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Aspiring Affiliates, Global Project Networks and Local Embeddedness – Evidence from Bangalore, India

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Abstract:

In the context of India’s economic transformation process, Bangalore has become a worldwide leading ICT centre and a key target region for inward investments of a multiplicity of transnational corporations. Against the background of recent theoretical contributions brought forward in regional science and neighbouring disciplines, the rationale of the paper in hand is to examine how a foreign stand-alone R&D unit and its associated indigenous software service firms are embedded in their various networks and organizational relationships across different spatial scales. Adopting the methodology of a ‘critical case’ (Flyvberg 2001), the DaimlerChrysler Research Centre India (DCRCI) serves for the purpose of providing valuable insights into the embeddedness of such a unit. Based on four months of participant observation in the Centre and in-depth interviews with selected local actors, our findings indicate that beside the distinctive involvement in the local community, the DCRCI’s organisational structure and most notably its autonomy as well as its profound integration in the global corporate network of DaimlerChrysler significantly contribute to the unit’s performance. A comprehensive examination of an affiliate’s excellence at large thus not merely require analysing the degree of local embeddedness, but also the consideration of both extra-local networks and the intra-organisational dimension of embeddedness. Reinforcing the methodological value of corporate case studies in regional science, the present examination is suggestive for further qualitative, single-focused research on transnational organizations in general and TNC’s affiliates within the corporate global production network in particular.

Keywords: embeddedness, global networks, corporate organization, case study research, Bangalore, India
1. Introduction

In the global business world as well as from an academic perspective, the present transformation and restructuring of the Indian economy attracts a great deal of interest. Even though still featuring typical indicators of a less developed country – such as a downright low income per capita amounting to just about US$460 in 2001 (compared to the global average of US$5120) – the country constantly achieved annual GDP growth rates in excess of 6% over the last decade. Today, despite an extraordinarily high illiteracy rate and an internet penetration of just 1%, several Indian locations are ranking among the world’s leading centres for information and telecommunication technologies (ICT) (Arora et al., 2001; Rosenberg, 2002). To a certain extent, this astonishing anomaly corresponds to the shift in India’s economic policy towards a more liberal paradigm (Kapila, 2001; Nissel, 2001). Since the Indian government dropped its hostile attitude towards foreign direct investment (FDI) in selected industries, including ICT, capital inflows increased from a mere US$0.1 billion in 1990/91 to 5.0 billion in 2001/02 (Murthy et al., 1999; Bajpai, 2002). According to Saxenian (2000), the ICT sector has furthermore benefited from policy reforms such as the abolishment of trade regulations and the implementation of specific export processing zone schemes like the ‘Software Technology Parks’. India’s low-cost, highly skilled and massively available human resources represent the ICT industry’s main asset in terms of international competitiveness (Heeks, 1996), a unique advantage consequential to India’s former self-reliance strategy triggering the development of a progressive scientific system at an early stage (Eischen, 2000).

The Indian metropolis Bangalore – situated in the southern central part of the country, at an altitude of 3,000 feet above sea level – constitutes India’s primal and in terms of turnover largest high-tech centre drawing in ICT companies from the beginning. Today, Bangalore’s highly export oriented software cluster embraces about a quarter of the Indian software industry in total (Balasubramanyam and Balasubramanyam, 2000). In addition to numerous indigenous ICT companies, which emerged in Bangalore since the early 1990s, a wide variety of transnational corporations (TNCs) set up affiliates in the region (Rosenberg, 2002). Initially, the overseas companies have been predominantly engaged in less skill-intensive, offshore software development. As the multinationals investing in Bangalore were increasingly conducting more sophisticated research and development (R&D) activities at this location, the character and quality of inflows has substantially changed during the most recent wave of FDI. Being one of these foreign stand-alone R&D centres, the DaimlerChrysler Research Centre India (DCRCI), which provides technological support for the DaimlerChrysler AG (DC) business units and related companies, serves as the vantage point of the case study in hand.¹

Whereas India’s universal competitive advantage is largely driven by low labour costs, the Bangalore technology region offers further benefits for local actors. Particularly the specific quality of
the technology-oriented environment and economies of agglomeration have fostered the rise of higher-level functions in the city. Against this background, exploring the local embeddedness of the actors situated in Bangalore is one of the key foci in this paper. As will be demonstrated, territorial innovation models (Moulaert and Sekia, 2003) present an auspicious conceptual basis for this purpose. Indigenous ICT firms and TNC units, however, are not merely embedded in their local socio-economic context; but a web of extensive international relationships and global interdependencies are equally central determinants of today’s firms’ economic performance and spatiotemporal behaviour. As opposed to the majority of domestic firms – which above all are handling offshore ICT projects for international, mainly U.S. customers – foreign-owned R&D affiliates like the DCRCI embody an integral part of transnational corporate project networks and are profoundly determined by economic power relations on the global scale. Besides the local dimension, the extent to which the Bangalore ICT sector is embedded in international project ecologies (Grabher 2002) or global production networks (Henderson et al., 2002) therefore represents a second central focus of our analysis. The third subject of scrutiny is the degree of autonomy of the DCRCI and its position within the corporate hierarchy: an affiliate’s degree of autonomy profoundly determines a unit’s potential to develop external local networks and – as recent work of e.g. Zanfei (2000) or Anderson et al. (2001) has shown – is subject to both internal corporate interdependencies and the potential resulting from the local milieu.3

About a decade ago, Erica Schoenberger (1991), Ann Markusen (1994) and a number of other scholars already stressed the value of corporate case studies in regional studies and economic geography. Recently the substantial value of a case study approach has again been highlighted (e.g. Flyvberg, 2001; Peck, 2003). The results presented in this paper are based on a four months period of participant observation in the DCRCI and detailed, semi-structured face-to-face interviews with Centre managers and several senior executives of indigenous ICT firms representing the former outsourcing partners of the affiliate. The unit’s intranet and internal meetings attended during the fieldwork provided additional sources of information about the DCRCI’s internal corporate relationships and its pattern of project organization. The investigation of the actors’ extra-local linkages, which are generally considered not to be sufficiently studied in recent work concerned with innovation processes (Bunnell and Coe, 2001), complements the information revealed on the Centre’s local networks and its indigenous external partners. With insights on both the characteristics of the local cluster and its integration into the global economy, the present study represents the application of Flyvberg’s (2001) notion of a ‘critical case’.

The remainder of this paper is structured as follows. The next section briefly reviews the basic ideas and conceptual work related to territorial innovation and local embeddedness, as well as global networks, project organisation, and the TNC unit’s autonomy. The characteristics and the development of the software cluster in Bangalore in the context of the Indian ICT industry are
subsequently outlined. We then explore the organizational modes and the relationships shaping the project business of the DCRCI and its domestic partner firms with regard to their embeddedness on the global and local scale, and the specific structural features of the company’s networks. The concluding remarks assess Bangalore’s level of integration in the global ICT industry and the significance of the local context for a firm’s international competitiveness.

2. Local Embeddedness, Global Production and Project Networks, and the Role of a TNC Unit’s Autonomy

In order to explain the international competitiveness of the indigenous export-oriented ICT industry and TNCs’ incentives to establish R&D centres in Bangalore, different strands of theoretical work are reviewed here. First, we explore the notion of local embeddedness as a central element in territorial innovation models in which economic action and innovation is considered to be deeply rooted in territories or localities. The second set of contributions refers to the evolution of complex international and global interdependencies, particularly within multinational companies; within this strand of literature, again the significance of the local context for innovative activities is taken into account. We finally address the level of autonomy of a TNC’s subsidiary which will be shown as determining the unit’s potential to develop external local networks to a significant extent.

