.32
Average Turnover Per Employee (Rs. Million)	0.753	0.427	0.555	0.659	0.551	0.595	0.757	0.430	0.409	0.593	0.428	.420
1996												
Total Firms	205	98	153	172	60	120	187*	62**	134***	925(742)	363(305)	694(560)
Total Employees	16,924	7,277	14,114	29,900	16,826	22,664	16,214	3,990	13,252	84,924	36,999	62,691
Total Turnover (Rs Billion)	25.714	5.960	22.367	31.690	14.266	21.170	34.954 29.718	6.945 5.451	26.647 24.901	107.733 96.019	33.19 29.05	79.262 73.938
Average Turnover Per Employee (Rs. Million)	1.519	0.819	1.584	1.059	0.847	0.934	2.150 1.771	1.740 1.366	2.010 1.879	1.268 1.130	0.897 0.785	1.264 1.170

* 86 out of 187 Firms in Delhi have not disclosed the number of employees, which has skewed the Average Turnover per Employee in its favour

** 25 of the 62 have not given Employee figures

*** 62 of these 134 have not divulged employee figures

The Figure in Italics for Delhi and All Locations excludes the firms without information about employees

Source: Dataquest 1993 and 1996

The analysis of data for all type of IT firms and those that are specialising in software and services only show that, Bangalore has the largest concentration of IT industry in India. The comparative figures for 1993 and 1996 (Fig. 1) reveal that Bangalore's share of total number firms and employees has in fact fallen (from 39.9% to 27%), but the Turnover per Employee has increased during the same time period , and is second highest after Delhi (Fig 2)

A brief analysis of the IT firms in Bangalore shows that a majority of the IT firms in Bangalore started their operation between 1991 and 1996 (Table 5). The combined share of firms starting their operation between 1986- and 1996 is over 80 percent. One-fifth of all the firms started in India during 1986-90 period and a quarter of the firms that started operation in India during 1991-96 period established themselves in Bangalore (Table 5).

TABLE 5

India: Start up of Firms by Location

Year	Location								
	Bangalore	Bombay	Calcutta	Delhi	Hyderabad	Madras	Pune	Others	Total
1950-59		1							1
1960-69		6		2	1				9
1970-80	10	18	1	9	3	2	5	3	51
1981-85	20	25	2	12	4	14	6	9	92
1986-90	71	64	10	82	26	60	8	26	347
1991-96	104	58	15	82	41	93	9	23	425
Total	205	172	28	187	75	169	28	61	925

Source: Dataquest, 1996

TABLE 6

Bangalore: Turnover of IT Firms (1996)

Bangalore	Turnover of the Firms (Rs. Million) 1995-96	
	Count	%
Not Available	11	5.4
0-9	104	50.7
10-20	28	13.7
21-30	14	6.8
31-40	10	4.9
41-50	2	1.0
51-99	9	4.4
100-250	14	6.8
260-500	6	2.9
760-1000	2	1.0
1001-2000	2	1.0
2001-3000	1	0.5
3001-4000	1	0.5
7001-9000	1	0.5
TOTAL	205	100

Source: Dataquest, 1996

In 1996 half of the IT firms in Bangalore had a turnover of under Rs. 10 Million (US \$ 32,000), and another 14 percent had a turnover between Rs. 10- 20 Million (Table 6). Bangalore has largely the smaller firms, unlike Bombay, which has all the large IT industries (i.e. more than 500 employees). One-third of Bangalore's IT firms employ 10 or less number of employees, and another quarter between 11 and 25. In fact over 70 Percent of Bangalore's IT firms employ 50 or less number of people (Table 7).

In Bangalore, software only firms dominate the IT

scene (Table 8). The combined strength of all the firms employing software professionals in Bangalore is over 75 percent, which is unlike Delhi, which has a heavy hardware base, combined with software. Hence it is very well established from the tables that Bangalore dominates the software industry in India. It is also pertinent to note that firms listed in Dataquest are only a small number of what might actually exist in Bangalore. Other computer magazines have listed the number of software firms in Bangalore even as high as 800. But since their authenticity cannot be established, the study would conform to the number of firms provided by Dataquest in 1996.

