

Government Policies with respect to an Information Technology Cluster in Bangalore, India

MEINE PIETER VAN DIJK

The southern states in India have developed a strong reputation as a source of software development services, with Bangalore, the capital of Karnataka, having the strongest reputation of all. This article focuses on the following issue: what determines the competitiveness of an information technology (IT) cluster? The following questions will be addressed: How did Bangalore become an IT cluster? What is the role of the external environment and, in particular, of the national, state and local governments for the development of this IT cluster? Will the Bangalore cluster benefit or suffer from the present recession in the IT industry in the US? Finally, what explains the success of an IT cluster?

The demand for software increased at about ten per cent per year in the 1990s, and there has been, moreover, a shortage of software experts in most developed countries. Given the labour-intensive nature of this work and the price of labour it is typically an activity to outsource to a country like India where many people have been trained in this field.¹ They speak English and are generally paid salaries, which are on the average one fifth of the salaries in developed countries. The interest in outsourcing is also linked to a trend in Western companies to concentrate on core activities and the perception that information technology (IT) service vendors have the economies of scale and technical expertise to provide services more efficiently than internal IT departments [Lacity and Hirschheim, 1995].

There are about half a million people working in the IT sector in India, with large concentrations in Mumbai, Bangalore, Delhi, Hyderabad and Chennai in that order – if measured in terms of number of headquarters of IT firms.² The southern states in India (especially Andhra Pradesh, Karnataka and Tamil Nadu)

Meine Pieter van Dijk is IHS Professor of urban management in emerging economies, the economic and financial aspects, at Economic Faculty, Erasmus University, Rotterdam. An earlier version of this article was prepared for the working group on science and technology for development at the EADI Conference, 2002, Ljubljana, Slovenia, 19–21 September [year?].

have developed a strong reputation as a source of software development services. In particular, Bangalore is often called the Indian version of Silicon Valley, referring to the concentration of computer-related enterprises in the city.

The article focuses on the issue of what determines the competitiveness of an IT cluster. After explaining the background of the IT cluster in Bangalore and its competitiveness, the research methods deployed will be discussed and the role of the government at the different levels mentioned will be analysed. Subsequently, the questions about how the IT sector in Bangalore reacted to the worldwide recession in the IT sector will be discussed.

BACKGROUND OF THE IT CLUSTER IN BANGALORE

With around 1,000 software companies employing over 80,000 IT professionals, Bangalore is the undisputed IT Capital of India (*Hindu*, 28 Feb. 2002). According to the same article in 2000–1, at least one company with 100 per cent foreign equity participation has set up shop in this city every week. Apart from IT majors like Infosys, Wipro, Tata Consultancy Services and Microland, the world's leading IT companies like GE, Texas Instruments, CISCO, Digital, IBM, HP, Compaq, Motorola, Lucent Technologies, Microsoft, Sun Micro Systems, Oracle, Novell and several others have made Bangalore their home.³

Since the 1970s software production has been outsourced to specialised companies. It took some time before India was accepted as a source for mass-production products of acceptable quality levels (*Swagat*, 2001, *Journal of India Airlines*). Cost-cutting has been high on the agendas of many computer firms and led to outsourcing [*Bhamagar and Madon*, 1997]. A catalyst for outsourcing has been the improvements in satellite communications. Secondly, the time difference between India and the United States is such that Americans can stop working on a job in the evening, send it by satellite to India, from where it can be sent back at the end of the working day, resulting in a 24-hour, across-the-world economy! Sixty per cent of Indian software exports go to the US. Also, many Indian programmers working on short-term contracts have gone to the US, which increased the total number of visas given to software professionals in 2000 to 100,000. Half of this number were Indian (*Financial Times*, 8 May 2001), of which an estimated 10,000 now have to go home because of the recession in this sector in the US.

