

Chapter 16

Bangalore's Software Cluster: Global Webs and Local Corporate Systems

Rasmus Lema

1. Introduction

Nationally or regionally specific models of capitalism may combine the institutional arrangements of markets, hierarchies, and networks in different ways, resulting in interfirm relations that are complementary to different 'varieties of capitalism'. Whereas the current 'phase' of globalisation is often thought of as rooted in and guided by Anglo-American principles of capitalism, most of the cases examined in this book exhibit some variety and degree of 'Asian capitalism'. The key debate between the 'globalists' and the 'globalisation sceptics' in this regard, is whether the increasing transnational coordination of economic activities is outstripping local organisational structures and institutional arrangement combinations. The proposition forwarded in this book is that local forms of organisation may show considerable resilience towards external pressures, varying with the 'agency' of local actors and the institutional capacities for local adjustment (see chapter 6).

This chapter delves into the issue of the relationship between the increasing transnational coordination of production and local organisational structures, focusing specifically on the relationship between 'global economic webs' and local 'corporate systems' in the case of the fast growing software cluster in Bangalore in southern India. As an unambiguously export-oriented cluster, particularly dependent on the US market, Bangalore provides an interesting case for the examination of the propositions at stake. Moreover, understanding the corporate system in Bangalore and its adjustment to global webs reveal important insights into the global organisation of high-tech industries and its local implications, not least for the many developing countries trying to emulate India.

* This chapter, including quotes and other primary data, is based on a study conducted jointly with Bjarke Hesbjerg, and therefore this chapter reflects his efforts as much as my own (see Lema & Hesbjerg 2003). Fieldwork was undertaken in the third quarter of 2002. I would like thank GlobAsia and associated researchers particularly, Laurids S. Lauridsen and Birger Linde.

Two basic facts validate that Bangalore should receive serious attention. Firstly, while only 55 software firms in the world have reached level five in the globally acknowledged quality certification, Capability Maturity Model for software (CMM), 22 of these are located in Bangalore (Naidu 2002:7).¹¹⁵ Secondly, Bangalore is placed on a shared fourth place in terms of the most advanced technology hubs in the world (UNDP 2001:45).¹¹⁶ During the last 15 years Bangalore has grown rapidly and has become established as a hotspot on the global IT-map. The city has drawn much attention as a successful knowledge-oriented hub in a developing country.

The central questions addressed in this chapter are the following. (a) How is the character of the local corporate system in Bangalore related to the clusters export success? (b) What has been the role of global webs in forming the corporate system? (c) What are the immediate developmental implications of Bangalore's insertion into global economic webs? I explore these questions by focusing on firms based in the software cluster in Bangalore, their interfirm relations, as well as relations to firms external to the cluster. Although the primary empirical material is related to the local level it is used to discuss the broader patterns of local-global interaction.

Accordingly, the chapter proceeds in seven short sections. The next section briefly discusses different types of global webs and corporate systems and the relationship between them, while section three provides a brief outline of the software production process. The three subsequent sections are more directly concerned with the question posed above. Section four discusses the role of global webs in forming local outcomes, while section five continues the discussion of the character of the local corporate system. Building on the preceding discussion, section six discusses the dynamics of the industry with regard to the implications for industrial upgrading. The concluding section returns to the discussion of the wider implications of the case of Bangalore for the discussion of whether expanding global webs are outstripping local organisational structures.

Contrary to the expectations that follows from the 'resilience hypothesis' forwarded in this book, the chapter argues that in the case of Bangalore it was primarily global change processes and international actors that shaped its development pattern. The software industry in Bangalore

¹¹⁵ The SEI-CMM (Carnegie Mellon Institute Capability Maturity Model) is a model for judging the maturity of the software processes of an organisation.

¹¹⁶ Thus, on UNDPs 'technological achievement index', Bangalore had a score of 13 along with Austin, San Francisco, and Taipei.

constitutes a form of capitalism that is complementary to the US-dominated mode of globalisation. While this model has buttressed fast growth in the cluster, it may also have important shortcomings in order for the cluster to move further up the value chain.

2. Global Webs and Local Corporate Systems

A central feature of current global capitalism is the increasing transnational organisation of production, captured in this book under the heading of 'global economic webs' (see chapter 4). Whereas global webs are related to the vertical sequence of global-scale production, 'corporate systems' relates to linkages between firms at the local level (see chapter 2). Corporate systems, then, refer to interfirm relations within bounded localities, often (but not necessarily) between firms that are horizontally related vis-à-vis the process of production.

In both global economic webs and local corporate systems relations between firms may take a variety of forms. Although scholars have identified a broad variety of interfirm set-ups, one may perceive of interfirm relations as varying in simple continuum between 'thinly' and 'thickly' relational linkages. Thinly relational linkages may be confined to the formalised and short-term exchange of goods and services as well as information on prices and quantities. Firms are 'arms-length' related and exhibit a large degree of autonomy in relation to each other. Thickly relational linkages, on the other hand, reflect more reciprocal and durable relations between firms. Such linkages may be based on authority or trust and are often embedded in personal relations between actors.