TABLE 7

Bangalore : Employees in the IT Firms (1996)

Turnover Range (Rs. Million) 1995-96		%
Not Available	11	5.4
0-9	104	50.7
10-20	28	13.7
21-30	14	6.8
31-40	10	4.9
41-50	2	1.0
51-99	9	4.4
100-250	14	6.8
260-500	6	2.9
510-750	0	0
760-1000	2	1.0
1001-2000	2	1.0
2001-3000	1	0.5
3001-4000	1	0.5
7001-9000	1	0.5
TOTAL	205	100

Source: Dataquest, 1996

TABLE 8

Bangalore: Break up of the IT Industry

Bangalore	Category of the IT Industry	
	Count	%
Information Technology ¹	12	5.9
Hardware Only	18	8.8
Software & Services Only	98	47.8
Dealers	37	18
Peripherals & Others	34	16.6
Training including Software Training	6	2.9
Total	205	100

¹ Includes firms doing business in Hardware, Software, and System Integration

Source: Dataquest, 1996

Given the growth trend of Bangalore's computer software industry over the past decade, many of the business journals/magazines even outside India have started referring to it as the "India's Silicon Valley/Plateau"⁹. Now, however, there are concerns over whether that growth can be sustained in the face of growing domestic and international competition, inadequate infrastructure and escalating costs. 85 percent of new software companies that chose Bangalore as their headquarters, mainly because of the availability of "a large pool of low cost professionals" (Arthur Andersen Study- c.f. Business Standard, 1995, New Delhi). According to this report in the Business Standard, Andersen has advised a number of multinationals on siting for their new Indian operations. Based on a range of factors including transport, power, telecommunications, labour availability and "livability", Andersen rated Bangalore as the first preference for locating software development. Bombay was ruled out because of its extremely high property prices, while Andersen says, "Delhi and Madras could be considered as alternative, backup locations" (Business Standard, 1995). The capital of Karnataka, thus owes its success in attracting new IT investments to a combination of political, industrial and geographical factors (Financial Times, 1995).

To gather further insight to the Bangalore situation, an empirical study of the IT firms has been carried out, which probes in detail the reasons for Bangalore's emergence as a premier centre for IT business in India.

5. UNDERSTANDING THE URBAN COMPETITIVENESS OF BANGALORE

The discussion on the geography of the IT industry in India revealed that Bangalore is not only the premier centre for IT business in India in quantitative terms, it also has a high productivity level (measured in terms of turnover per employee). Only Delhi has higher productivity than Bangalore. The current section of the paper will examine the reasons behind Bangalore's success in attracting more IT firms than any other Indian city. The analysis, it is hoped will contribute to the

current debate on urban competitiveness, and to extend the case of Bangalore's IT industry in understanding the issue of the competitiveness of cities.

The Study Methodology

The empirical analysis was conducted at two levels. One at the national level of policy making, and another at the city level. The research used both secondary sources of data and primary data collection. The study relied on two types of field surveys, a firm-level survey and a policy makers survey. An understanding of competitiveness of Bangalore was carried out using a set of indicators which include *inter alia* level of telecommunications infrastructure, government policies, availability of industrial/office space, skilled labour and specialised services. The field work for the research was carried out in Bangalore between July and October, 1995. In all 52 IT firms were surveyed. Of these 20 were domestic, and 16 each were foreign owned and joint venture firms. These 52 IT firms can be broadly grouped into IT firms (those involved both in software and hardware), software only firms, hardware only firms, value added resellers, and peripherals manufacturers. A structured interview was the main format of the investigation. A vast amount of information was also gathered through discussion with these firms, and with many experts in and outside Bangalore. The questionnaire was administered to over 70 firms in different locations in Bangalore. Only 52 of them provide complete information to facilitate meaningful analysis.

