3

Bangalore's Software Cluster in the 1990s

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3.1   Introduction

A key insight of the institutional approaches to industrial dynamics is that specific models of economic organization may combine the institutional arrangements of markets, hierarchies, and networks in different ways, resulting in inter-firm relations that are complementary to different types of "business systems" or "varieties of capitalism." This chapter sets out to examine and discuss the particular local and global models of industrial organization that underpinned India's software industry during the "takeoff phase" in the 1990s. As one of the most celebrated cases of rapid integration into the world economy this case holds important insights for the ongoing debate on local institutional dynamics in the age of deepening globalization. Is the increasing transnational coordination of economic activities overriding local organizational structures and institutional arrangement combinations? If so, what are the implications for the process of industrial upgrading in new growth regions?

This chapter delves into the debate on global-local interaction, by using the concepts of "global value chains" and "local market organization" to assess the case of the software cluster in Bangalore in southern India during its establishment on the world economic map in the period between 1991 and 2001. The central questions addressed are the following: (1) How was the character of local market organization

in Bangalore related to the industry's export success? (2) What was the role of global value chains in shaping local market organization? (3) How have global value chains and the local variety of market organization impacted upon Bangalore's industrial development trajectory? The chapter explores these questions by focusing on Indian-owned firms based in Bangalore, their interrelations as well as relations to firms external to the cluster.

The chapter proceeds as follows. Section 3.2 briefly presents the conceptual underpinnings of this chapter while section 3.3 draws up the backdrop for the discussion of Bangalore's growth and transformation. The two subsequent sections are more directly concerned with the question posed above. Section 3.4 discusses Bangalore insertion into global value chains, while section 3.5 discusses the character of the local mode of market organization. The concluding section 3.6 reviews the insights on the dynamics of the industry and the implications for industrial upgrading during the 1990s. The key argument made in this chapter is that the insertion into global value chains and the heavy reliance on global linkages was profound in shaping the local organizational structure as well the "horizon of opportunities" in Bangalore. Despite strong national institutional legacies a distinct globally integrated organizational setup emerged in the software sector. On the one hand this setup underpinned and facilitated rapid economic growth but on the other hand it gave rise to certain impediments for structural transformation. However, section 3.7 looks beyond the 1990s and discusses the further development of the cluster in the new millennium. It suggests that since the turn of the century Bangalore firms have slowly initiated a new phase of development.

3.2   Global Value Chains and Local Market Organization

A central feature of current global capitalism is the increasing transnational organization of production through "global value chains" that connect users and producers across countries and continents.[1] Whereas global value chains are related to the vertical sequence of global-scale production, "market organization" relates to linkages between firms at the local or national level.[2] Market organization, a key component of a nations or regions business system, refers to inter-firm relations within bounded localities, often (but not necessarily) between firms that are horizontally related with regard to the

value chain. In this chapter I explore market organization at the level of the cluster.[3]

Linkages between firms in both internal and external markets may take a variety of forms. A simple but useful distinction can be made between thin and thick linkages. Thin linkages are confined to the formalized 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 mutual autonomy. Thick linkages, on the other hand, involve authority, trust or community relationships. They are more durable, based on reciprocity and may be embedded in personal relations between actors. Thick linkages are generally argued to provide the mean for interactive learning and collective knowledge generation.[4]

McKendrick, Doner & Haggard have argued that IT industries tend to be organized into two different types of clusters, "technology clusters" and "operational clusters".[5] 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, often based in low-cost locations, is focused on bases processes of generic manufacturing, assembly and logistics. Hence, while interrelated, these clusters are focused on different lines of activity for which firms and supporting institutions specialize.

According to Sturgeon the global value chains that link lead firms and operational suppliers are increasingly taking the form of thin and flexible, yet information intensive, linkages among firms. This constitutes a successful "new American model of industrial organization". Building on a strength-of-weak-ties argument, Sturgeon argues that flexible relationships between firms in these networks spur greater adaptability to changing market conditions than do various forms of thick relational networks. Hence, there are signs that such thin relational networks may become the dominant form of global value chains; they may be replacing more relational production network forms that, in turn, will become isolated. Furthermore Sturgeon contends that global lead firms seek to leverage thick linkages locally, in geographical areas of cutting-edge technology characterized by a large degree of tacit knowledge (e.g., the ideal-typical Silicon Valley), while to an increasing degree outsource all aspects of production that can be codified to suppliers that can leverage lower costs and economies of scale in base processes. Although Sturgeons work has been centered on U.S.-based lead firms and their strategies, he argues that the

supply platforms inserted into such "modularized" value chains tend to be "relatively open systems that can fulfill a specialized role within larger, global-scale production networks". According to Sturgeon the supply bases in such operational clusters may experience fast upgrading in the sphere of operational provision of base processes and services but they are effectively de-linked from the innovation activities of lead firms that generate high rents.[6]