Bangalore is a city of about 5 million inhabitants, a quarter of which are estimated to live in one of the 700 slums. It is not the only IT cluster in the country, but is often called India's IT capital, and specialises in software production. The capital of Andhra Pradesh (Hyderabad, or Cyberabad, as the Chief Minister likes to call it) and the capital of Tamil Nadu (Madras or

Chennai) are important competitors.⁴ Microsoft has, for example, selected Hyderabad for its development centre, while a computer firm called E4E has recently set up labs in Bangalore and Madras.⁵

During the Second World War India's first aircraft factory 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' [*Srinavas, 1998*]. In the years after independence the national government established some of the country's biggest public sector factories in Bangalore, notably Indian Telephone Industries, Hindustan Machine Tools, and Bharat Electronics and Bharat Earth Movers [*Renu, 2000*]. They have been drivers of Bangalore's fast growth. Bangalore is now known as a centre for outsourcing the development of software, a practice that was established up in the 1970s. Renu [2000] adds that overstaffing in the traditional government-owned industries resulted in skill supply for other enterprises and plenty of specialists, many of which became entrepreneurs of their own account. The private sector took advantage of the large number of engineers and skilled workers trained in the public sector companies. Contributing to the growth of this was the establishment of the Peenya industrial area, later called 'Electronic City' [*Bordia and Martin, 1998*].

Wipro is now India's largest listed software services company and earns about a third of its global IT revenues by providing research and development (R&D) services in areas such as broadband to equipment makers such as Nortel (*Financial Times*, 8 May 2001). In 1996 Philips of the Netherlands opened a software development centre in the city, where, by 2000, 750 people were already working only four years after the centre opened. The company grew 60 per cent per year in the early years (*Flying Dutchman, 2002*, Journal of KLM Airlines, No. 1 [Also given as 2001 in original]). Smaller firms often operate from residences and many of them are recent start-ups; Renu [2000] notes that the residential areas change their character when the buildings are used for commercial rather than for residential purposes. IT firms, however, are usually located in the city, or at one of the following locations: **Electronic City** [City/city?] (78 IT firms – 60 per cent of the total number at that location), ITPL-Whitefield, the Peenya industrial area and the Rajajinagar industrial estate. ITPL-Whitefield is the location for the international technology park. It has been established with an investment of around **Rs15.4 million** and is [was or is being] constructed with the active participation of Singapore.⁶ It caters exclusively to the needs of the IT industry and houses the state-of-the-art infrastructure necessary for the further development of the IT sector.

Renu [2000: 23] gives a more detailed picture of the IT sector in Bangalore by distinguishing the location of:

- Predominantly hardware firms in Rajajinagar, Malleshwaram, Jayanagar and Indiranagar;
- Software companies in Korammangala; and
- Computer peripherals in S.J.P. Road, Balepete and Chickpete.

She also classifies firms that are not hardware or software producers but dealers/agents, training institutes and others.

Renu, moreover, mentions that with a compound annual growth of almost 30 per cent between 1987 and 1991 the Indian software industry expanded almost twice as fast as the world-leading US software industry in that period [2000]. In Bangalore, major software companies Wipro, Satyam and Infosys continue to grow, but new activities are also developing – in particular, what is called ‘business process outsourcing industries’, ranging from call centres to managing back-office tasks.

Renu went on to consider why companies choose Bangalore city. The city is known for its favourable climate, which is slightly better than in many other Indian cities due to its altitude, and cosmopolitan character, having grown rapidly due to migration. It has been the state of Karnataka’s capital since the early twentieth century and had one of the first polytechnics in India. The availability of the Internet has facilitated this development and is now used to identify excellent Indian companies that have registered for outsourcing. Many IT companies selected Bangalore for setting up a plant because of the availability of cheap specialised labour and because Karnataka was the first state to develop its own IT policy. Also, the presence of a number of good research and training institutes is often mentioned [2000]. To this, Sachs *et al.* [2002] add that high-tech services such as information- and communication-based industries are almost always reliant on a network of universities and urban labour markets. Finally, a high quality of life at the location in question is also important.

We will try to establish whether these factors are important for the clusters studied, but we also try to identify other relevant and some city-specific factors.

RESEARCH STRATEGY

The major issues studied here are: how does the IT sector in Bangalore compare with IT clusters in other cities like Hyderabad? Is it an innovative cluster, which is able to be competitive? The theoretical framework used is based on Van Dijk [1999, 2000], which deal respectively with a classification of cluster case studies and with competitiveness at the regional, city, cluster and enterprise level. The research question formulated are:

- Which factors are influencing the competitiveness of the cluster of IT enterprises in Bangalore City?
- How does Bangalore compare with other Indian cities?
- What are the effects of local institutions and policies of local government?
- What are the advantages and disadvantages of a cluster of IT enterprises?
- To what extent is innovation taking place in the cluster?
- What explains the success of the IT cluster?