2.1. Local Embeddedness in Territorial Innovation Models

Regardless of the diversity of the group of territorial innovation models, known as the ‘TIM-family’ (Moulaert and Sekia, 2003; see also Lagendijk, 2003 for an overview of its conceptual genealogy), it is clear that a number of key ideas in these approaches have great relevance for this analysis. The TIM-family contains a multiplicity of traditional concepts – in particular those focusing on industrial districts (e.g. Becattini, 1990) and innovative milieus (e.g. Camagni, 1991) – which may be regarded as rather well established in the field. However, substantial findings brought forward more recently in the context of the so-called ‘new regionalism’ literature are also accounted for. These are most notably the conceptualisations of ‘localized capabilities’ (Maskell and Malmberg, 1999), ‘regional innovation systems’ (Cooke and Morgan, 1998) and ‘untraded interdependencies’ (Storper, 1997). Partly based on Granovetter’s (1985) work in economic sociology, they all stress the distinctive role of embeddedness of economic action within social and political practices.

Within the TIM-family, a region’s institutional endowment - i.e. concrete, formal organizations as well as informal conventions, routines or a specific entrepreneurial culture (North, 1990) – is assumed to influence the capabilities of local firms to innovate and to have a positive impact on their competitiveness (e.g. Amin and Thrift, 1994). Or in the words of Taylor and Asheim (2001, 320), ‘to be embedded locally in the institutional tissue of social and transactional networks in a region is
reckoned to be vital for the creation of internationally competitive entrepreneurship, localized learning, innovation and growth.’ The institutional context builds the central base for a region’s localised capabilities and embeds the biggest share of the tacit knowledge available to the locality (Maskell and Malmberg, 1999). As a consequence, the competitive advantages of indigenous firms situated in the Bangalore technology region and the achievements of a foreign-owned, but institutionally integrated affiliate are to a large extent arising from the immobility and uniqueness of these very localised capabilities.

Network phenomena constitute a further key element for the explanation of territorial innovation processes in most of the TIMs; socially constructed beyond markets and hierarchies, networks are based on reciprocity and trust at first (Grabher 1993; Håkanson and Johansson, 1993). The work of Scott (1988), Maillat et al. (1994) or Saxenian (1994), for instance, have demonstrated that local networks based on stable relationships of trust entail reduced transaction costs, and, even more importantly, generate collective learning processes and innovative dynamics. In addition to the frequently studied territorialized and formal network formations, an agglomeration’s potential to cultivate various interpersonal face-to-face contacts within communities of practice has to be recognised as yet another crucial aspect. In his notion of untraded interdependencies, Michael Storper refers to interpersonal networks when perceiving regional economies as ‘stocks of relational assets’ (1997, 28). Originating from locally specific conventions, habits and informal rules and facilitating the transfer of uncodified, noncosmopolitan knowledge, interpersonal communities emerge, at least to some extent, through contingency: albeit not formed explicitly for innovative activities, they are often used exactly for this purpose (Storper and Venables, 2002). In the Bangalore technology region, where the local business world consists of managers of both foreign TNC units and indigenous ICT firms, the presence of interpersonal communities is therefore of particular interest.

Though it is acknowledged that territorial innovation systems do not constitute closed organisms (e.g. Kamann, 1998), in sum, the majority of TIMs tends to focus merely on local networks. However, a TNC’s affiliate such as the DCRCI typically is intertwined in the global production network of its parent company. And without generating spatial transactions or physical transport costs, the software developed by Bangalore-based ICT firms, for instance, is virtually transmitted to worldwide customers. But so far, innovation processes have only rarely been related in any systematic way to globalisation: ‘While local networks have been increasingly well studied, research on extra-local networks is far less commonplace’ (Bunnell and Coe, 2001, 571). On this account, we now turn to reflections taking into consideration the interdependencies between both the local and the global.

2.2 Global Production Networks and Project-based Organisation

At present, the Global Production Network approach, conceptualised by a group of researchers surrounding Jeffrey Henderson and Peter Dicken in Manchester and developed on the basis of
Gereffi’s (1994) theory of global commodity chains, represents one of the most comprehensive attempts to relate global economic activities to different geographical scales (cf. Henderson et al. 2002). In respect of our concerns, it is regarded as a particular powerful and tractable concept. As a major conceptual element, the connotation of embeddedness is treated in a twofold manner: in relation to the ‘anchoring’ of the firms forming a Global Production Network (GPN) in particular places, embeddedness is first assigned a territorial dimension. Unless GPN operations become territorially embedded in the host region by means of a local network, they may not contribute to regional economic growth. This is a crucial issue in relation to the benefits of FDI, which is a major concern in regional studies (e.g. Turok 1993; Dicken et al. 1994; Phelps et al. 2003). The notion secondly refers to the connections between a GPNs’ elements or members regardless of their locational origin. ‘Network embeddedness’ suggests that GPNs are characterised not only by their territorial embeddedness, but also by the structure and degree of connectivity within the network, the stability of its agents’ relations as well as the importance of the network for the participants. As in the case of the export-oriented Indian ICT industry, such networks link economic actors and coordinate them at distant locations.

The idea of network and territorial embeddedness, however, is not merely relevant against the background of a global economy, but is also applicable to single units of multinationals, which represent the ‘global network flagships’ that in turn tend to dominate the GPNs (Ernst and Kim, 2002, 1418). TNCs themselves are perceived in today’s turbulent competitive environment as developing their internal structure towards ‘networks within networks’ (Dicken and Malmberg, 2001, 352), characterized by less hierarchical relations, global efficiency, and – most notably regarding our concern – local adaptability. By means of setting up host country-based R&D centres like the DCRCI, multinational companies are increasingly establishing cross-border networks of asset-augmenting FDI in order to access local knowledge sources conducive to their dynamic competitive advantages (Dunning, 2000). The R&D units located abroad therefore gain importance for the evolution of the group’s core knowledge base by specialising in the host country’s technological competencies, which complement a TNC’s globally-integrated R&D programme (Pearce, 1999). These investments are drawn into a network of agglomerations, which Markusen (1996) strikingly labelled as ‘sticky places in slippery space.’ Even though there appears to be a globalisation of the innovative activities of multinationals, only a small number of ‘sticky’ places meeting the requirements of high technology operations can attract these R&D related investments. Thus, a concentrated dispersion of TNCs’ innovative activities is taking place (Ernst and Kim, 2002).

The organization of innovative activities by multinationals is subject to both centrifugal and centripetal forces, a phenomenon specified by Zanfei (2000) as a ‘double network’: with the notion of internal networks, he thereby refers to innovative activities of a multinational like DC, which are shaped mainly by the global interplay of various in-house units rather than by knowledge transfer
from the centre to the periphery, a common strategy in the past. External networks, on the other hand, refer to the fact that foreign affiliates increasingly extend their activities beyond the boundaries of the firm in order to gain access to local sources of contextual knowledge. As ‘interfaces between generic knowledge that is being circulated in the internal network, and context-specific information that becomes available locally by means of external networks’ (Zanfei, 2000, 517), host country-based R&D laboratories such as the DCRCI represent central elements within the process of knowledge creation and innovation, a key dimension of long-term economic growth. Hence they form particularly interesting research subjects from the management as well as the academic perspective.