3.3   Bangalore's Growth and Transformation

Bangalore was the first Indian city to have a software technology park in 1991 and this marked the beginning of the software industry's takeoff phase and Bangalore's firm establishment on the world economic map. The "end" of this decade long "takeoff phase," which is the focus of this paper, was marked by the slump in the U.S. technology sector shortly after the turn the millennium. The reasons and background factors for India and Bangalore's export success in the software industry are reasonably understood and widely documented. Hence they shall not be discussed here in any detail.[7]

Software exports from Karnataka state (in which Bangalore is the capital city) rose from two million in 1991 to two billion in 2001. The number of registered companies exporting from the state (including MNCs) rose from thirteen to more than one thousand.[8] This quickly made Bangalore the largest exporter of software in India. Throughout the decade first-mover companies grew in size and benefitted from economies of scale and reputational effects while smaller start-ups cumulatively joined the industry and faired with differentiated results. This created a top-heavy industrial structure.

But to what extent did massive entrepreneurial dynamism and rapid export-growth of the software industry translate into industrial upgrading toward increasingly high value added activities? Much of the discussion of this question has tended to assume that upgrading and industrial transformation would entail a gradual transition from outsourcing services to own-brand software products for the global market.[9] However, revenues generated from products were limited to 4% at the turn of the millennium, a figure which was decreasing during the 1990s.[10] Hence the remainder of this paper concentrated on the offshore services segment and the different types of activities within it.

The development process for software services aimed at customized solutions, the main space in which Indian firms operate, is often

described as consisting of six steps.[11] The first step of requirement analysis takes place in consultation with the specific end-user. The second step is the design, architecture and integration of products/ projects that is built up of objects or modules, whereas the third step is concerned with the design of these specific modules. The fourth and fifth step, where actual software code is written and tested respectively, is referred to as "programming." The last step consists of the maintenance of existing software systems. The next section discusses how these steps in the software development process are distributed in the global value chain.

3.4   Bangalore in Global Value Chains

The global value chains that Bangalore feed into reflect the transnational dispersion of the software development process. In most outsourcing relationship, the OECD based customer and lead-firm undertake requirement analysis and provide high-level design specifications which involves close interaction with the end-user. For firms or business units catering for end-users in the market for IT consulting services, these are the critical and strategically important lines of activity. Success in these areas requires deep domain and customer related knowledge as well as relationship assets.

Indian firms, on the other hand, concentrated on the remaining functions in the production chain including programming and low-level design. Programming is a labor-intensive process with low barriers to entry, stemming from relatively small fixed costs. Onsite teams at the lead firm premises provided a key communicative interface between buyer and vendor. Nevertheless, this model entailed a clear division of labor between the end-user facing lead-firms and the service-oriented Indian suppliers. Thus during the 1990s, the Indian software industry became firmly rooted in the emerging offshore model and was dominated by routine-based tasks in the field of standard application development and maintenance.[12]

This niche was complementary to the changing nature of external lead firms that were increasingly following "core competence" strategies throughout the 1990s.[13] The emergence of the offshore model can be seen as a co-evolving process along with the vertical disintegration of their customers. The onsite business (body-shopping), which dominated the (slower) growth model before the 1990s, was complementary to the vertically integrated "old American firm." And although a large share of onsite work was still conducted in the

period under review, the move toward increased outsourcing among customer firms was paramount in spurring offshore model of service delivery in India. However, as will be argued, there were no preexisting practices for offshore software development before this period and the successful transition to the offshore model was dependent on significant entrepreneurial dynamism, experimentation and adaptation related to the development of this model within Indian companies.

A manager in one of Bangalore's leading firms, Infosys, explained the logic behind typical outsourcing arrangements between local firms and their foreign customers as "win-win alliances" based on a clear division of labor. He used the case of the Infosys-Microsoft relationship to illustrate the case of a symbiotic relationship.

> 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.

Thus these outsourcing relationships involved a dedication to downstream activities in the Indian firms. Customers confirmed the importance of the suppliers' dedication to remain "pure-players" in the downstream segments. While there were (and still are) variations this was a rule of thumb and was clearly articulated discussions foundational discussions. A Microsoft employee, for instance, expressed this when he was commenting on a particular relationship with a Bangalore supplier.