Table 11 is based on the answers given to the question on why any IT firm should be interested in India. As evident from Table 11, each type of firm seems to have their own vision of why any IT firm should be interested in India. While domestic firms based their view largely on lower wages alone, the foreign firms stated that they were interested due to the value and quality of the IT professionals in India. Large untapped domestic market seems to have caught the attention of the surveyed joint venture firms. Over 60 percent of the joint ventures firms see that as a main reason for firms to be interested in India, a *raison d' être* for their being in India?

⁹ There is a geographical connotation that needs to be clarified here. Bangalore is on a plateau, and it is what many (Economist, 1994; Financial Times, 1995) believe as India's answer to Silicon Valley in the US. So should it be called the Silicon Valley of India or Silicon Plateau of India?!

TABLE 9**Bangalore: Category of the Surveyed Firms**

Category of the Firm	Number	Percent of Total Surveyed Firms
Software and Services Only	42	80.8
Information Technology	4	7.7
Hardware Only	3	5.8
Peripherals	3	5.8
Total	52	100

Source: Field Survey, 1995

TABLE 10**Start up year of the Surveyed IT Firms in Bangalore**

Year of Commencement of Production	Number	Percent of Total Surveyed Firms
1970-1980	3	5.8
1981-1985	7	13.5
1986-1990	20	38.5
1991-1995	22	42.3
Total	52	100

Source: Field Survey, 1995

TABLE 11**Single Most Reason for any IT Firm to be Interested in India**

Characteristics	Category of Firm (% to the total responses)		
	Foreign Owned	Domestic	Joint Ventures
• Best of Value and Quality	62.5	20.0	25
• Lower Wages Compared to Competitors	6.3	35.0	12.5
• English Speaking IT Professionals	6.3	25.0	0
• Hardworking and Reliable	0	10.0	0
• Large Untapped Domestic Market	25.0	10.0	62.5

Source: Field Survey, 1995

IT Firms: Main Reasons for Choosing Bangalore as a Production Base

Almost certainly, all the surveyed firms acknowledged the enormous amount of investment made by the Indian central government in the electronics and the telecommunications sector in the city. This according to them was the foundation of the high technology industry in the city. It is interesting to note that what is now known as Silicon Valley (of the Santa Clara County) in California, USA received huge amount of US federal government funding in defence related activities during the time immediately after the second world war. This combined with the proximity to the Stanford University laid the foundation for modern day Silicon Valley. Similarly, the Indian federal government invested huge amount of money in defence related activities in firms in Bangalore. The existence of the Indian Institute of Sciences, and other engineering colleges was again extremely useful in laying the foundation of what is now evident in Bangalore.

Some of the surveyed firms, also made reference to the "technology and industry culture" that originated in the region in the early part of this century. In the early part of the twentieth century two *Dewans* (Prime Ministers) of the then Princely State of Mysore, Sir Viswesvarayya and Mirza Ismail, 'launched a remarkable programme of agricultural, industrial and social development. Viswesvarayya established a polytechnic in Bangalore, and government-owned factories there and elsewhere in the state' (Holmström, 1994: 16). India's leading industrial firm Tata endowed what is now the Indian Institute of Science, 'to be followed by a host of publicly and privately funded research institutes' (Holmström, 1976: 8). During the Second World War, India's first aircraft factory Hindustan Aircraft (now Hindustan Aeronautics) was founded in Bangalore. Thus at the threshold of India's Independence (in 1947), Bangalore had one of the most technologically advanced industries and work force of the time in India.

In the years after the Independence, the national government established some of the country's biggest public sector factories, notably Indian Telephone Industries, Hindustan Machine Tools (making machine tools and watches for export and domestic market), Bharat Electronics (mainly supplying the defence forces), and Bharat Earth movers. The private sector, according to Holmström, 'followed, taking advantage of the large number of engineers and skilled workers trained in the vast public sector factories' (Holmström, 1994: 18).

The causal factors for choosing Bangalore as expressed by all the 52 surveyed IT firms is summarised in Table

12. The factors have been divided into three major category, viz., government related factors, city related factors, and others. Over 85 percent of the firms ranked city related factors as most important reason (Rank 1) in choosing Bangalore. Within the city related factors, the surveyed firms have accorded highest importance to the availability of high technology professionals in Bangalore. In the city based factors, availability of high technology professionals and research institutes together account for almost 50 percent of all responses in city based factors.