According to Sturgeon (2002; 2003), global economic webs are increasingly taking the form of a 'new American model of industrial organisation', i.e. of thinly relational and flexible linkages among firms (see chapter 4). Building on a 'strength of weak ties' argument, Sturgeon contends that open, thinly relational linkages among firms in these networks spur greater adaptability to changing market conditions than do various forms of relational networks. Hence, there are signs that such thinly relational networks may become the dominant form of global webs; they may be replacing more relational production network forms that, in turn, will become isolated.

McKendrick, Doner & Haggard (2000) have argued that IT industries tend to be organised into two different types of clusters, 'technology clusters' and 'operational clusters'. Lead firms that focus on product development and ongoing innovations dominate the first type of cluster, relying to a large extent on tacit knowledge and face-to-face interaction. The

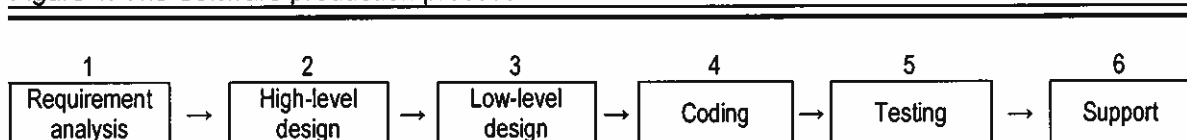
second type of cluster is focused on generic manufacturing, assembly and logistics. Hence, while interrelated, these clusters are focused on different lines of activity, linking firms and supporting institutions. In line with these arguments Sturgeon contends that lead firms seek to leverage relational linkages locally in areas of cutting-edge technology characterised by a large degree of tacit knowledge, while to an increasing degree outsource all aspects of production that can be codified. Although Sturgeons work has been centred on US-based lead firms and their strategies, he argues that the regions tapped by such ‘modularised’ production networks tend to be ‘relatively open systems that can fulfil a specialized role within larger, global-scale production networks’ (Sturgeon 2003:217).¹¹⁷ They may be viewed as pools of resources and infrastructure which global firms can dip into as and when required (cf. Amin & Thrift 1992:577).

3. The software production process

A key distinction in software development is that of customised and productised software. The first type take the form of costumer-specific solutions that are sold by IT consulting firms, including leading ones such as such as PricewaterHouseCoopers, Accenture, and Cap Gemini Ernst and Young. This form of software development involves close interaction with the end-user. Software products, on the other hand, are generic in the sense that they are not aimed at specific end-user although they may be aimed at a specific type of users (such as the financial market). Examples of leading software product firms include Microsoft, Oracle, and Sun Microsystems.

The production process for software may be described as consisting of six steps, decreasing in skill intensity and value-addition. These steps are shown in figure 1:

Figure 1: The Software production process



Source: Arora et al. (2001a:1268f)

¹¹⁷ In systems theory ‘open systems’ appear nested within a larger systems and the linkages between these levels can have important ramifications. ‘Closed systems’ on the other hand exhibit internal inter-locking relationships between its components. In this context a ‘stand alone’ cluster may resemble a closed system.

The first step may take place concurrently with market surveys (e.g. for determining the needs for a new generic licensed product) or it may take place in consultation with a specific end-user. The second step is the design or architecture of products/projects that is built up of objects or modules, whereas the third step is concerned with the design of these specific modules.¹¹⁸ The fourth and fifth step, where actual software code is written and tested, is referred to as 'programming'. The last step consists of the maintenance of existing data systems.

For firms catering for end-users in the market for software products and IT consulting, the first two steps are the critical lines of activity. Success in these areas requires large R&D and 'branding' investments. If successful, however, such activities also offer high revenues for firms that can focus on niche markets. Moreover the development of software products also offer close to infinite economies of scale (zero marginal costs) and 'downstream' business in the form of services related to the products. Programming is a labour-intensive process with low barriers to entry, stemming from relatively small fixed costs

4. Bangalore in global webs

The global webs that Bangalore feed into reflect the transnational dispersion of the production process shown in figure 1. These webs may be divided into two broad varieties.

The first variety is driven by foreign direct investment as TNCs locate wholly owned subsidiaries in Bangalore to undertake software production activities. More than 100 of the 1154 software companies in Bangalore (including those with headquarters outside Bangalore), are wholly owned foreign subsidiaries of TNCs (April 2003). Among the ten largest software exporters in Bangalore four firms are subsidiaries of US and European brand-name TNCs: IBM Global Services India, Texas Instruments, Cisco Systems India, and Philips Software Centre (KSDIT 2003). Bangalore is used as supply base buttressing TNCs' different lines of business. Some, such as the Texas Instruments subsidiary, provide process-inputs and even R&D conducted in the Bangalore to the parent company. Others, such as Cisco, have also entered alliances with leading Indian owned firms for the development of products marketed by the parent companies. TNCs such as IBM and Philips (who both have large IT consulting divisions) use

¹¹⁸ Hence the second stage, where subcontractors produce specific modules for a leading firm offshore may be seen as similar to 'original equipment manufacturing', OEM, whereas the third stage may resemble 'own brand manufacturing', OBM (Tschang 2001:20).