> We felt we could enter into this business relationship with them and not worry that they'll be competing with Microsoft in the sales channel down the road which would cause customer confusion. In essence, we felt the relationship would be very symbiotic.... They [the Indian firm] clearly articulated what they are going to do but were also very specific as to what they are NOT going to do. Being clear as to what you are and are NOT going to do, helped us to establish trust and confidence in what their long term plans were.

Thus as a reflection of buyers' interests, the niche and business model of most Indian software firms was based on providing complementary services with regard to their foreign customers with defined horizons of action. Kshema Technologies, a startup of the mid 1990s defined its role as that of a "virtual extension" to its foreign customers. This

business model in precise way captures the essence of the nature of outsourcing relations between local firms and their customers:

> The Virtual Extension is a customer centric business model that involves the creation of a software unit which operates like the customer's own software services unit and offers a virtual ownership of a part of Kshema to the customer. The virtual extension…has unlimited scalability.[14]

Thus an important element of customer centricity was the development of software units that operate like the customer's own software services units. These are known as dedicated ODCs, offshore development centers. Firms earmark an isolated part of the company's premises and a team of employees to the customer as to protect information of the customer firm.[15] The business model of most Bangalore firms was similar to the "virtual extension" but came under different names. As a revenue model the virtual extension was highly effective. As an example, Infosys maintained an on average 30% plus profit margin throughout the latter half of 1990s. This gave companies little incentive to change their business model. As explained by the Infosys representative quoted earlier,

> 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.

Making money was equal to offering cheap software-process services with little risk and high scalability for 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. Large software firms worked with several hundred customers simultaneously. This large number of customer firms in a broad range of business domains was enabled by the focus on somewhat generic bases processes in the software development cycle which could be deployed across customer domains.

With regard to the nature of inter-firm linkages in the development process, 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 forth. Multiple site visits confirmed that ODC staff had online access to the customers' information repositories and were able to retrieve "real-time" design specifications, appraisals and other production related information. The linkages between local firms and their customers, however, are not appropriately described as "thick." All projects are delivered with detailed codified documentation, enabling others to fix and develop the software further. Because of the limited degree of tacit knowledge embedded in most relationships "switching costs" were reduced. Furthermore, in order to reduce risks connected with the "sharing" of information the customer firms often conditions the relationship in very detailed written contracts. In this ways, the relationship between buyer and supplier was characterized by mutual autonomy as in the modular global value chains described by Sturgeon. How did such modular global value chains relate to local inter-firm connections? This is the questions for the next section.

3.5   Local Market Organization in Bangalore

A number of studies of "local clusters in global chains" have identified strongly hierarchical forms of local market organization, where outsourcing orders from distant customers are received by a few leading firms within the cluster that, in turn, coordinate a network of local subcontractors. This has meant that leading firms in such clusters have upgraded and evolved into "comprehensive solution providers." On the one hand they maintain linkages with customer-firms and on the other hand subcontract less-skilled work to SMEs in the cluster.[16] As discussed in section 3.3, there was a top-heavy structure in Bangalore too, with huge differences between the leading (large and successful) and following (small and striving) firms of the cluster.

Certainly these differences reflect differences in linkages to customers, varying with the number of linkages and their "throughput capacity." However, they do not reflect their position in a cluster-internal division of labor. Limited differentiation in the customer-centric virtual extension business models was a critical feature of the local form of market organization in Bangalore. This had important implications for the type of competition among firms. Informants used expressions such as "cut-throat" when asked about the relations of competition with regard to cooperation among firms in Bangalore.

Neighboring firms bid for the same projects and therefore perceive competition as a zero-sum game.[17] Competition for customers was reinforced by competition for skilled personnel. As the software industry was growing rapidly, and as tasks often demanded skills that went well beyond "programming" as such, the market for experienced software professionals was highly competitive with one of the highest attrition rates in the world at around 25% toward the end of the millennium.[18]

The relatively narrow source of competitive advantage left little scope for deep specialization. This, in turn, meant that the possibilities for building alliances based on complementary competencies were limited. For reasons and because of contractual clauses the firms in Bangalore tended to be vertically integrated undertaking all tasks in-house. This also meant that successful firms in the cluster were also large firms in terms of people employed. 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. Labor from such companies was brought on to the premises of the contract-winning firm to do simple programming work when supply-side bottlenecks occurred. Hence, some firms have utilized this form of "in-sourcing" when the companies are under-staffed for shorter periods of time in relation to specific projects since this would circumvent constraints imposed by the customer with regard to the guarantee of no direct third party involvement (such as subcontracting). Some companies employed staff through staffing companies such as Manpower or smaller local companies on a permanent basis.