With regard to the different structural modes of innovative activities currently experienced, temporary projects become an increasingly common organisational practice. In Bangalore – whether within the DCRCI, indigenous ICT firms, or between the Centre and the cooperation partners – projects likewise constitute a dominant mode of organisation. And as project-based organizing is hardly reconcilable with a corporation-centred empirical approach, the integrity of the firm as the basic analytical unit has to be called into question. Against this background, Grabher’s (2002) connotation of what he calls ‘project ecology’ comprehends an additional set of considerations relevant here. Being less systematic and less coherent than the more established territorial innovation models, project ecologies represent a ‘heterarchic form of social organisation’ (Grabher, 2002b, 246). As a central element, he introduces ‘learning by switching’ effects: local learning processes, he argues, do not necessarily occur through sustained interaction, but through switching (Grabher, 2002a, 211), whereby reputation holds together the chains of repeated cooperation. This goes beyond the notion in the TIM-family, according to which interactive learning is above all considered to be the key mechanism for knowledge creation. Again, the firm-centred perspective is extended: hence, the mere focus on DaimlerChrysler as the parent company and its internal affiliates (in the first instance the DCRCI) has been expanded in the present study.

Similar to the GPN and the double network concept, Grabher’s approach is not confined to the local space, but allows for the global context to be taken into account as well: conceptualising projects as being embedded in layers of networks, localities and institutions, project ecologies refer to both organizational and physical space. Firstly, they involve international business relations and corporate networks. These “project spaces” are by means of ICT disembedded from particular locations. In this context, Storper and Venables (2002) suggest that distinct geographies correspond to each stage of knowledge development. Depending on the degree of tacitness of the knowledge involved, various supplementary communication technologies are required for a successful accomplishment of the project. Despite the substantial technological advances regarding communication, temporary colocation of the project partners and face to face interaction remain crucial concerns.
Secondly, project ecologies are shaped by personal relations within “communities of practice”, which – in contrast to project spaces – are conceived of being strongly rooted in particular localities. They result from what Grabher (2002b, 254) refers to as ‘hanging out’, a metaphor that is suggestive of the contingent character of personal networks. This idea approximates the notion of the ‘buzz’ of a city or agglomeration, a term introduced and defined by Storper and Venables’ (2002) as follows (see also Bathelt et al. 2003):

‘Buzz [...] incorporates the upstream conditions of knowing what is happening; intentional face-to-face contacts; and unintentional or more diffuse face-to-face “rubbing elbows”, or the force of “being there”.

Thus, buzz is more than the “circulation of information”, or the participation in “networks”.’ (Storper and Venables, 2002, 32)

Regardless of which of these terms is preferred and in spite of the presence of global project networks, be they of distant client relations or internal to the corporation because of their ability to ‘filter noise into signals’ (Grabher, 2002b, 258), it cannot be denied that localised communities do constitute a major element in project business in particular and also in the worldwide innovation process and creation of knowledge in general.

2.3. The relevance of a TNC units’ level of autonomy

By gradually acquiring higher functions within the corporation, individual corporate units exhibit a general prospective to develop and enhance their strategic position over time (e.g. Dicken et al., 1994). The augmenting autonomy of an affiliate is, according to Zanfei (2000), subject to the following two cumulative forces: on the one hand, an affiliate’s autonomy and organisational performance is severely constrained by its inherent necessity for integration in a system of international interdependence in terms of knowledge, financial resources and markets. Such centripetal effects strengthen the connections within the TNC and represent a central constitutive element in the unit’s ‘actor-network embeddedness’ (Henderson et al., 2002), i.e. the architecture, durability and stability of the relations between the members in the overall corporation’s network. On the other hand, centrifugal forces are in operation: the better the prospects offered by the local context, the more distinct the need for a high level of autonomy. Through greater autonomy, the units are able to enter partnerships with local firms or institutions in sole responsibility. In turn, the more comprehensive and committed intensive an affiliate’s external networks are shaped, the higher the degree of autonomy admissible to it. Pointing out that the key challenge for TNCs’ technology organisation consists in ‘harnessing decentralised R&D competences to coherent group-level creative programmes without stifling the individualism of their contributions’, Pearce (1999, 161) accurately summarises the basic dilemma resulting from the oppositional operation of these two diametric effects.
When discussing the role of an affiliate’s autonomy, a brief note on the role and impact of a subsidiary’s capacity on the strategic behaviour of the multinational company as a whole is necessary. It should also be noted that the extent to which a TNC is dependent on the resources and capabilities of its subsidiaries does not only determine the organisational structure and autonomy of the affiliate, as shown by Anderson et al. (2001), but that a subsidiary’s performance, in turn, may also have a considerable effect on the overall corporate strategy (e.g. Phelps and Fuller, 2000). According to the results of our study, this also applies to the case of the DCRCI in Bangalore, whose capacities are to a great extent the result of the Centre’s distinct embeddedness in the local economy, have a decisive impact on the affiliate’s overall global network integration.

Given these reflections on an affiliate’s autonomy and the theoretical arguments dealing with territorial innovation, local embeddedness, global networks and project organisation, as outlined in the previous two sections, our key research objectives are to explore (i) what kinds of external networks a foreign R&D centre like the DCRCI has developed with local agents, (ii) to what extent the local partner firms of the DCRCI are embedded in local as well as non-local networks, and finally (iii) how the affiliate’s hierarchical position has evolved in recent years, and which role it plays for the corporation and its global project-based network of knowledge generation. In presenting our research results, three different dimensions of embeddedness – the local, the global network, and the organizational – are distinguished. This provides a way to structure the perceived complexity of the different organisational fabrics and extensive relationships developed by a TNC’s affiliate in general, and a R&D unit in particular, and its associated indigenous firms in their local and global interdependencies respectively. Before this is done, a brief account of the characteristics and the evolution of the Indian ICT industry and the Bangalore software cluster is outlined in order to allow for an adequate grading of Bangalore’s economic development path in the context of the overall trajectories of this sector in India.

3. India’s ICT Industry and the Emergence of the Bangalore Software Cluster

Compared to the industrialized world, the ICT revolution in India came into force with a considerable delay. Regarding the development of the national ICT industry, the vast majority of advances have been achieved only recently, and the 1990s have by far been the most important period for the evolution of the sector. The key driving force behind the growth of the Indian ICT industry is the export of software and services such as contract programming, typically to the Unites States. In 2002, while capturing just 0.2% of the global market for software products, in this sub-segment, the country commanded a 16% world market share (Economist, 2003).

According to Heeks (1998), the substantial expansion of ICT in India began between 1989 and 1990. At that time, the country generated software export revenues valued at approximately US$105
Before, during the 1980s, due to limited possibilities concerning communication technology, software production had been mostly carried out onsite, i.e. at a client’s site overseas, rather than offshore in India (Saxenian, 2000). In 1998, however, the revenues for customised software services already accounted for more than US$1,700 million, and added up to even more than US$7,600 million in 2002. As displayed in Table 1, from 1997 to 2002 the growth rates in this sector, rising to a remarkable 50% or higher, with the exception of the last year reported, consistently lie considerably above those of the ICT industry in total. In 2002, the software and service sector accounted for 17% of India’s total exports and for more than 55% of the overall Indian ICT market.