Bangalore as an export platform to provide brand name IT consulting service and solutions, while leveraging from the low cost of engineering manpower.

The second variety of global webs – which will be given the most emphasis here – is based on outsourcing relations as software production tasks are shifted from the traditional software producing countries (primarily the US but also Japan and European countries) to Bangalore-based software suppliers. The vast majority of firms in Bangalore are Indian owned and cater almost exclusively for the foreign markets (or for the MNCs located in India). The six Indian owned firms among the top ten firms are, Infosys Technologies, Wipro, Tata Consultancy Services, Digital Global Soft, I-Flex Solutions , and Mphasis BFL (ranked by export turnover).

The nature of the outsourcing relations between Bangalore and OECD-based firms has changed significantly during the last twenty years. In the early 1980 when the first few software firms were established, these firms sent Indian software programmers overseas to their customers' premises to conduct low-end maintenance and testing work. While onsite work still constitute 50% of Indian software, many tasks, which were previously done 'onsite' were shifted 'offshore' to firms in India during the 1990s (c.f. table 2).

Today the niche of the majority of Indian firms is based on providing complementary services vis-à-vis their foreign customers. For instance Kshema Technologies, a successful software service firm established in 1997, in it's marketing efforts explain their 'business model' as one in which the local firm is a 'virtual extension' its foreign customers. This business model in precise way captures the essence of the nature of current outsourcing relations between local firms and their customers:¹¹⁹

The Virtual Extension is a customer centric business model that involves the creation of software unit which operates like the customer's own software services unit [and therefore this model] offers a virtual ownership of a part of Kshema to the customer. The virtual extension ... has unlimited scalability (Kshema 2003).

In the industry such software units that operate like the customer's own software services units known as dedicated ODCs, offshore development centres. Firms earmark an isolated part of the company's premises and a team of employees to the customer as to protect the intellectual property of the customer firm. The customer centricity is underscored by the term

¹¹⁹ Elsewhere, Lema & Hesbjerg (2003:164-67) have argued that it captures the essence of relationship between Bangalore and customer destinations broadly, in which Bangalore may be seen as a virtual extension to leading technology clusters in the west.

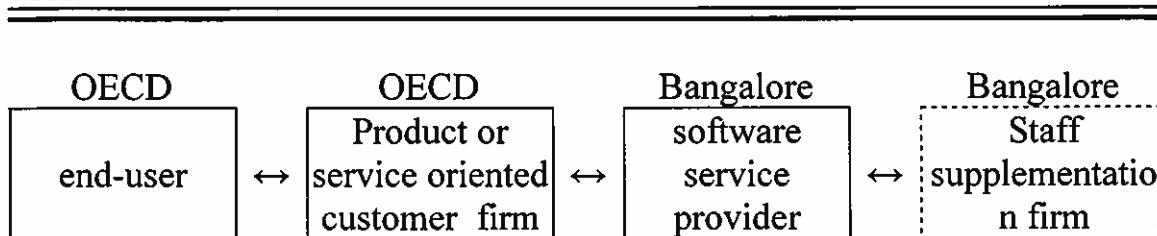
'offshore' adopted by the industry which is seen from the customers' point of view.

The business models of most Bangalore based firms are similar to the 'virtual extension' but come under different names. This model entails a clear division of labour between product or brand-name service oriented customers and 'generic' service oriented local firms. An interviewee in Bangalore's leading firm, Infosys, explained the logic behind outsourcing 'alliances' between local firms and their foreign customers as win-win situations:

Microsoft was clearly one of those; they did not have a services portfolio, we did not have a product portfolio. We say we will not get into products and that's a very strong statement from us, and from them they have made a commitment that services will be given to partners

In this arrangement Microsoft do need to fear the loss of intellectual property such as ideas and design for productised software, and in return Infosys acquire lucrative outsourcing orders. Currently Infosys has on average more than a 30% profit margin on each project that it undertakes. This arrangement clearly illustrates the division of labour in the global-scale webs that most Bangalore based firms feed into. Brand name customers located in the OECD – primarily the US – such as Microsoft in products or Accenture in IT consulting services handle contact with end-users and/or develop and market products for end-user markets. The Bangalore based software service providers function as suppliers, offering cheap software process services with little risk and high scalability for the lead firms. Therefore local firms focus on process tasks applicable across a wide range of business domains. Software service providers, if successful, cater for a very large number, sometimes hundreds, of customers, as opposed to a small number in some relational networks. For instance Infosys had over 300 customers during 2002 while Wipro had close to 250 (The Hindu 2002a). This large number of customer firms in a broad range of business domains also underscores the generic or non-specific character of software production in Bangalore. As discussed in the next section these service providers sometimes 'in-source' low end programming staff on temporary basis. Figure 2 below show a descriptive and stylised model of the global-scale webs inking Bangalore with OECD based firms and end-users through outsourcing relations.

Figure 2: Global webs linking Bangalore with OECD-based firms and end-users



Source: Interviews

Often, the OECD based customers undertake requirement analysis and provide high-level design specifications (steps one and two in figure 1) while local firms provide the remaining functions in the production chain including low-level design (step three to six). Indian software export normally take the form of modularised inputs but may in some instances extend to high level design (step 2), in which case they provide entire programs that are marketed by the customer firm in an American or European brand name wrapper.