The contractual arrangement between the buyer and supplier of services excluded the options of third party involvement. Even in some cases where co-located companies work on the same problem for the same costumer, all communication (if any) would normally go through the customer. Since Bangalore's firms undertake tasks that were virtual extensions of their customers' processes, these customers are effectively demanding non-disclosure and "professional" forms of corporate governance. Indian firms were effective in setting up systems and processes to tackle sensitive issues. A particular case in point is the very high level of attrition which remained high throughout the 1990s. The introduction of graded security-levels, employee stock option schemes (ESOPs) and confidentiality agreements were among the elements in the focused efforts to confine attrition to lower-level staff and mitigate the negative impact of a high attrition rate. Recent interviews with customers based in the OECD suggest that they were

assured that suppliers were capable of handling the problem effectively. A head of global sourcing in a large multinational company stated retrospectively that: "We were expecting high attrition [in the supplier firm], but we also knew that our partners in India had the teams and the processes for handling that".

The statements given by the suppliers in India was that high attrition levels posed real challenges, but from an operational perspective rather than a knowledge perspective (apart from the occasional senior-level exit). High levels of documentation ensured that ongoing work was continually codified. Informants suggested that the ability to codify work at the level of the programmer was high and that business and technical issues were easily separated even at the level of system architects and project leads. This facilitated the "interchange-ability" of the bulk of resources in a given project, although replacement of staff in a project is time consuming and depends on the availability of other people with matching skills. At the industry level attrition was probably hampering the industry from growing even faster and the systems mentioned above incurred high transaction costs on firms. On the other hand these principles increased customer confidence and became essential standard elements of long distance outsourcing relationships.

In this way Indian firms were actively engaged in adaptation to changing external needs and requirements of commanding customers. Arguably this responsiveness with regard to organizational change and business model adaptation was among the key but largely overlooked factors behind the success of the industry. Not surprisingly interviews with customers confirmed the importance ascribed to adaptation. One informant in large U.S. software house emphasized the ability of suppliers to be "responsive to customer issues" as the key determinant in supplier selection overall, and this was also the reason given for choosing a particular Bangalore firm for more demanding work which was critical to the buyer. Similarly a manager in the IT wing of a large European multinational commented on the relationship with its Bangalore supplier stating that "they have shown very high responsiveness to our needs" when they were requested to do this. These needs related much to the building of new skills and capabilities but also to issue of organization and modes of interaction as well as the clear and trustworthy articulation of longer term intentions. The general picture emerging from customer-side interviews is one of overall satisfaction with the adaptation and responsiveness exhibited by the Indian entrepreneurs. Importantly these customer

interviews were biased toward successful relationship with high-level of customer satisfaction.[19] However, this only underlines and connection between responsiveness/adaptation and performance and suggests that software firms in Bangalore are under constant pressure to strengthen their adaptive capabilities and customer centric business models in order to compete with the market leaders.

Overall, customers' interests appear to have had a decisive influence on intra-firm dynamics and the local mode of market organization. Global value chains and the relative "power" exercised by lead firms are important in explaining why traditional subcontracting and other forms of inter-firm linkages were among the things they "were NOT going to do". One local business leader commented on his participation in the local industry from it 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.

To sum up, the Bangalore was characterized by a low degree of market organization.[20] The compartmentalized and parceled structure of firms was, in effect, an open pool of cheap and secure software production offerings. This is to say that the "nature" of the global value chains that Bangalore feed into produced a special kind of cluster that was very different from the ideal-typical description of traditional technology clusters. In the case of Bangalore's software cluster the two spheres of global value chains and the local form of business organization form an inseparable complex with important consequences for the industrial dynamics in the cluster. The next section outlines some of the implications of these dynamics with regard to the industrial upgrading of Bangalore-based firms.

3.6   Concluding Discussion: Implications for Industrial Transformation

So far this chapter has examined Bangalore firms' insertion into global value chains, the character of local market organization and the relationship between the two. This concluding section summarizes the

arguments made so far and then goes on to discuss the implication for industrial transformation and upgrading in the cluster.

The chapter has argued that in the case of Bangalore, "forces of globalization" were a decisive shaper of organizational outcomes. However, this was not a passive or automatic process. Local entrepreneurs were effective in adapting to changing external needs and requirements, thereby securing successful interaction and learning with and from external actors. By securing competitiveness in global markets this model has buttressed one of the most outstanding cases of local economic development in recent history. Growth and competitiveness in Bangalore during the 1990s required the establishment of a highly open mode of market organization that ensured the client firms' flexible, secure and cheap access to software development resources. The success has been dependent on entrepreneurial dynamism and Bangalore-based firms' ability to develop "suitable" business models and process capabilities to support their efforts.