India’s considerable skill base is an extremely important competitive asset in an increasingly knowledge-based economy. In the context of international IT skill shortages, labour cost differentials have been a major reason for the recent Indian ICT industry growth: in 1995, for instance, wages of software development programmers in India were less than one-fifth of those in the U.S. and less than half of those in Ireland (Arora et al., 2001). Moreover, apart from international TNCs setting up software development centres in India, the dynamic evolution of the Indian software and service export sector was mainly driven by an indigenous industry benefiting from the distinct tendency towards international offshore software development. As also depicted in Table 1, with regard to the delivery model of the Indian software exports, onsite development with programmers working at the customer’s facilities abroad constantly loses its relevance, while offshore production performed in India becomes more and more commonplace allowing the programmers to work at facilities in India.

Table 1: Growth of the Indian ICT Sector, Delivery Modes of Software Exports and the Evolution of Bangalore’s Software Cluster

<table>
<thead>
<tr>
<th></th>
<th>1997/98</th>
<th>1998/99</th>
<th>1999/00</th>
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<tbody>
<tr>
<td><strong>ICT industry</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenues (US$ millions)</td>
<td>5,021</td>
<td>6,014</td>
<td>8,357</td>
<td>12,410</td>
<td>13,783</td>
</tr>
<tr>
<td>Growth rate (%)</td>
<td>33.5</td>
<td>19.8</td>
<td>39.0</td>
<td>48.5</td>
<td>11.1</td>
</tr>
<tr>
<td>Share of GDP (%)</td>
<td>1.22</td>
<td>1.45</td>
<td>1.87</td>
<td>2.66</td>
<td>2.87</td>
</tr>
<tr>
<td><strong>Software &amp; Services Exports</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revenues (US$ millions)</td>
<td>1,759</td>
<td>2,600</td>
<td>3,962</td>
<td>6,217</td>
<td>7,647</td>
</tr>
<tr>
<td>Growth rate (%)</td>
<td>59.9</td>
<td>47.8</td>
<td>52.4</td>
<td>56.9</td>
<td>23.0</td>
</tr>
<tr>
<td>Share in India’s Exports (%)</td>
<td>4.9</td>
<td>7.6</td>
<td>10.6</td>
<td>13.8</td>
<td>17.0</td>
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<tr>
<td><strong>Delivery of Software Exports</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Offshore (%)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>38</td>
<td>41</td>
<td>51</td>
</tr>
<tr>
<td>Onsite (%)</td>
<td>n.a.</td>
<td>n.a.</td>
<td>62</td>
<td>59</td>
<td>49</td>
</tr>
</tbody>
</table>

Source: NASSCOM, 2003
Yet in 1990, onsite production accounted for 90% of Indian software exports. And whereas still in 1999, merely 38% of all software exports have been delivered offshore, according to the most recent estimation of the industry association NASSCOM (2003), the National Association of Software and Service Companies, still in 2003, this share will rise to 60%. The present global economic downturn obviously fosters the Indian ICT sector, as for a multinational company or customers located in highly industrialized countries with high wage levels, cost savings resulting from offshore software operations are more important than ever: amongst the Fortune 500 companies, 185 have outsourced their software development to India (UNDP, 2001), which strengthens the country’s position within the global high-technology business regime.

The recent expansion of software and service exports from India represents a challenge to other countries specialised in the same sector, such as Ireland and Singapore, for example (e.g. Rajan and Rahul, 2002). By attracting globally mobile ICT investments like localisation plants for continental operations or software product manufacturing, the ICT industries of these rival economies already succeeded in specialising in superior stages of software production and in occupying market niches (Coe, 1999). India’s ICT industry, in contrast, remains dominated by the provision of software services mainly for the U.S. market (Heeks, 1998; Rosenberg, 2002). The bulk of projects outsourced to India still involve less skilled activities like coding, testing, or maintenance. Nevertheless, there are examples of Indian firms that managed to move up the value chain by focusing on rather high quality services or by moving towards more sophisticated software products in recent years (Arora et al., 2001). Many of the firms now focusing on high-tech products have started by developing customised software and supplying services for the domestic market and at a later stage of their life cycle have moved towards software packages for foreign markets.

Nevertheless, the country still remains in the lower categories of international country rankings, such as the United Nations 2001 Technology Achievement Index. This has to be attributed to pronounced economic interregional disparities, since only the southern and western Indian States are in a dominant position as software-exporters and recipients of FDI, whereas the north-eastern part of the country distinctively lags behind (Sachs et al., 2001). Next to Mumbai, Bangalore, the capital of the south Indian union state Karnataka, which is rated eleventh among 46 global hubs of technological innovation in 2000 (UNDP, 2001), is the country’s main ICT centre. Aside from representing the dominant location for Indian software company headquarters (Heeks, 1998; Nissel, 2002), the city has witnessed an outstanding increase in the number of software firms (Table 2): according to NASSCOM (2003), more than 1000 companies, among them 150 foreign equity companies and major Indian software corporations such as Infosys and Wipro, have been registered under the Software Technology Park scheme in Bangalore in 2002. This programme entitles software firms to a 10-year tax holiday (Saxenian, 2000). Among all Indian ICT agglomerations, Bangalore achieved the highest proportion of software exports in 2002, with a share of 27% (Government of Karnataka, 2002).
Table 2: The Evolution of Bangalore’s Software Cluster

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<tbody>
<tr>
<td>Number of Firms</td>
<td>207</td>
<td>267</td>
<td>782</td>
<td>928</td>
<td>1038</td>
</tr>
<tr>
<td>Growth rate (%)</td>
<td>27.0</td>
<td>28.0</td>
<td>192.9</td>
<td>27.5</td>
<td>11.9</td>
</tr>
</tbody>
</table>

Source: NASSCOM, 2003

The development of the ICT sector situated in the Bangalore region in essence reflects an outcome of exogenous influences triggered by inflows of FDI, which started when Texas Instruments chose Bangalore as one of its prime locations for offshore software development in the late 1980s. At that time, the region lacked international telecommunication links which are the necessary infrastructure for software exports; software service export was only feasible via satellite links. For Texas Instruments, the establishment of a satellite earth station marked a lengthy and complicated procedure involving the violation or removal of more than twenty government rules (Saxenian, 2000). In spite of these constraints, the corporation succeeded in 1986 to settle down in the region, which exemplifies the factor-creating power and locational freedom of industries as conceptualised by Michael Storper and Richard Walker (1989). Soon, accompanying high-tech TNCs such as Motorola and Hewlett-Packard followed, established further software development centres, and indigenous firms and qualified labour from other parts of the country poured into the city (Balasubramanyam and Balasubramanyam, 2000).

However, the opening of this ‘window of locational opportunity’ (Storper and Walker, 1989) in Bangalore does not imply that all other Indian regions have been able to attract new industries as well; for the regional process of technological catching up, basic preconditions in terms of scientific and technical knowledge are required (Boschma, 1997). In Bangalore, where a strong technological tradition had already existed prior to economic liberalisation in India, software companies comprise only one feature of the industrial base. Examining Bangalore’s economic structure, Heitzman (2001) identifies six principal industries which have been dominant in the early 1990s. In addition to chemicals, textiles, automotive and transport, he assigns electronics and engineering as well as aeronautics as key elements in Bangalore’s industrial base. Moreover, several military R&D institutions, such as the Indian Space Research Organization or the National Aeronautics Laboratories, settled in Bangalore due to its strategically preferential distance from India’s borders (Balasubramanyam and Balasubramanyam, 2000). In combination with the presence of numerous, educational institutions with a high reputation like the world-wide recognised Indian Institute of Science\(^5\), this strong research tradition gives Bangalore the image of a ‘science city’.