As a result of this division of labour R&D in local firms is concentrated on the enhancement of downstream processes (primarily steps three to five). Typical areas of R&D efforts are 'process-innovations' i.e. technologies to create repeatability across projects in the form of 'software components' that are reusable. Other areas are development of project management frameworks and work related to industry standards.

The nature of linkages in the outsourcing relations between local and foreign firms, the type of information flowing between the Bangalore based firms and their customers extend well beyond price and requirements as in some thinly relational linkages. Rather, large amounts of production related information flows back and fourth. In one ODC dedicated to an America brand name network technology firm which was visited during fieldwork the manager explained how ODC staff had online access to parts of the customers intra-net and was able to retrieve 'real-time' design specifications, appraisals and other production related information. Furthermore, linkages between Bangalore firms and customers in most instances involve some sharing of sensitive information, such as intellectual property (design specifications) or end-customer data (in IT consulting). The linkages

between local firms and their customers, however, are not appropriately described as 'thick'. In order to reduce risks connected with the 'sharing' of critical information the customer firms often conditions the relationship in very detailed written contracts. Furthermore, as the interaction between local firms and overseas customers have become formalised and digitised to a very large extent, the relationship between buyer and supplier has moved towards autonomy. Because of the limited degree of tacit knowledge embedded in the relationships 'switching costs' are small.

In trying to move up the value chain leading Indian firms now aim to take a full-service stance in providing end-to-end consulting 'solutions'. In these cases, firms move toward analysis and requirements for software service projects. Besides bringing more downstream work, such work is more skill-intensive and generates higher revenues per man-hour. However, Indian firms have had little success in this area. For instance Bangalore's leading firm, Infosys, is also one of the firms that has moved farthest in terms of consulting; yet revenues generated from this line of activity constitutes four percent of overall revenues. The provision of consulting solutions requires tacit domain or firm-specific expertise while downstream work, constituting the vast majority (less than 1%) of the Indian service providers' revenues, does not.

Some firms have also sought to penetrate the software product market. India's most notable technology-driven company, I-flex, is located in Bangalore and is ranked among the top 10 firms by export revenues. Around 60% of I-flex's revenues are generated from product licenses and related activities, aimed at the financial services market.¹²⁰ However, Iflex is a lone star and many of the firms trying to break their way into productised software where intellectual property rights are acquired are SME's. They often lack the resources necessary for success in this area, a problem that is reinforced by Indian venture capitals widespread conservatism and unwillingness to finance product development (Arora, et al. 2001b:22). During the financial year 2001-2002 products constituted a mere four percent of total Indian software exports (c.f. table 2)

5. Corporate system outcomes

Recent developing country cluster studies have identified strongly hierarchical corporate systems, where outsourcing orders are received by a

¹²⁰ Recently the firm was chosen by the International Monetary Fund to implement its flagship-banking product, Flexcube, to streamline operations in the areas of lending, deposits, financial accounting, and business intelligence (The Hindu 2002b).

few leading firms within the cluster, but which are actually undertaken by a number of SME's (Bair & Gereffi 2001). This has meant that leading firms in such clusters have upgraded and evolved into 'full-package' suppliers, on the one hand maintaining its linkages with customer firms and on the other hand subcontracting less-skilled work to other SME's in the cluster. As shown in table 1, there is top-heavy structure in Bangalore too, with huge differences between the leading (large and successful) and following (small and striving) firms of the cluster.

Table 1: Number and size of companies with headquarters registered in Bangalore

Value in US \$ Million	1999-2000	2000-01	2001-02
Above US \$200M	0	2	2
Between US \$20M-200M	6	13	13
Between US \$2M-20M	51	66	95
Less than US \$2M	100	189	246
Less than US \$0.5M	277	212	326

Source: KSDIT (2003)

Certainly these differences reflect differences in linkages to TNCs, varying with the number of linkages and their 'throughput capacity', largely dependent on suppliers ability to ramp up fast. However, they do not to any considerable extent reflect their position in a cluster-internal division of labour.

Limited differentiation in customer-centric business models and capabilities is a critical feature of the local corporate system in Bangalore. Obviously, this has wide reaching implications for the type of competition among firms. Informants used expressions such as 'cut-throat' when asked about the relations of competition vis-à-vis cooperation among firms in Bangalore. Neighbouring firms bid for the same projects and therefore perceive competition as a zero-sum game. When projects are floated on the market, local firms engage in a competitive bidding race, pushing the price down and the rents towards the customer (c.f. Arora, et al. 2001b:4).

Competition for customers is reinforced by competition for skilled personnel. As the software industry has grown rapidly, and as tasks now often demand skills that go well beyond programming, the market for experienced software professionals is highly competitive with one of the highest attrition rates in the world. While there are no labour organisations associated with the industry, firms develop advanced complementation packages (health insurance, tuition fees for children etc.) in the competitive race for employees.