The hypotheses concerning the advantages of clusters formulated in theoretical studies such as Van Dijk [1999] can also be tested in this situation:

1. Clusters with limited interrelations between the enterprises are at an early stage of their development.
2. A labour division cluster would lead to more inter-firm relations.
3. A more developed cluster will stimulate innovation.

In explaining the level of development of these IT clusters, we will pay in particular attention to the demand conditions, the role of large firms in the cluster and the reliance on a network of universities and research institutions. Finally, the quality of life in Bangalore will be considered, as will some other city-specific factors.

To begin this section, though, two definitions and related criteria. 'Competitiveness' is considered a measure for the performance of a firm, cluster, city or region. IT companies are defined as companies for which selling, producing or developing hardware, software or products based on an intelligent combination of the two are important activities. 'Cluster' is defined as a physical concentration of similar or related enterprises. The following defining characteristics of a cluster were suggested for the fieldwork [Van Dijk, 1999]:

1. Spatial proximity (or nearness) of the enterprises. In the case of Bangalore the cluster extends only over a limited number of square kilometres.
2. A high density of economic activities, resulting from the relative concentration of similar or related enterprises.
3. The presence of firms involved in the same (competing), similar or subsidiary activities.
4. The existence of inter-firm linkages between enterprises as a result of (vertical) subcontracting, and specific forms of (horizontal) co-operation.

No primary data was collected by the author because a number of studies were already available and the main focus of the article is on the role of different levels of government with respect to the IT cluster in Bangalore, which can be

assessed in a more direct way by approaching the different institutions concerned and their relevant websites. Renu [2000] and Bordia and Martin [1998] collected primary data, while the work of Heeks [1996] and Heitzman [1999] contains information on policies in this city and state. Business journals like the *Financial Times* and Indian newspapers have also frequently and extensively covered the IT industry in Bangalore.

Use was made of a study of 120 IT enterprises studied with a pre-coded questionnaire with a limited number of open questions [Renu, 2000]. The research enables one to make the theory of the advantage of clusters specific for an urban economy in an Asian country in which activities related to the computer industry play an important role. It should also be possible to provide feedback to the computer companies and local government on how to increase the attractiveness of different Indian cities for IT activities and how to proceed with their nascent IT clusters.

THE ROLE OF DIFFERENT LEVELS OF GOVERNMENT

The fact that by now almost every Indian city is trying to build up an IT centre in the city or the region means it may be more interesting for new start-ups to eschew Bangalore as a location and benefit from the incentives provided elsewhere in the country. Some state or local governments certainly provide substantial benefits to make investments in this sector attractive. For example, the central government and the state concerned promote new investments in IT companies very seriously. There is certainly a tradition of stimulating the IT sector in general and clusters of enterprises specifically in states like Andhra Pradesh, Gujarat, Karnataka, Maharashtra and New Delhi. In 2001, for example, the government of Gujarat placed a huge advertisement proclaiming Gujarat to be the next big IT destination in almost all national journals (for example, *Times of India*, 29 June 2001). On the same day the *Economic Times* reported that P. Mahajan, minister of parliamentary affairs and IT, presented a strong case in Orlando (USA) to the CEOs of 150 IT companies to outsource to Indian IT firms.

Table 1 provides an overview of possible support for IT clusters in India. The policies listed are ranged from higher level (national), to state-level, city-level and enterprise-level initiatives. Unfortunately, only limited evidence could be found concerning the last type of initiatives. Also, public-private partnerships are not yet very common in India, while factors such as climatologically and quality of life seem to be the most important factors for locating in Bangalore.⁷

Moreover, Table 1 summarises the framework for the analysis of the Bangalore IT cluster.⁸ Each category will be considered in terms of what extent it is important in the case of Bangalore. Some varieties of public support could

TABLE 1
IT CLUSTER PROMOTION ACTIVITIES,
PARTIALLY THROUGH PUBLIC-PRIVATE CO-OPERATION

1. Policy-related incentives (for example)

1.1 Fiscal
1.2 Targeted Education and Training
1.3 Marketing Support – Cluster Marketing through Advertising, and so on.
1.4 Industrial Policies – Dispersal

2. Prices and Subsidies

2.1 Land*
2.2 Electricity and Water Supply
2.3 Enterprise Buildings

3. Innovation Promotion

3.1 Involving Research Centres
3.2 Stimulating Incubator Centres
3.3 Promoting Linkages with Training and R&D Institutions*

4. Physical Support

4.1 Space
4.2 Secondary (electronic) Infrastructure

5. Stimulating Co-operation

5.1 Group Formation of Enterprises and Consultation of these Groups
5.2 Promotion of Inter-Firm Relations*

6. Other Initiatives and Factors

Note: * These cases could lead to a public-private partnership.

even lead to public-private partnerships, something quite uncommon in the case of Silicon Valley – the classic example of an IT cluster [*Castells and Hall, 1994*].