In addition to these elements fostering Bangalore’s institutional thickness (Amin and Thrift, 1994), Karnataka was the first Indian state to announce a special ICT policy in 1997, in order to
overcome the city’s infrastructural constraints (Fromhold-Eisebith, 2001). Finally, the city’s favourable geographical, physical and social setting ensuring good living conditions – a prerequisite for attracting highly skilled professionals (e.g. Florida, 2002) – are additional reasons for Bangalore’s auspicious position in the hierarchy of the world’s leading ICT centres. In particular, if compared to the other Indian metropoles, the ‘garden city’ offers outstanding cultural and recreational facilities and a pleasant climate:

“Besides two months in the summer, temperature is quite comfortable for business activities. So customers prefer to come to Bangalore to discuss with firms – and that helps developing the relationship from here better than any other place in India.” (Interview, 03.06.2002)

Overall, the outlined institutional infrastructure along with the soft location factors, such as the socio-cultural scenery and the comparably mild climate, make up the bottom line ensuring a sufficient availability of qualified labour and support the development of non-local interpersonal linkages.

On the other hand, India’s general inadequacy of infrastructural facilities, i.e. roads, airports, power supply, and, most notably telecommunications, is a concern frequently articulated by software and other IT producers (Saxenian 2001). The state of the infrastructure imposes significant direct and indirect costs on producers and still undoubtedly constitutes a considerable barrier to foreign investment, something which is also true for Bangalore. Furthermore, as a result of the city’s rapid growth – not only with regard to its economic supremacy, but also in terms of population – real estate prices have risen massively and the local government faces substantial challenges in providing appropriate infrastructure facilities for the ICT industry (Lateef, 1997). Given the provision of tax holidays as incentives for the significant number of export-oriented companies, Bangalore is almost inevitably short of financial resources to overcome this insufficiency. As a consequence, the agglomeration today faces strong intra-national competition from Hyderabad or Mumbai, for example – locations which provide superior infrastructural endowments and in addition, offer a plentiful supply of qualified software engineers (Eischen, 2000).

Nonetheless, Bangalore remains the focal point for the Indian ICT industry. There is evidence to suggest that in contrast to the ICT locations competing with the city, the involvement of foreign firms in Bangalore features less an asset-exploiting character, but consists of asset-augmenting FDI (Dunning, 2000), i.e. investments designed to enhance TNCs’ future value-creating capabilities. The city accounts for more than half of the 77 foreign stand-alone R&D centres, which have been established by international corporations in India over the last three years alone (India Business Insight, 2003), indicating that the quality of the ICT industry differs from other Indian ICT clusters in a significant manner. On all accounts, Bangalore has become a centre of excellence within India as well as in the global ICT industry.
4. Local Embeddedness and Global Network Integration of the DCRI

Using the example of the DCRCI, the following sections discuss a TNC’s foreign affiliates commitment to the region in which it is situated, its local interdependencies with regard to indigenous institutions, as well as its integration in global networks. Having firstly examined the local dimension of embeddedness both for the Centre and its associated local outsourcing partners, and secondly looked at the unit’s incorporation in global networks together with its suppliers and contractors, we finally proceed to discuss the organisational structures shaping this foreign stand-alone R&D centre.

4.1. Local Embeddedness in Bangalore

By pointing out that the DCRCI’s mission is “to look at Bangalore to survey the market, to see where new capabilities and technologies come up, and to leverage those on behalf of the corporation as a whole”, the Managing Director (MD) of the Centre indicates the importance of the local context for its competitive advantage. Three distinct types of local networks nurturing the affiliate’s embeddedness have been detected. Firstly, there are various outsourcing arrangements the Centre develops with indigenous ICT firms, mostly delivering engineering software services in the area of CAD such as converting two-dimensional drawings into three-dimensional models. Projects between the DCRCI and indigenous ICT firms are based on framework contracts that last several months. Due to the high specificity of those software services, these projects require frequent interaction between the parties involved. Beside the need for cost savings, the specific know-how and capabilities in the locality serve a key motivation for the outsourcing of activities to and the collaboration with indigenous firms. Hereby, trust primarily emerges in the course of collective learning mechanisms that require intensive face-to-face interaction and for which spatial proximity is proven to be favourable. In the long-term, by ‘mediating’ between the TNC and indigenous firms, the DCRCI aims to develop valuable suppliers for the corporation. Access to qualified Indian suppliers enables the TNC to obtain flexibility and competitiveness in an era in which the share of value added related to ICTs among all sectors – and thus also in the automotive sector which still represents the key business of DaimlerChrysler – constantly increases. Without discounting the role of local contractors, however, the significant part played by foreign affiliates of other multinationals operating in Bangalore must not be overlooked. Two formal collaborations with the R&D units of competing TNCs have been forged by the central department in Germany. As both undertakings have been considered rather successful and are assigned to have notably spurred the innovative activities of the DCRCI, the Centre’s MD aims not only to deepen cooperation with local firms in the future, but also to conduct further projects in formal cooperation with some of the remaining foreign affiliates in Bangalore.

The second type of network fostering the affiliate’s local embeddedness embraces the diverse relationships with the local educational and research institutions, which involve more core research
activities than projects undertaken with indigenous firms. The proximity to the local ‘research scenery’ (e.g. the Indian Institute of Science or the Indian Space Research Organization) is commonly referred to as a locational advantage for both local firms and the foreign R&D affiliate. Apart from joint research activity together with the Indian Institute of Science, the DCRCI has established a chair for automotive electronics at the Indian Institute of Information Technology, Bangalore (IIITb), reflecting the aim to develop a ‘hub’ within the region, with the main focus on automotive-related ICT. Particularly in the area of IT security, the Centre employs interns from universities and receives consultancy from scientists and academic staff. Furthermore, the MD himself advises a small number of doctoral candidates, a fact that underlines the reciprocity inherent to the networks developed with local universities.

The third type of local networks is made up of a set of locally based, untraded interdependencies (Storper, 1997), or broadly speaking of a range of interpersonal relationships occurring between the affiliate staff and other local actors. The Centre’s executives interact with various players of the local public defence and research laboratories dealing with specific technological topics. Furthermore, they cooperate informally with project managers of other TNC affiliates located in the region. These links not only embody mutual information exchange concerning business issues (e.g. visa regulations, salaries, travel expenses, or taxation), but also help to keep up to date with the activities of other TNC affiliates in the region. Events organised by national institutions like the Confederation of Indian Industry (CII) or NASSCOM for instance, provide a crucial arena for establishing interpersonal contacts. Invitations to company foundations, jubilee festivities, and functions of socio-cultural organisations further facilitate the integration of local ‘IT-communities’. These communities are considered to deliver valuable business information as well as valuable contacts. Though not directly contributing to technological core knowledge, they provide supportive functions for the Centre’s innovative activity. Informal networks, interpersonal contacts and the resulting IT-communities are important platforms for the circulation and discussion of ideas and therefore they also significantly account for the generation of knowledge in Bangalore.