Furthermore, as local firms fear the theft of customers and customers fear the loss of intellectual property, software firms in Bangalore tend to be vertically integrated undertaking all tasks in-house, rather than taking the risk of 'exposure'. Simply, as more orders are received, more employees are hired: 'profitability and business expansion is sustained by linearly adding more people to the workforce' (D'Costa 2000a:157). This means that successful firms in the cluster are also large firms.

However, some firms have tried to work their way around problems of decreased flexibility and risk of excess capacity by making use of staff-supplementation firms. Labour from such companies are brought on to the premises of the contract-winning firm to do simple programming work when supply-side bottlenecks occur. Hence, some firms have utilised this form of 'in-sourcing' when the companies are under-staffed for shorter periods of time in relation to specific projects.

As mentioned, customers are often afraid of information leakage and fear the loss of intellectual property. This reduces the propensity to create cluster internal linkages and inter-firm cooperation. An illustration of how such linkages restrain domestic linkage building is the relationship between a group of local firms – Infosys, Wipro, TCS and Sasken¹²¹ – and their client Nortel, a leading Canadian telecommunication firm specialising in network technology. Despite all four Indian firms working for the same client, the outsourcing relationship is organised in a modularised manner in which interaction between the Indian firms is not required. Each Indian firm is associated with independent sub-projects and Nortel alone is responsible for the integration. Hence, the local firms in the 'Nortel network' do not work together on projects. There are some limited interaction related to the standards adopted by Nortel but this does not extend to any forms of horizontal production related linkages. The organisation of the outsourcing arrangement, then, limits the opportunities for collectively building

¹²¹ Wipro, Infosys and Sasken are based in Bangalore, whereas TCS is not.

additional competencies in respect to Nortel, as well as in general (Basant, et al. 2001: 8f).

To sum up the corporate system in Bangalore is characterised by a low degree of inter-firm organisation, that ensures the flexibility and safety of client firms. The compartmentalised and parcelled structure of firm's functions as an open pool of cheap software production capabilities. This is to say that the 'nature' of the global economic webs that Bangalore feeds into produce a special kind of cluster that is very different from the ideal-typical description of technology clusters. In the case of Bangalore's software cluster the two spheres of global webs and the local corporate system form an inseparable complex with important consequences for the industrial dynamics in the cluster. The next section outlines some of these dynamics with regard to the industrial upgrading of Bangalore-based firms, as they appear from the perspective adopted for the present chapter.

6. Developmental implications

The growth of the software industry in Bangalore is very impressive, as is the structural transformation of the local industry in a relatively short time span. Inspired by the Indian experience scholars have constructed a simple and stylised three-stage model for industrial upgrading of software exporters in developing countries (shown in table 2).¹²²

¹²² The first two stages seem to correspond with the Indian experience. Whether other countries have followed or are likely to follow these 'stages' is beyond the discussion here, although it seems doubtful. Similarly as India has made little progress beyond the first two stages it is less clear what the future may hold. The highest 'stage' is normally described as the development of software products. However, as argued by corporate managers in Bangalore, firms may opt for moving further up the value chain within the service segment by undertaking consulting work. Therefore, while downstream work remains the same, one may distinguish between a value chain for services and one for licensed products. Hence, I have added 'consulting' to the third 'stage'. What distinguishes this stage from the preceding ones in the present discussion is that it requires requirement analysis as well as more direct linkages to end-users.

Table 2: A three-stage model for software export industry progression

Description	Indian Status
In stage one the industry delivers export of labour, mainly through the supply of onsite programming services that are performed at the customers' premises	When the software industry emerged in India in the early 1980s it was based solely on the onsite service business model. In the early 1990s the share of onsite work had decreased to 77 per cent of Indian software exports
In stage two the industry moves to the export of such services through primarily offshore work, conducted in the developing country and then transferred to the customer	During the financial year of 2001-02 the share of onsite work had decreased further to 48 per cent. Hence, Indian firms now provide a mix of onsite and offshore services, indicating a point of gravity midway between the first and the second stage
In stage three the industry moves to the export of products through the development of software products or the procurement of consulting services sold in the international markets	India is only now touching the third stage, which is reflected, in the basic fact that the revenues generated from products (4 per cent) and consulting (less than one per cent) are negligible.

Source: UNCTAD (2002:16ff.); NASSCOM (2001:23; 2003); Lema and Hesbjerg (2003: 79ff)

The progression of Bangalore based firms may be interpreted as complementary to the changing nature of TNCs, increasingly following 'core competence' strategies including the upsurge in outsourcing to low-cost locations.. The move up the value chain by firms in Bangalore can be seen as a co-evolving process along with the vertical disintegration of their customers. This process was lubricated by the developments in IT which made long distance interaction smoother as well as the development of widely accepted and more open standards and programming languages. The onsite business model was complementary to the vertically integrated 'old American firm'. And although a large share of onsite work is still conducted as many clients continuously seek to retain control over production, the move towards increased outsourcing among customer firms spurred the offshore model of service delivery in India.