As result the agglomeration of software firms in Bangalore differs fundamentally from known models of industrial organization. It differs from the typical "technology cluster," characterized by dense networks, as has been found in Silicon Valley. Software firms in Bangalore have succeeded individually, not as parts a thickly inter-linked collective of firms. As an "operational cluster," based on the success of customer-centric business models, there is little scope for building local linkages and forming a cluster-internal division of labor. Rather, the supply base residing in Bangalore is weakly interlinked. In this way the mode of market organization in Bangalore was the outcome of successful adjustment to the needs and practices of customer firms based in the United States and elsewhere. In this process a system has developed that not only was quite different from the ideal typical technology cluster, but also from that of many other sectors and spheres of the Indian economy. As observed by the *Economist*, "quality standards, management styles, and ideas of corporate governance owe more to western, especially United States, models than to traditions of Indian firms".[21] Bangalore's software industry may be characterized as a high-growth industrial cluster underpinned by a market-driven model and operating as an extension of an Anglo-Saxon model of capitalism.

Hence the case of Bangalore also differs from the ideal-type descriptions of the "Asian model" of network capitalism in countries such as Japan, Korea, or Taiwan and therefore this case challenges the frequently contended view that U.S. capitalism is generally based on

combinations of atomistic markets, formal private hierarchies and rela-
tively loose networks while the combination of networks and commu-
nity relationships predominate Asian models. Needles to say, Asia is
not homogenous. Although scholars have identified a distinct type of
business system which is heavily shaped by the institutional legacy of
the inward-looking (pre-reform) period[22] this seems not to apply to the
software which was a global from its inception and had greater exter-
nal than internal linkages. As emphasized by the global value chain lit-
erature the metaphor of network capitalism and atomistic markets are
applicable in the context of internal markets as well as external mar-
kets. The important point emerging from this chapter is that despite
strong national institutional legacies islands of distinctiveness may
emerge where external linkages are the defining feature of sectors.[23]
Understanding the dynamics and evolution, in this case, necessitates
a scrutiny of its global linkages. In the other words the dynamics of
inter-organizational change and structural transformation in "global
supply platforms" are not easily captured with locally centered focus-
ing devises.[24]

In the case of Bangalore's software industry it is evident that
this global supply platform model was highly effective in securing
fast growth during the 1990s. But what where the implications of a
growth-agenda defined by Bangalore's participation in global value
chains with regard to structural transformation and further transi-
tion toward a "next stage" growth-model based on increasing knowl-
edge and learning? Central features of both global value chains and
the local form of market organization have strained such a progres-
sion. The innovative capabilities of local firms were strained by the
"centralizing" tendencies of lead firms' core competences and the
importance of tacit knowledge. The core innovative activities of
OECD-based software lead firms tended to be "non-globalised" and
"bound" to their home locations.[25]

In other words the organizational models rarely provided prox-
imity to end-users and access to knowledge and resources embed-
ded in end-customer facing functions. As a result of the "modular
approach" to software development, learning possibilities were lim-
ited since exposure of Indian firms to knowledge creating processes
was fractional.[26] In this way—as it was normally codified knowledge
that flowed through the links—the global value chains that Bangalore
feed into exhibited inherent barriers to entering certain innovation-
based tasks. Bangalore was constrained but the logic governing oper-
ational clusters/supply platforms.

3.7   Beyond the 1990s

The previous sections were concerned with the ten year period between 1991 and 2001. As has been argued this period witnessed an impressive accumulation of software development capabilities. However, the acquisition of innovation capabilities which could allow firms to progress beyond the offshore-model, to "the next stage," was limited. This section turns to the subsequent five year period between 2001 and 2006. Did firms in Bangalore progress to a new growth stage based on innovation capabilities?

On the one hand it is clear that offshore model-type growth, as described in the preceding sections, has extended firmly into the new millennium. Industry statistics suggest that application development and maintenance, activities typical of traditional outsourcing orders, continues to dominate.[27] On the other hand there is evidence of newfound knowledge-creating capabilities which gives rise to (cautious) optimism. One indicator of this progression is the increasing diversification of IT software business lines. IT consulting, remote infrastructure management, offshore product development services, independent testing services, and proprietary technology or product development are all examples fast growing business lines in which established and new companies have been able to redefine their role in the division of labor in this sector.