A relevant factor in examining local embeddedness in Bangalore is the interaction between local firms. For the indigenous ICT industry in Bangalore, again, local networks chiefly depend on formal relationships on the one hand, as well as interpersonal, informal contact of both executives and employees on the other. In contrast to the detected networks of the DCRCI, in which formal collaboration with the R&D units of competing multinationals have proved to be nothing exceptional, indentured cooperation among local, competing firms is still scarcely found. Only two of the surveyed local firms cooperate formally with local competitors by sharing projects on the basis of explicit contracts. This finding has to be attributed to the fact that the growth of the Bangalore ICT industry depends largely on external relationships to international customers rather than being based on the mobilising endogenous potential as predicted by the TIM family. By pointing to the significance of
reputation for the firm’s survival, one of the interviewed senior managers itemizes another causal factor as the reluctance of formal, horizontal collaboration:

“We are only doing joint activities with customers, not with competitors. Mainly for the reason of being confidential. We are a young company, one and a half year old, and loosing the confidentiality of our customers is a big risk” (Interview, 29.04.2002)

Also with regard to the supply side, local firms’ alliances with hardware and software companies are mainly restricted to simple arm’s-length market relations. Long term, innovative collaborations, such as the joint development of specific engineering software, collectively undertaken by two or more local software suppliers, still represent a rare phenomenon. To summarise the argument, in terms of formal interfirm collaboration the links to international clients and their local affiliates, such as the DCRCI, dominate the network patterns of the local firms in Bangalore. This stresses the subsidiaries’ role as focal institutions and their significant influence on the region’s overall competitiveness.

With respect to informal contacts and personal relationships, indigenous firms also feature distinct interdependencies, which – in comparison to the foreign affiliate – are even stronger. Many of the local companies exhibit a wide array of interpersonal linkages to various actors throughout the Bangalore ICT community. Along different lines, these relations are constructed by firm’s executives and their employees, with competitors, university staff, and also with the managers of the foreign affiliates. The benefits arising from these locally specific, untraded interdependencies are best summarised in the following statement of the manager of one local software provider: “Typically what happens there [in the ICT industry] is a lot of hype. And then there is only a little substance left. With informal contacts you can see what is under the carpet” (Interview, 06.05.2002). Moreover, the interpersonal relations developed with competing firms create opportunities for accessing additional capabilities that are not available within a single company. Facilitating shorter reaction times, in particular small and medium sized indigenous companies rely heavily on such socio-spatial networks:

“We are small, 65 people. It’s really impossible for me to serve the particular requirements of large customers with the internal resources of my company. So what I have to do is to tie up with people of other organisations. […] If a really challenging situation arrives, I need help very quickly and this help can only arrive through my informal network.” (Interview, 12.05.2002).

Similar to the DCRCI, local managers likewise interact with the staff and scientists of local universities if difficulties occur when serving their clients or if the proposed project becomes too complex. Most notably, these interpersonal contacts are based on still active contacts to former teaching staff and the participation in alumni events at the local university, where a large share of the executives have been educated: “If we have a certain technical problem, we have an employee who studied at the Indian Institute of Science and says: ‘Look, my professor is there, he is an expert in this field.’ So why don’t take his consultancy” (Interview, 06.05.2002). Apart from consultancy by
academics or joint research activities with universities, experts in public R&D institutions represent further crucial informal network partners for indigenous ICT firms. The company founders, some of whom have been working in public R&D laboratories before starting their business, stress that their large contact networks to former colleagues keep them in touch with technological change:

“Myself, I come from the Indian Space Research Organisation, some colleagues of mine have worked for National Aeronautical Laboratories. We have a network of people here out of these institutions – and whenever we need to discuss our experiences, we go back to them.” (Interview, 29.04.2002)

In addition to such personal contact networks, memberships in the industry association NASSCOM as well as events of other institutions like e.g. bi-national chambers of commerce are considered to be another important source for the construction of interpersonal network ties. Crucially, these organisations link local actors to the global market. The meetings with international delegations enable indigenous firms to contact potential customers and gather information about the requirements of markets. Or, as one local senior manager puts it, “[t]hey represent the front-end to the rest of the world for the Indian ICT industry” (Interview, 02.06.2002).

4.2. Global Network Anchoring in Bangalore

The DCRCI is interconnected with various units within the DC Corporation and also – due to the development of diverse forms of equity and non-equity relationships between the TNC and other firms – with partners external to DC, who fund the Centre’s projects. The resulting diversity of intra- and interfirm relations on the global scale verifies Dicken and Malmberg’s (2001) notion of TNCs as ‘networks within networks’. These relationships embed the DCRCI in global networks, which reach different locations in Germany and increasingly integrate corporate establishments elsewhere, for instance organisations in the U.S. or governmental institutions in Japan.

Projects are the predominant organisational mode shaping the affiliate’s activities, which are based on contracts lasting from six months up to one year and indicating the temporal limitations of the affiliate’s international links, be they corporate or not. However, as the same German central research departments have funded the bulk of projects carried out by the affiliate so far, recurrent networks between the DCRCI and central units extend beyond deadlines, although the composition of project teams may change. More recently, networks based on single projects ending with deadlines have emerged with other, external business units or firms that collaborate with the DC. As a result, an endless stream of names of different people, departments, business units, and firms involved in project business with the Centre appears in internal meetings as well as in the unit’s intranet. The DCRCI’s “scattered spectrum of funding partners” (Interview, 25.04.2002) epitomises the unit’s embeddedness in a diversity of relations, which Girard and Stark (2002) consider a crucial attribute of project organisations.
The relationships between the DCRCI and funding partners are geographically dispersed, with project organization being heavily reliant on ICTs. Work results that consist mainly of developed software dedicated to clients’ needs are transferred to partners via the Internet. Coordinating these projects requires constant communication via email and mailing lists as the ventures usually involve highly specific and dedicated tasks, such as programming work on navigation systems. From time to time, the spatial distance exacerbates short reaction times demanded by the departments, which are funding the projects. Furthermore, particular problems associated with a project are not always communicated adequately; the Centre’s MD refers to this as a characteristic of the Indian working culture. Efforts of the DC to establish knowledge management tools for the entire company reflect the difficult task of organising innovative activities within the virtual localities typical for the work provided by the DCRCI. In cooperation with several further DC units, the Centre developed a tool termed ‘ebook’, placed in the DC’s intranet, that aims to make special capabilities of certain people or units available for all corporate agents. Investments and efforts put into these kinds of new organisational architectures emphasise the need for new coordination mechanisms due to the increasing role of projects as organisational practice or standard in the contemporary business world.

The R&D centre’s business not only relies on ICTs, but also on face-to-face interaction, particularly in the case of first projects for new funding partners. Even though the bulk of R&D activity in the DCRCI has been conducted offshore in Bangalore, twelve projects required a partial presence of the Centre’s employees at customer facilities onsite in Germany, which explains the high travel intensity of the affiliate’s staff members. Labour mobility is necessary mainly in the specification and delivering phase of the project, during which other units’ managers also visit the DCRCI for project clarifications. Hence, face-to-face contact remains a crucial means of communication for stages of DCRCI’s project work involving non-codifiable knowledge. At the same time, it creates a vehicle for informal, subtle cohesion within the TNC, which Zanfei (2000, 535) considers to be ‘socially constructed’ rather than achieved solely by implementing the formal, ICT based coordination tools described above.