In the process of moving up the value chain local firms have benefited from the interaction with customers, in terms of 'learning' related to corporate governance, technologies, standards etc. As argued by D'Costa (2003:219), Indian firms have come 'a long way' in understanding the technical and commercial aspects of the business. It is not clear, however, whether the limits of this type of learning may have already been reached, indicating a point where a deepening of skills and closer proximity to end users is required for further development to take place. In addition, Bangalore and other software producing regions in India may also face global international competition, and be squeezed from Israel and Ireland and other higher-end software producing regions (from above), and e.g. China and the Philippines (from below). How Bangalore based firms may adapt to increased competitive pressures is still an open question, but it appears that central features of both global webs and the local corporate system strain current responses.

In terms of global webs, Bangalore seems to align with Sturgeons observation that TNC's outsource the tasks that can be codified, but will not do the same with their core competences which are often more tacit in character. The innovative capabilities of local firms are strained by the 'centralising' tendencies of lead firms' core competences and the importance of tacit knowledge: 'Export services that are outsourced to India are likely to remain non-critical adjuncts to central functions' (D'Costa 2003:214, 221). The core innovative activities of OECD-based software lead firms tend to be 'non-globalised' and 'bound' to their home locations since they are dependent on localised intricate linkages between firms and institutions, as is typical of technology clusters (c.f. Wibe & Narula 2002:243). Success in the products sphere as well as in consulting requires skills and capabilities in tasks that not only are the most unlikely to be 'shared' but which are also the hardest to copy or learn, particularly 'from a distance'. Whether Indian firms conduct less skill intensive onsite work or more sophisticated offshore projects, this does not provide the proximity to end-users and access to the resources embedded in technology clusters. As a result of the 'modular approach' to software development (see section 3), learning possibilities are limited since exposure of Indian firms to innovative project is fractional (D'Costa 2000b:5). In this way – as it is normally codified knowledge that flows through the links – the global webs that Bangalore feed in into exhibit inherent 'barriers to entry'.

In terms of the corporate system, Bangalore may be structurally constrained but the logic governing 'operational clusters'. The interviewee

in Infosys quoted earlier captured the dilemma quite clearly in the following ambiguous but illustrative statement:

We are here to make money. We are not here to impress somebody by moving up some value chain defined by someone. We are here to make money for our shareholders. And we do it the way we think is best. We will move up the value chain, and by that I mean we will make more money. It doesn't mean that we will do X kind of work or Y kind of work.

The quote illustrates a strong and important force in maintaining the current lucrative service oriented business model. This is to say that in a self-reinforcing manner, the criteria for success in terms of corporate system set-up in Bangalore is markedly different from the leading technology clusters with which it is inter-linked. The relatively narrow source of competitive advantage leaves little scope for 'deep' specialisation, which, in turn, means that the possibilities for building alliances based on complementary competencies are limited. Rather, the corporate system in Bangalore is weakly interlinked. Even if product-oriented firms can offer complementary capabilities linkages do not develop as the potential earnings from lignin up are considered too low a return on investment, compared to the revenue generated from the main activities of the firm and include a risk associated with 'exposure'. Such alliances may also 'blur' the business model to the dissatisfaction of customers and shareholders. As an example, one smaller firm developed a product which was sold in Japan. In efforts to expand to other OECD markets the CEO sought to enter an alliance with a large company which could utilise its marketing channels in return for a percentage of revenues. However, the offer was turned down for the reasons discussed above (see Lema & Hesbjerg 2003:140).

Another area, in which the differences between the line of activity between Bangalore and customer locations are clear, is in relation to R&D investments. The top 60 software and IT services companies in the world, invested in average 25% of sales in R&D and capital investments in 2001 (DTI Innovation Unit 2003) In comparison, Bangalore's leading firm, Infosys, invest 0,56% of turnover on process R&D. This conforms to the perspective of McKendrick, et al. (2000:45) in which firms based in operational clusters are primarily focused on improving processes and logistics. They also emphasise that supporting institutions in the clusters tend to be functionally geared towards their respective lines of activity and that the diffusion of best practise is distributed through information spillovers. Indeed, some of the most consolidated business forums in

Bangalore are complementary to the functions of operational clusters, such as the development of mechanism for entering the global webs through the protocols of codification. As an example, the strong local branch of the Software Process Improvement Network is concerned with the spread of knowledge and capability building related to the SEI-CMM de facto standard, an important 'protocols for interaction' in the global webs of software production. Similarly, one of the most prioritised tasks of the Indian National Association of Software Service Companies, apart from government lobbying, is 'quality assurance', i.e. adoption of globally renowned standards developed by US-based lead firms. The apparently impressive number of SEI-CMM Level 5 companies located in Bangalore may in fact be seen as expression of local firms' abilities to adopt the protocols established by cluster-external client firms, rather than achievements of innovation in evolving technologies. As dealt with extensively by Lema and Hesbjerg (2003), the institutions and networks within the cluster, to a large extent, complement and facilitate linkage building to organisations external to the cluster and may be seen as 'local institutions for global integration'.¹²³

The above discussion has been centred on some of the forces of circular causality resulting in a lock-in to a particular 'evolutionary stage' of industrial transformation. However, two current and increasingly important features of the industry may prove to be important 'counterforces' and 'exit points' in this regard. Firstly, the largest and financially strong firms in Bangalore are currently expanding overseas, primarily in the US, through acquisitions and overseas marketing offices. While these are strategies for expanding within the current line of activity, such initiatives may provide an important entry point for moving up the value chain, in providing access to the tacit knowledge in end-user markets. Secondly, similar opportunities arise through the widely documented transnational networks between Bangalore and so-called non-resident Indians in US technology clusters (see e.g. Dhume 2002). Such networks provide means for dipping into the resources of knowledge oriented regions. These two types of linkages may be perceived as global webs that are 'reverse' in character as they originate and are rooted in India.