Doctoral research by this author has concentrated on firms leading these business lines and has sought to examine the extent and circumstances driving the progression. This research suggests that a strengthening base of innovation-active companies now stand out.[28]

In the virtual extension model customers would get "more of the same thing, but faster cheaper and better" by outsourcing certain tasks. Today select Indian firms have become actively involved in defining requirements and specifications. Research on the buyer-side shows that customers are beginning to change their internal processes and practices due to their relationships with Indian IT firms. In this sense the value proposition has begun to change from operational efficiency (based on improved productivity and quality) to dynamic advantages (based on business transformation and innovation). Outsourced tasks are based not only on use of existing knowledge; they also involve the creation of new knowledge.

While previously the Indian firms were functioning as virtual extensions of the customer's teams their activities were largely confined to coding tasks. Today Bangalore firms are sometimes becoming

"comprehensive solution providers" in certain areas. Due to their sheer size Wipro and Infosys are important in this regard. To take a few examples Wipro have become a "one-stop" solutions provider in remote infrastructure management, handling all elements of customers infrastructure elements such as networks, databases or storage. Infosys increasingly engage in consultancy works such as business process modeling (BPM) for their customers. This extends to the "framing" phase of change and high-end value chain steps, including requirement analysis. Smaller companies are providing outsourced product development services, for instance, in which they design new products end-to-end, based on short visioning documents from customers.

How can one explain the noted increase in capabilities? The detailed analysis of knowledge linkages in the capability building process suggest that, while the local market-organizational setup is slowly strengthening, local linkages were only marginally important in the development of new capabilities. On the other hand, global value chains combined with intra-firm entrepreneurial dynamism and strategic intent—like in previous phases of progression—were factors of crucial importance. The evidence suggests that local firms have found ways to work their around the constraints associated with the offshore model which has allowed them to engage in processes of interactive learning with foreign value chain actors. In particular innovative companies have succeeded in developing much deeper and often trust-based relationships with customers. Also, as highlighted by Hansen in this book, many firms have become global companies which have allowed them to establish a firm presence in customer locations where critical and often tacit knowledge is produced. This has involved a radical transformation of the role of onsite staff from the days of the body shopping model. Onsite staff is increasingly co-involved in roadmap development and high-level design activities. Such developments have been facilitated by the increased spending power of Indian companies allowing them to "purchase" stronger relationship capabilities through people with cultural backgrounds and network assets in customer locations.

A key insight from research on the buyer-side is that there has been a radical shift in the nature of activities which some customers are now willing to outsource. These customers are rapidly adopting "open business models" in which companies look outside their boundaries for ideas and innovative work.[29] This adoption of open business models on the buyer-side may have a major influence on the future direction of the Indian software industry.

Notes

1. The term global value chain refers the full range of activities required to bring a product or service from its conception to its end use. A focal point in global value chains analysis is the type of inter-organizational relationship connecting buyers and suppliers. See Gereffi, G., Humphrey, J., & Sturgeon, T. (2005), "The Governance of Global Value Chains." *Review of International Political Economy,* 12:1: 78–104; Schmitz, H. (2004), *Local Enterprises in the Global Economy: Issues of Governance and Upgrading.* Cheltenham, UK: Edward Elgar.
2. "Market organization, or inter-firm relations, can be broadly compared across economies in terms of the extent to which transactions are primarily organized around long-term relationships between particular exchange partners as distinct from being *ad hoc* and at arm's length…markets exhibiting low levels of organization function like markets in which standardized commodities are traded between anonymous buyers and sellers" Whitley, R. (1992), "Societies, Firms and Markets: The Social Structuring of Business Systems," in Richard Whitley (ed.), *European Business Systems: Firms and Markets in Their National Contexts*. London: Sage, pp. 6–45. See also Whitley, R. (1996), "Business Systems and Global Commodity Chains: Competing or Complementary Forms of Economic Organisation." *Competition and Change*, 1: 411–425, Whitley, R. (2001), "Developing Capitalisms: The Comparative Analysis of Emerging Business Systems in the South," in G. Jakobsen, & J.E. Torp (eds.), *Understanding Business Systems in Developing Countries*. New Delhi: Sage.
3. Defined by Porter as "geographic concentrations of interconnected companies and institutions in a particular field". Porter, M. (1998), "Clusters and the New Economics of Competition," *Harvard Business Review*, November–December.
4. In both the value chain and business organization literature more sophisticated typologies of interfirm relations have been developed. For the present chapter, the simple dichotomy discussed here will suffice. Thick linkages such relationships are often emphasized in the "new economic sociology" that adopts the Polanyan notion of embeddedness. See Granovetter, M. (1985),

"Economic Action and Social Structure: The Problem of Embeddedness." *American Journal of Sociology*, 91: 482–510. On the importance of such relationships for interactive learning see for instance Lundvall, B., Johnson, B., Andersen, E.S., Dalum, B. (2002), "National Systems of Production, Innovation and Competence Building," *Research Policy* 31:2: 213–231.