National, State and City-Wide Policy Initiatives

In the years after independence the national government established some of the country's biggest public sector factories in Bangalore (see above). At the national level several other initiatives were taken to develop the IT sector in India. In this respect, the Prime Minister said recently that liberalisation has to go on (*Financial Times*, 7 Feb. 2002). However, Renu [2000] remarks that until 1977 the regulatory framework proved inadequate for the establishment of technological capabilities for new firms. The industrial policies restricted the access of these firms to technological resources from abroad, slowed down the innovation diffusion process and impeded quality competition. It was, however, successful in building the human capital stock necessary for the rapid growth of an indigenous computer industry. Hence, the emerging private

BOX 1
ATTENTION FOR THE IT SECTOR IN THE NATIONAL PRESS

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- 'Distorted duty regime to persist in finished component sector', *Economic Times*, 4 March 2002
 - 'Oracle is not scaling back in India', *Economic Times*, 4 March 2002
 - 'IT: the past, present and future', *Hindu*, 28 Feb. 2002
 - 'India prepared for the big bytes', *Economic Times*, 4 March 2002
 - 'Zhu's blessing puts Delhi in dilemma over IT alliance', *Financial Times*, 29 Jan. 2002
 - 'Blue chip cos. eye Bangalore for call center operations', *Economic Times*, 22 Feb. 2002
 - 'Software magnet', *Business Standard* (Bangalore), 22 Feb. 2002
 - 'Indian software weathers global recession', *Financial Times*, 6 Feb. 2002
 - 'Industrial service sectors growth expected to rise', *Financial Times*, 26 Jan. 2002
 - 'Have Silicon dreams. Need a push up?' *Economic Times*, 4 March 2002
 - 'IBM (India) plans focus on software solutions', *Economic Times*, 4 March 2002
 - 'Industry on a blazing trail', *Hindu*, 28 Feb. 2002
 - 'Welcome IT cluster', *Economic Times*, 21 Feb. 2002
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computer industry looked outside the country to replenish its stock of technological know-how. Presently, English-language newspapers in India announce new technology projects, usually at the national or state level, approximately every other day. Some recent headings are summarised in Box 1, which gives an impression of the importance attached to the development of the IT sector and the issues playing a role in its development.

The Indian authorities expect a lot from the IT sector and put considerable effort into its development. They are also willing to accept foreign investment in the sector if that could trigger off further development. Finally, the government clearly thinks in terms of public-private co-operation projects as a means of developing the IT sector.

BOX 2
STATE-LEVEL IT INITIATIVES IN KARNATAKA

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- First state to announce a comprehensive IT policy
 - Created a separate Department of Information Technology at an early stage
 - Used the available engineering colleges to train people for this sector
 - Houses and supports the Indian Institute of Science*
 - State government is setting up the government- and industry-led Indian Institute of Information Technology (IIIT-B) at Bangalore
 - Created Electronics City on the outskirts of Bangalore
 - Created Software Technology Park in Bangalore and Mysore; new ones due to open soon in Manipal and Mangalore
 - Created Information Technology Park at Whitefield, Bangalore
 - Introduced concepts of electronic kiosks and electronic governance
 - State-wide network being established
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Note: * Endowed by India's leading industrial firm, TATA.

Source: Renu [2000].

After the Prime Minister had set up the National IT Task Force in May 1998, chief ministers of various states have been setting up state-level IT task forces. The results for Karnataka are summarised in Box 2. The Karnataka state government is also considered very supportive for the development of the IT sector in the state. It will be concluded that policy efforts at the state and city level reinforced each other and contributed to the success of the IT sector.