¹²³ As dealt with extensively by Lema & Hesbjerg (2003:97-102), local institutions played an important role in the initial development of a critical mass of software engineering manpower.

7. Concluding remarks

Growth and competitiveness in Bangalore has required the establishment of a highly open corporate system that ensures the client firms' flexible, secure and cheap access to software development resources. The success has been dependent on Bangalore-based firms' ability to develop 'suitable' business models and adapt to the changing character of customer firms needs and requirements. Bangalore functions as an open service-pit tapped by mobile global firms, fulfilling a specialised role in global economic webs.

The agglomeration of software firms in Bangalore differs fundamentally from the typical 'technology cluster', characterised by dense networks, as has been found in Silicon Valley. To the extent they have succeeded, Software firms in Bangalore have succeeded individually, not as parts a thickly interlinked collective of firms. As an 'operational cluster' based on the success of customer-centric business models, horizontal relational linkages related to core firm level capabilities, does not conform to the logic of business from the perspective of the local firm. The case provides evidence in favour of the thesis that the way firms do business in the international economy is increasingly determined by their position in transnational networks of production (cf. Gereffi 1996:427).

This should be taken to mean that crucial features of the corporate system affiliated with software production in Bangalore, is the outcome of successful adjustment to customer firms based in the US and elsewhere. In this process a system has developed that is quite different from many other sectors and spheres of the Indian economy. The preceding discussion gives some indications that the software cluster in Bangalore may have been undergoing some extent of institutional 'reembedding', although this hypothesis certainly is in need of systemic examination. Tentatively, however it does not appear all too far fetched to argue that 'quality standards, management styles, and ideas of corporate governance owe more to western, especially US, models than to traditions of Indian firms' within the sector (The Economist 2001:15). One local business leader commented on his participation in the local industry from its early inception, and the limited importance of his social ties to local industry leaders such as Narayana Murthy, the creator of Infosys:

Just because I know Narayana Murthy, that doesn't mean I will get a sub-contract from Infosys. ... It would be highly unlikely. Normally people in India, in other industrial segments, if you know somebody and you have always been friends; you become a subcontractor for him. Not in the software industry.

As have been discussed there are good reasons why traditional subcontracting and other forms of interfirm linkages in Bangalore are limited. Relations to customers appear to have decisive influence on local corporate system outcomes in the software industry and may be the prime determinant in differentiating this segment from the Bangalore's machine tools industry. Within the latter, Holmström (1999) have documented how 'thick' linkages between firms in trust-based flexible specialisation-type networks have spurred competitiveness. However the reasons for the markedly diverging forms of corporate system affiliated with the two different Bangalore-based industries should be also further and systematically examined.

It was hypothesised in chapter six of this book that most of the case studies would show considerable resilience towards non-relational forms of capitalism despite the homogenising forces of global webs. The chapter argued an important reason behind such resilience is that in most of the cases US dominated global webs are complemented by regional Asian networks that are more relational and 'rooted' in character. Bangalore does not form part of such relational networks and may appropriately be characterised as a high-growth industrial district underpinned by some form of market-driven Anglo-American capitalist principals. One may form an alternative hypothesis, on this basis, contending that changes towards non-relational forms of corporate systems are probable in export oriented industries, particularly in low- and mid-level performing countries where there is no *viable* alternative. It should be clear, however, that this is not an argument for convergence of corporate systems and other aspect of capitalism across space. There may often be viable alternatives as well as domestic actors to pursue them and locally rooted institutions to shape the priorities. Furthermore in the case of Bangalore, dependence on global economic webs has not lead to convergence as such: although Bangalore is linked with and dependent on firms in technology clusters in the west, the differences in the tasks performed in these 'nodes' leads to very different organisational outcomes in which Bangalore show more thinly relational characteristics. To this extent, the case of Bangalore turns the notion of thin arms-length relations in US capitalism and more thick forms of linkages in Asia (and

elsewhere) upside down which suggests that one should pay attention to the limitations of these widespread ideal-types.