5. McKendrick, D., Doner, R.F., & Haggard, S. (2000), "A Theory of Industry Evolution, Location, and Competitive Advantage," in McKendrick, D., Doner, R.F., & Haggard, S. (eds.), *From Silicon Valley to Singapore: Location and Competitive Advantage in the Hard Disk Drive Industry*. Stanford: Stanford University Press.

6. The de-linking thesis is most clearly articulated in Sturgeon, T. (1997), *Does Manufacturing Still Matter? The Organizational Delinking of Production from Innovation*. Berkeley Roundtable on the International Economy (BRIE). This argument rests on the (problematic) premise that only certain value chains steps such as design contain innovation activities. This line of thinking is also innate in later publications. See Sturgeon, T.J. (2002), "Modular Production Networks: A New American Model of Industrial Organization." *Industrial and Corporate Change*, 11:3: 451–496. For the "open systems in global networks" argument see Sturgeon, T.J. (2003), "What Really Goes on in Silicon Valley? Spatial Clustering and Dispersal in Modular Production Networks." *Journal of Economic Geography,* 3: 199–225. In systems theory "open systems" are nested within larger system and the linkages between levels can have important ramifications for the dynamics of change. "Closed systems," on the other hand, exhibit inter-locking relationships between its components. Operational clusters (supply platforms in the global economy) may resemble open system that constitute pools of resources and infrastructure which global firms can dip into as and when required. See also Amin, A., & Thrift, N. (1992), "Neo-Marshallian Nodes in Global Networks." *International Journal of Urban and Regional Research* 16:4: 571–587.

7. Good overview articles are provided by Athreye, S. (2005), "The Indian Software Industry," in A. Arora, & A. Gambardella (eds.) *From Underdogs to Tigers: The Rise and Growth of the Software Industry in Brazil, China, India, Ireland, and Israel*. Oxford; New York: Oxford University Press, 2005. and Desai, A.V. (2005), "India," in Simon Commander (ed.), *The Software Industry in Emerging Markets*. Cheltenham, UK; Northhampton, MA: Edward Elgar. One of the best sources on the economic history of Bangalore is Heitzman, J. (2004), *Network City: Planning the Information Society in Bangalore*. New Delhi; New York: Oxford University Press.

8. Lema, R., & Hesbjerg, B. (2003), *The Virtual Extension: A Search for Collective Efficiency in the Software Cluster in Bangalore* (Roskilde: Roskilde University), Table 4.21, p. 92.

9. A stylized three-stage model for industrial development of software exporters in developing countries was put forth by UNCTAD among others. In stage one the industry delivers export of labor, mainly through the supply of onsite programming services that are performed at the customers' premises. This stage may be referred to as the "body-shopping model" 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 customers. This stage may be referred to as the "offshore model." In stage three the industry moves to the export of products through the development of software products. UNCTAD (2002), *Changing Dynamics of Global Computer Software and Service Industry: Implications for Developing Countries*. (Geneva: UNCTAD.). When the software export 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 as a proportion of total revenues had decreased to 77% of Indian software exports. During 2001 the offshore proportion exceeded the 50% milestone which signifies the progression to stage two in UNCTADs model. Thus the first two stages seem to correspond with the Indian experience. However, as is also recognized by UNCTAD, the progression from stage two to stage three (as defined here) is neither clear nor straightforward. As will be discussed in the last section of this chapter some Bangalore software firms are currently progressing to "the next stage," but increasing own brand product development (of so-called packaged software) has a relatively insignificant role to play in this process.

10. NASSCOM (2001), *The IT Software and Services Industry in India: Strategic Review 2001*. New Delhi: National Association of Software and Services Companies.

11. Needless to say this is a very simplified model of the software development process. In reality there are various feedback loops and iterations which are sometimes captured in similar so-called waterfall models of the software development process. Also, recent trends in the software development, such as the introduction of "agile" development methods with a modular architecture and constant testing, do depart from the description given here. Nevertheless, as it represents a fundamental essence of software development it is a useful heuristic tool for the type of value chain analysis embarked upon in this paper.