Policies at the City and Local Government Level

Many cities in India are trying to attract high-tech industries by giving, for example, financial support. This is obviously also the case with Bangalore, which has a history of proactive planning and policy-making. Bangalore Municipality was established in 1862, and the city has a long history of urban planning [Heitzman, 1999]. The Bangalore City Corporation (BCC) was founded in 1949, which became the Bangalore Development Authority (BDA) in 1976. In 1985 the Bangalore Metropolitan Region Development Authority (BMRDA) was created with the authority to plan for a metropolitan region including the Bangalore urban district, the Bangalore rural district and one taluka in the Kolar district. In 1995 a plan was presented for the whole region. The Bangalore municipal government then started to formulate positive economic policies, both generally and with respect to small and medium IT enterprises in the city. Local government is very active and developed, for example, its own IT policy and looks for public-private partnerships for infrastructure development.

Type of activities for IT cluster promotion in Bangalore

1. Policy-related incentives (for example)

1.1 Fiscal – IT companies settling in Bangalore usually get a number of tax incentives. Incentives are also provided in India for investments in infrastructure. This instrument is used on a limited scale in Bangalore, however.

TABLE 2
CENTRES FOR SCIENCE AND TECHNOLOGY AND CENTRES OF
HIGHER EDUCATION IN BANGALORE

<i>Science and Technology</i>	<i>Centres of Higher Education</i>
Indian Institute of Science (IISc)	Indian Institute of Management
Indian Space Research Organization	National Law School
Regional Remote Sensing Services Centre	National Institute of Advanced Studies
National Aerospace Laboratory	University of Agricultural Science
Defence Research and Development Organization	
Indian Institute for Astrophysics	

Source: BMRDA [2002].

1.2 Targeted Education and Training – Companies benefit from the large number of education and training institutes in the city. The important ones are listed in Table 2, where a distinction is made between centres of science and technology (S&T) and centres for higher education.

1.3 Marketing Support – The State government is actively promoting Bangalore as the capital of software in India and abroad. The Chief Minister often travels to the US and receives, for example, Bill Gates (Microsoft) when he visits Bangalore (*Business Times*, 15 Nov. 2002).

1.4 Industrial Policies: Dispersal – In November 1971 the government of Karnataka thought that it was necessary to disperse industries to backward areas in the state. For that purpose the state was divided into four zones. An incentive package and concessions were made available to industries installing themselves in areas around the city of Bangalore which were identified as backward.

2. Prices and Subsidies

2.1 Land – Renu [2000] notes that, originally, no specific policy seems to have guided the location and development of industries in and around Bangalore. It was often convenient to set up units along or in the vicinity of high roads. Subsequently, a policy of discouraging new industries in Bangalore itself became effective. Investment subsidies were, for example, not permissible in Zone 1 (covering the Bangalore urban agglomeration). However, interest subsidy on term loans was possible and price preference for small-scale units for the first five years was also possible. The policy was modified after two years when two industrial estates were excluded from the rule [Veerasandra and Bommasandra] **is this a reference to a study that isn't in the references or names of the two estates?** and Electronic City was shifted from Zone 1 to Zone 2. No examples of public-private partnerships based on land were found.

2.2 Electricity and Water Supply – The early industrialisation of Bangalore was positively influenced by the availability of cheap water and electricity and the authorities made an effort to keep up a regular supply of these services.

2.3 Enterprise Buildings – No examples of the government providing enterprise buildings were found. This is an important incentive for IT industries in China to opt for a certain location [Van Dijk, 2003].

3. Innovation Promotion

3.1 Involving Research Centres – No evidence was found of government efforts to stimulate IT companies to link with existing research institutions.

Although the presence of six major science and technology institutions and four major centres of higher education were not the main reasons to choose Bangalore, the companies located there do benefit from the substantial number of education and training institutes in the city. This helps in providing the large amount of skilled labour necessary for such an industry.

3.2 Stimulating Incubator Centres – No evidence was found of incubator centres created by local government in Bangalore.

3.3 Promoting Linkages with Training and R&D Institutions – This was not an official policy; however, some of the IT enterprises have developed linkages with the existing R&D institutions.

4. Physical Support from the Government

4.1 Space – Space has been made available for IT companies; Renu [2000] also notes co-ordination between industrial and urban development in the state, which contributed to successful industrialisation. The urban planning department recognised that the planning exercise must concern itself with the major function of [a/the?] city, which is providing economic growth in the state in this case. The approach was not so much controlling the pattern of land use, but rather optimising land use in terms of economic returns, employment generation, provision of shelter and the raising of additional resources for the city's development.