Temporary colocation of team members during the specification phase, in which the project’s targets and desired benefits are defined, also supports the process of trust-building between the different actors, many of whom had been unacquainted before. For the interpersonal global network of the DCRCI, the Centre’s head of business development plays a critical role in establishing trust and commitment in the face of incomplete representations of the project and its payoffs. His responsibilities include managing the international relations of existing projects and acquiring additional ventures in order to improve the unit’s position within the corporation. Only by means of continuous travelling to numerous corporate departments and units as well as to the Centre’s external partners, could the DCRCI’s ‘actor-network embeddedness’ (Henderson et al., 2001) or, more precisely, the process of embedding the affiliate in the global network of DC, be propelled.
The indigenous partner firms of the DCRCI also show network structures not confined merely to the Bangalore technology region. Apart from their relation to the DCRCI, they are all linked to international, mostly U.S. clients through the provision of software services. Some of these relations end with project deadlines and frequently the only reminder of the former relationship is the placing of the names of former clients on the company web pages in order to boost their reputation. Others appear as more stable constructs: “They invested a lot of time and money, so that’s the reason why they don’t want to lose us as partners and that’s the reason why we have this strong relation” (Interview, 12.05.2002). Among other things, the stability of a project constellation is accordingly determined by the level of sunk costs involved in the venture, i.e. by substantial investments in specific training or equipment from international clients for an Indian software service provider, for instance.

The trans-local client-supplier relations between the indigenous firms in Bangalore and international customers are shaped by diverse delivery models and by different organisational architectures that reflect the cyclical character of project organisation. Software services are provided either offshore at the client’s facility, onsite in Bangalore, or through a combination of both. The choice of location where work is carried out depends on the different tasks and requirements inherent to different projects stages. Occasionally, planned face-to-face contact appears to be a mutual requirement for both Indian suppliers and foreign counterparts. When clients’ needs are fuzzy and embedded knowledge must be internalised (Ernst and Kim, 2002, 1425), Indian software engineers go abroad to execute initial project stages onsite at customers’ facilities for a certain period of time. In addition, foreign managers travel to Bangalore to both discuss project targets and train Indian employees in specific technical domains, which further transfers embodied and embrained knowledge. The temporary co-presence additionally smoothes organisational and socio-cultural differences between the project partners:

“An organization is almost like a human being, there are a lot of particularities […] As a service provider you always have to enmesh yourself into the culture of the client organization […]. We are sending employees abroad to learn about the requirements and the culture of our customers.” (Interview, 03.06.2002)

Face-to-face contacts – which according to Storper and Venables (2002, 20) are ‘tools for signalling more efficient verification of the possible suitability of partnering’ – thus remain the most suitable means of socialising in Bangalore. This applies not only if all project partners involved in the production of software services are located in the local arena, but also if they operate on the international scale.

ICTs help sustain user-producer interactions in subsequent project stages. Besides email and videoconference facilities, even more sophisticated technologies are used to overcome distance: “We use a tool called ‘same time’ – one thing on my screen is exactly the same as on his [the project
partner’s] screen” (Interview, 17.05.2002). Many indigenous firms however also establish branch offices abroad or enter strategic alliances with foreign ICT firms. Whereas Indian firms conduct the ultimate programming work in India, the branch offices and the foreign partners execute marketing activities and manage existing customer relationships. These intra- and interfim configurations, which contribute to the creation of ‘project infrastructures’ (Grabher, 2002b), are designed to cope with the distance from potential markets, an obstacle frequently mentioned by local firms:

“We are in a field, which requires a lot of customer interaction, so the offices are near to the customers. [...] Wherever we have an office, we try to get a local contactor. This helps us to address the market in a better way.” (Interview, 12.05.2002)

Taking into account all these efforts undertaken by the DCRCI, Indian firms, and their foreign clients – be they investments in project infrastructures or ICT – the interaction in the global networks of the firms situated in Bangalore composes a complex process that involves the transfer of both codified and non-codified knowledge and requires a multitude of communication technologies. Thus, repeatedly colocation has proved to be beneficial. Additionally, the institutional and organisational structures in which the DCRCI and its associated suppliers are embedded, are likewise crucial for their performance. And the performance of the local actors, in turn, affects not only the improvement of Bangalore’s local arena, but also the development of the overall global networks in which they are involved.

4.3. The Organizational Dimension of the Centre’s Embeddedness

Initially driven by the personal motives of one manager of DaimlerChrysler, who had several links with Bangalore’s aerospace industry, the DCRCI was founded in 1996 as a wholly owned subsidiary of DC and part of the DaimlerChrysler Software Technology Lab. According to the DCRCI’s managing director (MD), the Centre holds “a medium hierarchical position” with regard to its overall status in the global network of DC and enjoys “a relatively high visibility in the corporation”. Effectively, it functions as a mere cost centre, i.e. in contrast to a profit centre, it does not close its own balance sheet. For this reason, the explicit ‘market performance’, a parameter used by Andersson et al. (2001) to measure an affiliate’s leverage, is not assessable. Nevertheless, the DCRCI shows structures and interdependencies that allow for conclusions about centripetal and centrifugal effects shaping the unit’s organizational embeddedness within the DC corporate network.

With regard to centrifugal or limiting forces, the work carried out in the DCRCI is subordinated and incorporated in the various subject areas of central R&D in Germany. In consequence, formalized cooperation between the DCRCI and other TNC units in Bangalore, as already stated, is still initiated and controlled by the headquarter departments in Germany. Further indications of the significant role of the corporate headquarter and the somewhat limited degree of autonomy of the DCRCI are the so
called “direct reporting line”, that incessantly links the Centre to the DC headquarters, and the large share of managers from the central research department in the affiliate’s Board of Directors.

Essential for the prospects of ‘internal cohesion’ (to use Zanfei’s (2000, 536) term) these features are opposed by several centrifugal forces that strengthen the hierarchical position of the DCRCI. Today, the unit has remarkable autonomy to adjudicate upon developments of the local branch, such as human resources management or workforce expansion. Although the DCRCI’s management constantly informs the German headquarters about their agreements with local ICT firms, the Centre possesses a great deal of autonomy in establishing these outsourcing arrangements. However, this has not always been the case. The Projects carried out by the affiliate, such as software development for e-business, for instance, depend on funding. At the time of the establishment of the DCRCI, when it consisted only of a handful of employees, the Centre was largely dependent on funding from central research departments and most of all undertook pure cost-driven routine tasks. Due to its growing reputation within the corporate network, it accessed new funding sources and acquired more sophisticated projects in recent years. Compared to projects funded by the central research institutions, the number of projects carried out for external clients is constantly increasing: In 2001 for example, i.e. only five years after the foundation of the Centre, more than 60% of total revenues were acquired from outside business units, whereas less than two fifth came from DC itself. The increased funding enabled raising the number of employees to 50 on a permanent base and 20 temporary staff members in 2002, and triggered the decision to progressively outsource certain parts of project work to local suppliers. As the DCRCI, with the exception of its director and the head of business development, is exclusively staffed with Indians, cooperation and the numerous business relations with local counterparts are fostered not only by spatial, but also by cultural proximity. As a consequence of the enhanced embeddedness in the local milieu, the Centre’s capacity for more complex project work has been significantly raised in recent years.