12. It is widely agreed that comparative advantage arose from factor costs differentials in low-skilled activities such as coding, testing and sometimes low-level design, which were shifted from the traditional software producing countries (primarily the United States but also Japan and European countries) to Bangalore-based software suppliers. For details see chapter four in Lema & Hesbjerg (2003).

13. Thus innovation activities in local firms have tended to be focused on the enhancement of base processes. Typical R&D efforts were focused on processes such as technologies to create repeatability across projects in the form of software components that are reusable or project management frameworks. Hence, while Indian software firms have been active in building capabilities, these have been concentrated in process and downstream service capabilities. See Athreye, S.S. (2005), "The Indian Software Industry and Its Evolving Service Capability." *Industrial and Corporate Change* 14:3: 393–418.

14. Kshema Technologies marketing material quoted in Lema & Hesbjerg (2003, p. 165). Kshema Technologies was recently acquired by MphasiS/EDS.

15. One interviewee likened this organizational principle with intelligence agencies where one unit does not know what the other is doing for security reasons.

16. See for example Bair, J., & Gereffi, G. (2001), "Local Clusters in Global Chains: The Causes and Consequences of Export Dynamism in Torreon's Blue Jeans Industry." *World Development* 29:11: 1885–1903.

17. Arora and colleagues argue that local firms engaged in a competitive bidding race, pushing the price down and the rents toward the customer. Arora, A., Gambardella, A., & Torrisi, S. (2004), "In the Footsteps of Silicon Valley? Indian and Irish Software in the International Division of Labour," in Timothy Breshnahan, & Alfonso Gambardella (eds.), *Building High-Tech Clusters*. Cambridge: Cambridge University Press. Despite such pressures, however, profit margins in the industry are relatively high. Moreover this bidding race was mitigated by steadily rising wages for skilled labor.

18. Mayer-Ahuja, N., & Feuerstein, P. (2007), "IT-Labour Goes Offshore: Regulating and Managing Attrition in Bangalore," in *SOFI Working Paper 2007–2* (Göttingen: SOFI).

19. Even in these cases numerous challenges—and sometimes shortcomings—were highlighted. This included, for instance, the "effectiveness of communication" and the difficulty of establishing a "shared understanding" of pressing problems. But on the positive side the same firms were praised for the willingness and ability to tackle these problems upfront.

20. The character of market organization is discussed at length in Lema & Hesbjerg (2003).

21. The Economist (2001), "A Survey of India's Economy: The Plot Thickens," *The Economist*, June 2.

22. Holmström, M. (2001), "Business Systems in India," in G. Jakobsen, & J.E. Torp (eds.), *Understanding Business Systems in Developing Countrie.* New Delhi: Sage.

23. However, dependence on global value chains has not lead to convergence as such. Although Bangalore was linked with and dependent on firms in technology clusters in the west, the differences in the tasks performed in different "nodes" of the value chains lead to very different local organizational outcomes. To this extent, the case of Bangalore turns the notion of thin arms-length relations in U.S. capitalism and more thick forms of linkages in Asia (and elsewhere) upside down.

24. This seems to questions many assumptions in local institutional approaches such as the business and innovation systems literature. Lema, R. (2006), "Production and Innovation in Supply Platforms: Insights from the Innovation Systems and Value Chain Approaches." *Journal of Electronic Science and Technology of China* 4:4: 339–344.

25. Wibe, M.D., & Narula, R. (2002), "Interactive Learning and Non-Globalisation: Knowledge Creation by Norwegian Software Firms." *International Journal of Entrepreneurship and Innovation Management* 2:2/3: 224–248.

26. D'Costa, A.P. (2004), "Export Growth and Path-Dependence: The Locking-in of Innovations in the Software Industry," in A.P. D'Costa, &

E. Sridharan (eds.), *India in the Global Software Industry: Innovation, Firm Strategies and Development*. Houndmills, Basingstoke, Hampshire; New York: Palgrave Macmillan.

27. In Karnataka such "Enterprise Application" development constituted 57% of exports in 2006.

28. An analysis of thirty-six innovation events in twelve such dynamic companies shows that firms have reached advanced levels of innovation capabilities, some which extends to "new-to-the-world" innovations. Lema, R. (2007), "Outsourcing and Innovation in Indian Software Industry," in *Paper presented at the Second International Workshop on The Changing Knowledge Divide in the Global Economy, 2–5 May 2007* (Institute of Development Studies, Brighton, UK).

29. Chesbrough, H.W. (2006). *Open business Models: how to thrive in the new innovation landscape*. Boston: Harvard Business School Press.