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Evolution of Innovation Networks across Geographical and Organizational Boundaries: Knowledge Flows in the Bangalore IT cluster

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Abstract

We investigate the evolution of innovation networks using dimensions of geographical and organizational distance. We find an interesting pattern of evolution across firms and geographies.

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C. Innovations across Firms: Projects, Networks, and Ecologies

Evolution of Innovation Networks across Geographical and Organizational Boundaries:

Knowledge Flows in the Bangalore IT cluster

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Abstract

Literature on innovation networks has seen them to develop in several different settings. These networks, during their evolution, span firm boundaries and geographic proximity. However, the evolution of innovation networks has not been investigated from the perspective of these two dimensions: geographical and organizational distance. In this paper, we investigate the evolution of innovation networks using a framework of these two dimensions of geographical and organizational distance. In order to find out a pattern, we chose the Information Technology cluster in Bangalore, India, where we find there are firms that operate and innovate within and outside organizations, and have strong links with firms within and outside of Bangalore cluster. The globalized nature of the cluster helps us infer the evolution of innovation networks that takes place across four-phases. We further find that the innovation networks develop within organizational networks and then extend to across organizational networks. Within the first part, the networks start with a non-local nature (phase-1) and develop into local networks (phase-2). However, within the latter part of the evolution, networks develop from local (phase-3) towards a non-local (phase-4) nature.

Keywords: Innovation Networks; Geographies; Firm Boundaries; Bangalore IT Industry

JEL - codes: F23, D85

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Introduction

The importance of knowledge for (technological) innovation and its complexity is ever increasing and networks facilitate gathering and processing of information and knowledge used in the innovation process (Powell, Koput, & Smith-Doerr, 1996; Ahuja, 2000). Innovation networks, whether within or between companies, are often concentrated geographically. With regard to intra-firm networks, the Allen curve tells us that communication in R&D labs drops exponentially beyond a distance of 50 meters (Allen 1984). However, multinational corporations (MNCs) are known for integrating knowledge bases from around the world and increasingly sourcing innovation from subsidiaries (Mudambi, Mudambi, & Navarra, 2007).

Concerning inter-organizational innovation networks, a large body literature on local and regional innovation systems has been studying geographically concentrated technology or industry clusters. As for non-local networks, scholars of sociology, economics and management disciplines such as strategic management (e.g. Peng & Luo, 2000; Tallman, Jenkins, Henry, & Pinch, 2004) or international business (e.g. Ellis, 2000; Frost & Zhou, 2005) developed several, partly interdependent theories on networks spread across distance. However, there is not much known about how inter- and intra-organizational innovation networks develop with regard to geographic distribution. This paper extends this perspective to understand how two classifications of networks – local and non-local networks on one hand, and intra- and inter-organizational on the other – shape knowledge transfer within and between organizations located in a 'cluster' (Porter, 1990) of firms that is made up of domestic as well as multi-national firms (Zhao & Anand, 2009) and other institutions in a 'triple helix' as conceptualized and measured in prior studies (e.g. Leydesdorff, Dolfsma, & van der Panne, 2006). Moreover, there are few studies that take a longitudinal

perspective on network evolution (e.g. Ahuja 2000).

A central aim of this paper is to investigate the evolution of innovation networks using a framework of geographical and organizational distance. Thereby, we can distinguish between local and non-local as well as intra-organizational and inter-organizational networks and the dynamics of interaction in the evolution of a globalized cluster. We chose a globally connected cluster as setting, because this provides a combination of local concentration of domestic firms, foreign subsidiaries with international linkages to MNC headquarters. The Bangalore IT cluster provides us with a unique context where we can investigate knowledge transfer that takes place through networks across organizational boundaries and across geographical distance, in order to stimulate innovation within domestic as well as MNC players within the cluster. Our findings indicate a 'network trajectory' (Glückler, 2007) combining interaction of non-local intra-organizational networks (for eg. that of MNC HQ and its subsidiary) and non-local inter-organizational networks (for example that of MNC HQ and domestic firms in the cluster) which extend prior network literature on local and global structural holes (e.g. Reagans & Zuckerman, 2001) and MNC innovation strategy (e.g. Almeida & Phene, 2004).