Today, the DCRCI enjoys the same level of autonomy as the remaining foreign R&D units of DC in Shanghai and Palo Alto (Silicon Valley). This underlines its overall significance for the corporation as a whole. And although experimental environments, machines, and testing infrastructure are missing in the Bangalore-based laboratory, the R&D work carried out by the DCRCI and its German counterparts is regarded as being equivalent. In conclusion, the affiliate’s augmented status and the progression of its global network have to be conceived as evolutionary processes driven by favourable developments, such as the availability of local talents, the mobilisation of various funding sources, or reliable and trustworthy relationships. Notwithstanding the increased autonomy of the affiliate, its improved status in fact can be associated with greater corporate integration, which is in accordance with Phelps and Fuller (2002): By “moving up the corporate hierarchy” (Interview, 25.04.2002), the DCRCI thus continuously and successfully contributes to the enhancement of DaimlerChrysler’s competitive edge.
5. Conclusions

Based on the explorative case study of the DCRCI in Bangalore, which – in spite of being located in a low cost country and the infrastructural constraints in India – in recent years has become a leading ICT centre in the Indian and in the worldwide context, our findings have shown how a foreign stand-alone R&D unit and its associated indigenous software services firms are embedded in their various networks and organisational interdependencies operating across different spatial scales. The key characteristics of the three different forms of embeddedness we applied in our study, which determine the competitiveness and performance of both Indian and foreign firms, are summarised in Figure 2.

![Figure 1: Organisational Interdependencies and Structural Embeddedness of the DCRCI in Bangalore](image)

With regard to the DCRCI’s embeddedness in the local context of the Bangalore technology region, we found that not only epitomised formalised interfirm networks, but also socially constructed interpersonal interdependencies notably influence the competitiveness and performance of the Centre and its associated indigenous firms. Through participation in interpersonal communities of practise, cross-institutional ties with local universities, and formalised outsourcing relationships with indigenous firms, the affiliate is heavily enmeshed in the regionally specific, institutional context. The latter aspect in particular is reinforced by spatial as well as socio-cultural proximity. The foreign
stand-alone R&D centre therefore represents a ‘sensor’ (Zanfei, 2000) for localised technological capabilities and by this significantly contributes to its parent company’s strategic competitiveness.

The investigated Indian ICT firms, in contrast, hardly ever feature formal, localised interfirm collaborations or traded interdependencies and, in consequence, lack cooperative competition, to which the success of more sophisticated technology regions such as the Silicon Valley generally is attributed (e.g. Saxenian, 1994). While the detected formal network patterns are predominantly restricted to international client-supplier linkages – the construction of which is heavily influenced by institutions with a nationwide reach, like NASSCOM for example – indigenous firms’ commitment to the local context rather consists of interpersonal, informally constructed relations or untraded interdependencies. To a large extent, the origins of these communities can be traced back to the technological heritage in Bangalore, once more highlighting the significance of a region’s specific developmental paths and socio-institutional trajectories for its economic upgrading.

On the global scale, operations of both the DCRCI and Indian software providers comprise remote, ICT-based networks operating across global project spaces on the one hand, and face-to-face contacts requiring the establishment of a specific local project infrastructures on the other. This reflects the cyclical character of project organization, whereby the choice of communication technology depends on the phase of the project and on the kind of knowledge transferred through interaction: ‘Face-to-face interactions […] are not substituted by communications technology, but technology is used by project managers as a means for compressing cycles of periodic face-to-face interactions at geographically dispersed project sites’ (Grabher 2002a, 210). While in some cases international relationships of both the foreign affiliate and indigenous firms appear to be relatively stable constructs, the overall picture of the detected global networks suggests that these actors are embedded in a diversity of relations and enhance their capabilities mainly due to learning by switching effects.

At the organisational level finally, similar to Zanfei’s (2000) and Andersson et al.’s (2001) recent findings on the interdependence of local embeddedness and organisational performance, we stated that the hierarchical evolution of the DCRCI is principally attributable to the following two interrelated developments: firstly, the rising actor-network embeddedness resulting in numerous funding sources improves the R&D unit’s hierarchical position and allows for autonomous decisions on outsourcing to local counterparts. Secondly, the development of numerous business networks in the region helps to acquire more complex, sophisticated projects leading to a growing reputation of the Centre within the corporation and, consequently, in increased autonomy. Moreover, the elaboration of the evolutionary nature of the affiliate’s autonomy and its external networks has shown that enhanced sovereignty favoured the exploration of new business partners and that the resulting augmented local embeddedness in turn enabled the acquisition of new funding sources.
Overall, the DCRCI in Bangalore provides a case where the competitiveness and performance of a foreign affiliate and its related indigenous firms has proofed to be associated to networks that are subject to both the local and the global scale. Since the DCRCI’s local embeddedness and its position in the overall global network of DaimlerChrysler are strongly determined by the Centre’s level of autonomy, our case study has shown that organisational structures not only affect the extent to which an affiliate is incorporated into the global, but also its performance. The presented findings also indicate that corporate organisation impacts on the overall competitiveness of the locality, where an affiliate is situated. Beside its own global network position, the performance of the subsidiary determines the integration of its associated local firms into the global economic circuits as well. From the perspective of the indigenous software service providers in Bangalore, therefore, not only the afore-mentioned industry institutions, but also foreign R&D units such as the DCRCI must be regarded essential; that is, local suppliers do not merely support an affiliate to ascend the corporate hierarchy, but may benefit themselves from superior access to the global markets.

Finally, reinforcing the particular value of corporate case study methods in regional science, our results indicate that, if focussing on the interdependencies between local embeddedness, global network integration and corporate performance against the background of organisational structures, future empirical work is well advised to encompass a comprehensive, multi-scalar approach. Taking the local, the global, and the organisational field as interacting and interrelated arenas of action will produce further insights into prevailing processes of innovation, inter- and intraorganisational learning and economic performance of corporations and localities, in the context of an increasingly globalising and knowledge-based economy.

Notes

1 Methodologically, our paper is based on four months of participant observation in the Centre, from April to July 2002, and on several field visits in Bangalore, where more than twenty semi-structured, in-depth interviews with key decision makers, such as senior managers of local firms or representatives from universities and other institutions have been conducted.

2 The present paper is not meant to be yet another conceptual work in the field of territorial innovation, global networks and regional development, but aims to deliver some insights and empirical results building on several of the various conceptualisations already brought forward in regional science, and thus to provide an methodological contribution to the discipline.

3 The remaining sectors in the classification provided by the National Association of Software and Services Companies (NASSCOM) are: hardware, peripherals and networking (25%), domestic software and services (17%), and training (2%).

4 Contrary to popular belief, the Indian software industry is not concentrated exclusively in Bangalore, although Bangalore is certainly a very prominent location, along with Bombay, Pune, Madras and Hyderabad (e.g. Arora et al., 2002).

5 Since its foundation in 1909, the Indian Institute of Science has grown into a premier institution of research and advanced instruction, with more than 2000 active researchers working in various areas at the forefront of science and technology. It is one of the oldest centres of its kind in India and has a strong international standing. For more details, see http://www.iisc.ernet.in.

6 For a discussion of the role of sunk costs in economic networks, see e.g. Johansson (1991).
References


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The Centre for Innovation & Structural Change (CISC) is a multidisciplinary research centre which undertakes programmes of research and research training related to the innovation processes and policies that underpin the knowledge-based economy and society. CISC is based at NUI Galway is partnered with DCU Business School and the Michael Smurfit Graduate School of Business at UCD, with other national and international collaborative arrangements.

The origins and consequences of innovation and technological change can be interrogated at many levels, and interpreted from different perspectives. Thus, CISC’s research is interdisciplinary and its structure collaborative. The complexity of innovation and structural change motivates CISC’s disciplinary openness and methodological diversity within the community of scholarship. Participants include economists, geographers, management scientists, as well as specialists in industrial relations, human resource management, and information systems. Research at CISC is structured into five priority research areas:

- Systems of innovation.
- Industry clustering
- Internationally traded services
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