To this, if the city's base as a high technology centre is added as an another locational factor, that accounts for 70 percent of all the city based factors as expressed by the all the surveyed IT firms in Bangalore. Thus three important city based factors (availability of skilled professionals, availability of research laboratories and institutes, and Bangalore being a centre for high technology production), account for almost three quarter of the city based factors (as expressed by Rank 1).

Government support, availability of high technology professionals, and research institutes and laboratories account for almost 50 percent of all the locational factors expressed by all the surveyed firms in Bangalore (Table 12). As evident from the Table 12, government support accounts for over 55 percent of the government related factors.

Unfortunately the ranking themselves do not reveal much of qualitative information. For example a particular factor may have got only one rank 1, and may have a high score on rank 2. This does not make it an extremely less important factor. To overcome that ranking problem, all the ranks were grouped into three major choice groups (Table 13).

Rank 1, 2 and 3 constituted most important choice; rank 4, 5 and 6 important choice; and 7, 8 and 9 less important locational decision (Table 13). Among the government related factors, more than 90 percent of the surveyed firms considered government support as an important locational factor (50 % of these find it as the most important locational decision). Availability of research laboratories and institutes scored higher than the availability of professionals. All the 52 firms find the research laboratories and institutes as an important locational factor (with 82.7% stating it as the most important factor). Interestingly, 5.8 percent of these 52 firms find availability of skilled professionals as a less important locational factor. This clearly demonstrated the importance attached by the IT firms in Bangalore to the research institutes and laboratories in Bangalore. Bangalore's position as a high technology centre, cheaper cost of living than Delhi and Bombay, and favourable physical climate were all cited as important locational decisions (but not the most important ones).

TABLE 12

Major Reasons for Choosing Bangalore (Ranked Scores)

Major Factors for Choosing Bangalore as a Production Base	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6	Rank 7	Rank 8	Rank 9	Total
Government Related Factors										
• Government Support	4	9	13	11	7	5	2	1	0	52
• Software Technology Park	0	0	0	2	5	5	16	22	2	52
• Electronic City	0	0	0	1	1	2	16	14	18	52
Sub Total	4	9	13	14	13	12	34	37	20	
Sub Total (% of Total)	7.6	17.3	25.0	26.9	25.0	23.0	65.3	71.1	38.4	
City Related Factors										
• Availability of High Technology Professionals	30	12	1	1	2	3	3	0	0	52
• Availability of Research Institutes and Laboratories	7	18	18	2	6	1	0	0	0	52
• Already a Major Centre for High Technology Production	3	6	10	18	4	5	5	1	0	52
• Cheaper Cost of Living than Bombay/Delhi	4	3	4	11	21	3	2	4	0	52
• Favourable Physical Climate throughout the year	0	4	3	4	4	26	5	4	2	52
Sub Total	44	43	36	36	37	48	15	9	2	
Sub Total (% of Total)	84.6	82.6	69.2	69.2	71.1	92.3	28.8	17.3	3.8	
Others										
• Sheer Convenience	4	0	3	2	2	2	3	6	30	52
Sub Total	4	0	3	2	2	2	3	6	30	
Sub Total (% of Total)	7.6	0	5.7	3.8	3.8	3.8	5.7	11.5	57.6	
Total	52	52	52	52	52	52	52	52	52	52
Total Percent	100	100	100	100	100	100	100	100	100	100

Source: Field Survey, 1995

TABLE 13

Importance of Locational Decisions (*Horizontal percentage*)

Major Factors for Choosing Bangalore as a Production Base	Very Important Locational Decision (Rank 1,2,3)	Important Locational Decision (Rank 4,5,6)	Less Important Locational Decision (Rank 7,8,9)	Total (%)
Government Related Factors				
• Government Support	50	44.2	5.8	100
• Software Technology Park	0	23.1	76.9	100
• Electronic City	0	7.7	92.3	100
City Related Factors				
• Availability of High Technology Professionals	82.7	11.5	5.8	100
• Availability of Research Institutes and Laboratories	82.7	17.3	0	100
• Already a Major Centre for High Technology Production	36.5	51.9	11.5	100
• Cheaper Cost of Living than Bombay/Delhi	21.2	67.3	11.5	100
• Favourable Physical Climate throughout the year	13.5	65.4	21.2	100
Others				
• Sheer Convenience	13.5	11.5	75.0	100