4.2 Secondary (electronic) Infrastructure – Renu [2000] concludes that the industrial areas and estates in Bangalore district are better serviced than those in other parts of the state. The existing electronic information infrastructure allowed the creation of back-up centres in rural India during the crisis between India and Pakistan in June 2002.

5. Stimulating Co-operation

5.1 Group Formation of Enterprises and Consultation of these Groups – No evidence was found that this is an important activity in terms of government input in Bangalore.

5.2 Promotion of Inter-Firm Relations – Two government organisations, the Karnataka Industrial Development Board (KIADB) and the Karnataka State Small Industries Development Corporation (KSSIDC), contributed to the promotion of industrial development. KIADB did this in and around Bangalore, while KSSIDC set up a large number of industrial estates (16) in the Bangalore district.

6. Other Initiatives and Factors

Karnataka is known for the relatively peaceful industrial relations that prevail in the state. Bangalore seeks to improve the quality of its urban environment by restructuring the inner city and stimulating expensive housing areas. The city is also cooler than most Indian cities because of its altitude. Finally, it is considered a green city, which has certainly contributed to its attractiveness to the IT sector.

THE RECESSION: LOSES OR BENEFITS?

Thousands of Indian software engineers are likely to return to India because of the slowdown in the economy of the United States (*Financial Times*, 8 May 2001). In many cases it means 'back to Bangalore'. The big question is whether the Indian concentration of software companies in this city is going to benefit from the recession because American firms will be tempted to subcontract more to a low-income country, or whether they will suffer from the slump in demand and the large number of unemployed IT workers.

It is known that American telecom equipment makers operating globally, companies such as Cisco and Nortel, not only cut jobs but also curb outsourced projects. The latter has put on hold a three-year, \$350 million investment in India, including a new research and development plant (*Financial Times*, 8 May 2001). The bigger companies, such as Wipro and Satyam, were somewhat hit, but also better placed to search for new markets – the European market, for example. Moreover, new activities have been developed, such as investing in call centres or managing back-office tasks for foreign customers – such as paying bills (*Economic Times*, 22 Feb. 2002). Finally, it has been noted that billing rates have fallen in the current recession and may not rise very fast even in a global recovery because of stiff competition from China (*Economic Times*, 21 Feb. 2002) and Taiwan (*Business Standard*, 22 Feb. 2002).

Ultimately, in terms of surviving the recession, much depended on whether the Indian software makers managed to find other markets outside the major contracting markets of the US and Japan; Europe has become more important recently. The crisis also forced companies to become more practical and focus on solving real-world problems (*Financial Times*, 13 Feb. 2002): it meant operating on leaner budgets and focusing on finding new customers.

The meltdown of the IT sector in the US had serious implications for the Indian information technology industry. However, US demand in 2001 was again 40 per cent higher than in 1999, the pre-crisis year (*Financial Times*, 18 July 2001). Indian software exports totalled \$1.9 billion during the last three months of 2001, a 25 per cent increase compared with the same period in 2000. Admittedly, this is slower growth than in the previous ten years, but it shows a basically resilient IT industry sector. The year 2001 was the first

recession that the IT sector in Bangalore has faced. However, they weathered the recession quite well and even achieved some growth in their production (*Financial Times*, 6 Feb. 2002). Although most companies have tried to diversify their production, two-thirds of the orders still come from the US.

OTHER FACTORS INFLUENCING THE DEVELOPMENT OF BANGALORE'S IT CLUSTER

The effects of the world-wide stagnation in the IT industry on India's emerging economy are limited. It could have been a threat because fewer products are demanded, but it was also an opportunity because there was even more demand for low-cost suppliers. The forecasts for the exports of the Indian software sector were lower growth in 2001 – decreasing from 55 per cent in 2000 to 40–45 per cent in 2001 (figures from the National Association of Software and Services Companies in New Delhi). The final figure was 25 per cent, which is still substantial. Nonetheless, the industry did face reduced demand for the first time after a decade of rapid growth.