References

- Amin, Ash and Nigel Thrift (1992). 'Neo-Marshallian Nodes in Global Networks'. *International Journal of Urban and Regional Research*, 16:4, pp. 571-587.
- Arora, Ashish, V. S. Arunachalam, Jai Asundi, and Ronald Fernandes (2001a). 'The Indian Software Industry'. *Research Policy*, 30, pp. 1267-1287.
- Arora, Ashish, Alfonso Gambardella, and Salvatore Torrisi (2001b). 'In the Footsteps of Silicon Valley? Indian and Irish Software in the International Division of Labour'. Discussion Paper No. 00-41. Stanford Institute for Economic Policy Research, Stanford University: Stanford (CA).
- Bair, Jennifer and Gary Gereffi (2001). 'Local Clusters in Global Chains: The Causes and Consequences of Export Dynamism in Torreón's Blue Jeans Industry'. *World Development*, 29:11, pp. 1885-1903.
- Basant, Rakesh, Pankaj Chandra, and Lynn K. Mytelka (2001). 'Inter-Firm Linkages and Development of Capabilities in the Indian Telecom Software Sector'. Economics Series No. 14. East-West Center: Honolulu.
- D'Costa, Anthony P. (2000a). 'Capitalist Maturity and Corporate Responses to Economic Liberalization in India: The Steel, Auto, and Software Sectors'. *Contemporary South Asia*, 9:2, pp. 141-163.
- D'Costa, Anthony P. (2000b). 'Export Growth and Path-Dependence: The Locking-in of Innovations in the Software Industry'. Conference paper: 4th International Conference on Technology Policy and Innovation: Learning and Knowledge Networks for Development: Curitiba, Brazil, 28.-31. August.
- D'Costa, Anthony P. (2003). 'Uneven and Combined Development: Understanding India's Software Exports'. *World Development*, 31:1, pp. 211-226.
- Dhume, Sadanand (2002). 'From Bangalore to Silicon Valley and Back: How the Indian Diaspora in the United States Is Changing India', in *India Briefing: Quickening the Pace of Change*. Alyssa Ayres and Philip Oldenburg eds: The Asia Society.

- DTI Innovation Unit (2003). 'R&D Scoreboard: 2001/2002'. Department of Trade and Industry, UK, http://www.innovation.gov.uk/projects/rd_scoreboard/database/search2002.html, last accessed 22. April
- Gereffi, Gary (1996). 'Global Commodity Chains: New Forms of Coordination and Control among Nations and Firms in International Industries'. *Competition and Change*, 4, pp. 427-439.
- Holmström, Mark (1999). 'Bangalore as an Industrial District: Flexible Specialization in a Labour-Surplus Economy?' in *Industrial Districts, Flexible Specialization and Employment*. Philippe Cadene and Mark Holmström eds. New Delhi: Sage.
- KSDIT (2003). 'It Scenario Karnataka'. Department of IT and Biotechnology, Government of Karnataka, www.bangaloreit.com/html/itsckar/itindustriesothercities.htm, last accessed December 2003
- Kshema (2003). 'Virtual Extension: A Mature Business Model'. Kshema Technologies Ltd., Source: <http://www.kshema.com/DM-VirtualExtn.htm>, last accessed December
- Lema, Rasmus and Bjarke Hesbjerg (2003) 'The Virtual Extension: A Search for Collective Efficiency in the Software Cluster in Bangalore'. *Public Administration and Public Economics & International Development Studies*, Roskilde University,
- McKendrick, David, Richard F. Doner, and Stephan Haggard (2000). 'A Theory of Industry Evolution, Location, and Competitive Advantage (Chapter 3)', in *From Silicon Valley to Singapore : Location and Competitive Advantage in the Hard Disk Drive Industry*. Stanford, Calif.: Stanford University Press, pp. xvi, 351 p.
- Naidu, B. V. (2002). *Growth of the Indian Software Export Industry - Role of Stpi*. Bangalore: Software Technology Parks of India.
- Nasscom (2001) 'The It Software and Services Industry in India: Strategic Review 2001'. Nasscom,
- Nasscom (2003). 'Indian Software and Services Exports'. National Association of Software and Services Companies, www.nasscom.org/artdisplay.asp?cat_id=314, last accessed 20. June
- Sturgeon, Timothy J. (2002). 'Modular Production Networks: A New American Model of Industrial Organization'. *Industrial and Corporate Change*, 11:3, pp. 451-496.

- Sturgeon, Timothy J. (2003). 'What Really Goes on in Silicon Valley? Spatial Clustering and Dispersal in Modular Production Networks'. *Journal of Economic Geography*, 3, pp. 199-225.
- The Economist (2001). 'A Survey of India's Economy'. *The Economist*, 2. June.
- The Hindu (2002a). *The Big Bytes*, Sunday, Oct 20, Bangalore
- The Hindu (2002b). *I-Flex Banking Solution for Imf*, 17. October, Bangalore
- Tschang, Ted (2001). 'The Basic Characteristics of Skills and Organizational Capabilities in the Indian Software Industry'. ADB Institute Working Paper: Tokyo.
- UNCTAD (2002) 'Changings Dynamics of Global Computer Software and Service Industry: Implications for Developing Countries'. United Nations Conference for on Trade and Development. UNCTAD/ITE/TEB/12,
- UNDP (2001). *Human Development Report 2001: Making New Technologies Work for Human Development*. New York: United Nations Development Programme, Oxford University Press.
- Wibe, Mona Domaas and Rajneesh Narula (2002). 'Interactive Learning and Non-Globalisation: Knowledge Creation by Norwegian Software Firms'. *International Journal of Entrepreneurship and Innovation Management*, 2:2/3.