Source: Field Survey, 1995

Bangalore's Future and the Issue of Competitiveness

Most of the firms established a clear reason for being located in Bangalore. They were further probed on the sustainability of the Bangalore situation. In the set of questions that addressed this issue, the first one asked the firms if they still considered Bangalore as an attractive city for the location of the IT firms in India since they began their operations. More than three quarters (78%) of the surveyed firms still considered the city as an attractive location for setting up IT business in India. The most important reason to support that answer (in order of importance) were: better telecommunications and data communication infrastructure than any other city in India (35%), best city for IT business in India (28%), and more and more IT firms choose Bangalore as a production base (37), all of which according to the surveyed firms indicate Bangalore's continued competitive position. However, the overall infrastructure supply in the city came under severe criticism, with only a little over half of the surveyed firms (53%) agreeing that Bangalore's infrastructure was adequate to support further growth of IT industry in the city. This is a clear message to the urban administrators of Bangalore.

The surveyed firms referred to three clear problems that need to be addressed by the city's administrators

immediately. The first and foremost problem mentioned was the woefully inadequate power supply situation in not only the city but throughout the state of Karnataka. This was notwithstanding the fact that most of the IT firms consume very little electricity, and many of them have their own captive power generating facility independent of the state power supply. However these firms cannot provide electricity to the homes of its executives! Increasing pollution levels in the city, and congestion on the roads of Bangalore was the next major problem (34%). Absence of an international airport (20%), and very high turnover of professionals especially the software engineers (20%) were other problems largely worrying the surveyed firms.

6. SO WHERE DO WE STAND?

Having provided the analysis of the firms, and having explained the causal factors behind Bangalore's growth as a premier centre for IT business in India, the discussion turns to the title of this paper. Can whatever that is happening in Bangalore be understood within the theoretical framework of urban competitiveness? There are no clear cut answers to this question.

First and foremost the theme of urban competitiveness is still nascent. It is only in the last few years that

studies on the issue of urban competitiveness have started appearing in the field of urban and regional economics. Secondly, very few of these have attempted to define urban competitiveness. If one were to believe Krugman (1996) then there is still a long journey the competitiveness related studies have to traverse, before they are able to get methodical. Third, of the studies that offer some insights into the issue of urban competitiveness, most of them have adopted a very weak methodology in actually evaluating a set of urban locations, vis-à-vis the theme of competitiveness.

Many of the urban areas in the developing world are still struggling to have an independent economic identity, and one may ask a question "where are the resources for these cities to plan for their future, let alone talk of competitiveness?". To those who advocate such a view, the study of urban competitiveness may not seem to offer much. In fact it is precisely for this very reason that the study of urban competitiveness assumes even greater meaning and importance to the cities of the developing world. By specifically targeting on a group of economic activities, cities may be able to

attract investment into a particular sector or an activity. When two cities within a nation vie to host an international sports event, what can that be described as? Is it not competition? Although many a times the ultimate decision is political, still the basis of such a competition is on certain factors that only a particular city enjoys or offers. That is precisely what the study of urban competitiveness aims to do. To identify the key sectors or economic activities that offer maximum leverage to an urban area, so that the urban area can consolidate its position in that activity, and attract a larger share of investment than other urban areas. In this context the study of IT industry in Bangalore does offer tremendous insight into how the city has been able to project itself as a major centre for IT industry in India and abroad, and thus seems to answer the question raised in the title of this paper. However, there are many factors that have performed poorly in Bangalore. Poor urban infrastructure in Bangalore, and absence of venture capitalists to fund increasingly growing IT business in Bangalore are perhaps two of the most crucial factors that may elude Bangalore from being fully competitive in the IT sector in India.

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