To find out to what extent the cluster is a real cluster with labour division and innovation diffusion, we looked at the inter-firm relationships. Normal economic relations (buying and selling) between companies in the cluster are not very well developed. However, other types of co-operation (the exchange of ideas, carrying out projects together, and so on) seem to be quite important. Many IT firms have well-developed relationships with other companies, government or universities, but it does not seem to lead to much labour division or innovation.

Innovation is certainly taking place in individual companies and many companies invest a substantial part of their profits for this purpose. Some firms consider innovation to be the result of carrying out jobs for others. The overall evidence suggests that this cluster is not yet a fully developed, innovative cluster [*Van Dijk, 1999*]. The cluster still has to develop further into a full labour division cluster, which currently is hardly the case. Complementary activities are carried out jointly on an infrequent basis; only when these activities are more frequent could Bangalore's IT cluster become a truly innovative cluster.

In the case of Bangalore, then, the importance of **local demand** is not so significant. The **role** of large firms is important, but these were **not necessarily large foreign firms**. [not entirely clear] R&D was present and has been developed, although it is not the key to understanding the success of Bangalore. Finally, the quality of life factor certainly contributed to making Bangalore an attractive city for a knowledge-intensive industry.

POLICY RECOMMENDATIONS FOR FURTHER DEVELOPMENT OF THE IT CLUSTER

Significant activity is already occurring at the international level to promote India as a country for software outsourcing. Central government is aware that high-tech industries can help to employ people, attract investments and earn foreign exchange. Typically, India was one of the first developing countries to sign international agreements on intellectual property rights. Different levels of government can do more, though, to develop IT activities. In particular, the following policies would be recommended at the different levels:

State level –

- Provide space and appropriate infrastructure for IT companies, to the extent that this goes beyond the border of the cities;
- Provision of incentives and the facilitation of exports by state-level authorities;

City level –

- Develop a vision and strategy for the further development of the IT sector, answering the question ‘what is the best strategy to develop the sector further?’
- Provide co-ordination between the different levels of government, such as between the different plans of different districts;
- Stimulate entrepreneurs to organise their own networks and accept those in discussions as the major private-sector partners for the government;

Local government level –

- Consider the entrepreneurs or their organisations as partners for a dialogue;
- Provide space and infrastructure;
- Supply buildings and business support services;
- Provide other incentives;
- Attract foreign investors;
- Provide information to entrepreneurs;
- Set up an enterprise network;
- Promote linkages with local knowledge centres, such as the existing universities and R&D institutions.

In general, the Indian government should provide an enabling environment for IT enterprises and, in particular, create a starter-friendly environment. At the enterprise level, the choice is between focusing on a narrow market segment and building sectorial expertise or capturing broader markets. At the national level, a more positive attitude towards foreign investments in this sector could



help to attract foreign capital and the latest technology. Foreign direct investment may also help to conquer new markets and provide benefit from international management practices.

CONCLUSIONS

Bangalore, a state capital, became the location of the first concentration of IT industries in India, but it is not one of the most important cities in India; rather, it happened to be the first technology centre in India. Bangalore seeks to improve the quality of its urban environment by restructuring the inner city and stimulating the development of expansive housing areas. In Bangalore, a weak demand for its products was never an issue because of the importance of software exports. In terms of our theoretical framework, several educational institutes and research centres are located in Bangalore and contributed to the development of the city as an IT centre. However, this was not a crucial factor, except for providing the necessary cheap and skilled labour.

There may be not enough relations between the existing R&D institutions, the universities and the IT sector. However, the low wages and the high number of skilled workers have worked to the benefit of Bangalore. This labour force speaks English and has received a solid technical education. Indian government policies focused on creating an enterprise-friendly environment and on attracting foreign capital to the city; the authorities did use the locally available knowledge resources as a sales factor. Bangalore also has some large technology enterprises. The most important factors for the city's success, though, were the climate and the presence of already established high-tech industries, which provided the right environment for the software sector to develop.

The development of the software sector in India in general and in Bangalore in particular has had a 'demonstration effect' for other industrial sectors. IT industries are non-polluting and labour and knowledge intensive. It demonstrated to other companies that export-orientation can pay off, that foreign investment can give access to technology and markets, and that strategic alliances may be very rewarding. It has also improved India's image abroad in terms of entrepreneurial and technological capabilities [Renu, 2000]. In terms of **Porter's diamond** [will the readership understand this phrase?], the existence of a large local market also contributed to the development of the sector [Porter, 1990]. [Odd place to introduce a new theorist/idea.] For the time being, India's attractiveness for software development remains undiminished.

NOTES

1. Hewlett-Packard, for example, has facilities in India, as well as Mexico, Singapore, Scotland and other countries (*Datamation*, 2000).
2. To put this figure in perspective, 560,000 people have lost their jobs in the IT sector in the US since the IT bubble burst in 2001 ('US high-tech job market plunges', *International Herald Tribune*, 20 March 2003).
3. TCS, Infosys, Wipro, Satyam and HCL are considered the big five in IT in India (*Economic Times*, 21 22[2, 12?(i.e., Feb., Dec?)] 2002).
4. India's capital, New Delhi, also has an important concentration of computer-related industries.
5. These labs will provide the kind of support Stanford University has provided to Silicon Valley (*Financial Times*, 28 Feb. 2001).
6. The rate of exchange was 45 rupees to the dollar during 2002.
7. No efforts were made to assess the quality of life in an objective way, but entrepreneurs interviewed often referred to the attractiveness of Bangalore as a city to live in.
8. The framework has been developed for a comparative analysis of two Asian and two European IT clusters, together with Willem van Winden at Erasmus University.

REFERENCES

- Berg, L. van den, E. Braun and W. van Winden**, 2001, 'Growth Clusters in European Cities: An Integral Approach', *Urban Studies*, Vol.38, No.1, pp.185-205.
- Berg, L. van den and W. van Winden**, 2000, *ICT as Potential Catalyst for Sustainable Development*, Rotterdam: EURICUR.
- Bhatnagar, S.C. and S. Madon, 1997, 'The Indian Software Industry: Moving Towards Maturity', *Journal of Information Technology*, No.12, pp.277-89.
- BMRDA, 2002, *Metropolitan Bangalore: The Future City*, Bangalore: Bangalore Metropolitan Region Development Authority.
- Bordia A. and A. Martin, 1998, *A Study on IT Clusters in Bangalore and Hyderabad*, Ahmedabad: IIMA.
- Castells, M. and P. Hall, 1994, *Technopoles of the World: The Making of 21st Century Industrial Complexes*, London: Routledge.
- Dijk, M.P. van, 1999, *Small Enterprise Clusters in Transition, a Proposed Typology and Possible Policies per Type of Cluster*, Copenhagen: Copenhagen Business School.
- Dijk, M.P. van, 2000, 'Decentralization Provides New Opportunities for Urban Management in Emerging Economies' inaugural address, IIS Erasmus University, Rotterdam. [date?]
- Dijk, M.P. van, 2003, 'Is the Concentration of IT Companies in Nanjing an Innovative Cluster?' in D. Fornahl and T. Brenner (eds.), *Cooperation, Networks and Institutions in Regional Innovation Systems*, Cheltenham: Edward Elgar. [page nos?]
- Dijk, M.P. van and H. Sandee** (eds.), 2002, *Small Enterprises and Innovation*, Cheltenham: Edward Elgar.
- Heeks, R.B., 1996, *Indian's Software Industry State Place, Liberalization and Industrial Development*, New Delhi: Sage India.
- Heitzman, J., 1999, 'Corporate Strategy and Planning in the Science City: Bangalore as Silicon Valley', *EPW* (Jan. 30). [page nos?]
- Lacity, M. and R. Hirschheim, 1995, *Information Systems Outsourcing: Myth, Metaphors and Realities*, Chichester: Wiley.
- NCU, 1988, ...[?]
- Porter, M.E., 1990, *The Competitive Advantage of Nation*, London: Macmillan.
- Ravindra, A.**, 1996, *Metropolitan Bangalore: A Management Perspective*, Calcutta: Times Research Foundation.
- Ravindra, A.**, 2001, *Urbanization of India, Need for a Greater Momentum*, Bangalore: Government Press.
- Renu, R., 2000, 'Autonomous IT Firms in Bangalore City: Location Rationale', thesis for postgraduate diploma in planning, School of Planning, Ahmedabad.
- Sachs, J.D., N. Bajpai and A. Ramiah, 2002, 'Geography and Regional Growth', *The Hindu*, 25 Feb. 2002.
- Srinavas, S., 1998, 'The Information Technology Industry in Bangalore: A Case of Urban Competitiveness', DPU Working Paper No.89, April.