The remainder of the paper is structured as follows. We first outline the theoretical foundations of different types of network ties and innovation literature. We then explain our research methodology followed by the description of the research context. We then present our findings and explain the emerging framework. Finally we discuss the implications and directions for future research in the area.

Theoretical Background - Social networks within and across space

Research into social networks has surged dramatically over the last years (Brass, Galaskiewicz, Greve, & Tsai, 2004; Parkhe, Wasserman, & Ralston, 2006). Broadly speaking, social network theory can be divided in two camps: either looking at structure vs. relation; or emphasizing cohesion (Coleman, 1988) and embeddedness (Uzzi, 1997) vs. a focus on structural holes (Burt, 1992) and weak ties

(Granovetter, 1973). These lead to opposite predictions about the optimal network configuration. Ahuja (2000) identifies three types of social network structures that have differential effects on firms' innovation: direct ties, indirect ties, and structural holes. Dense networks of direct ties give the focal firm access to knowledge and resources and indirect ties do so to a lesser extent. Networks characterized by structural holes, that is focal actors in a network with non-redundant ties that bridge previously unconnected actors (Burt, 1992) provide focal firms with increased information and knowledge flows. Scholars have begun to move beyond this controversy to emphasize the benefits of certain network types using contingency approaches, specifying industry life cycle stages, environmental conditions, or tie function (Walker, Kogut, & Shan, 1997; Rowley, Behrens, & Krackhardt, 2000; Gulati & Higgins, 2003). Rowley, Behrens and Krackhardt (2000) relate strong ties to exploitation and weak ties to exploration. Gargiulo and Benassi (2000) found cohesive networks less adaptive in the context of the computer industry, which is a fast-changing environment; and Hansen (1999) found weak ties to be highly useful in search, but impediments to the transfer of complex knowledge. Ahuja (2000) finds diametrically opposed conclusions regarding the relevance of structural holes depending on whether the emphasis is laid on resource sharing or knowledge spillovers as the main benefit of a network.

Hence, the question most often asked is what type of network configuration is most beneficial for a certain purpose – rather than the question how networks evolve over time. In our case, the purpose of innovation networks being knowledge rather than resource sharing the question of interest is, how do knowledge networks evolve over time and contribute to innovation with changing configurations?

Inter-organizational networks for innovation have been seen as an extension of managing knowledge internally. In relation to this, scholars have increasingly studied location of the firm as a determinant of competitive advantage (Canina, Enz, & Harrison, 2005; Bell, 2005) with particular attention paid to the role of geographical clusters as a source of concentrated knowledge (Dolfsma & van der Panne, 2003) and a preferred environment of MNCs (Phene & Almeida, 2008; Birkinshaw & Hood,

2000; Hitt, Lee, & Yucel, 2002; Hansen, 1999) aiding knowledge transfer across organizational boundaries. Firms based in local or regional agglomerations benefit from locating in clusters as they outperform those located outside these clusters in terms of innovation outcomes (Baptista & Swann, 1998; McCann & Folta 2008; Bell, Tracey & Heide, 2009) thus indicating a clear role of local inter-organizational networks in addition to the local intra-organizational networks. However, negative repercussions to locating in clusters stem from increased competition and potential knowledge leakage (Folta, Cooper, & Baik, 2006; Alcacer, 2006; Alcacer & Chung, 2007; Arikan, 2009). One recurring theme in cluster research which has been tested empirically is the role of *local* social networks that are instrumental in the transfer of (tacit) knowledge (Maskell, 2001) through informal networks, collaboration, labor mobility and spin-offs (Almeida & Kogut, 1999; Breschi & Lissoni, 2001, Stuart & Sorenson, 2003; Giuliani, 2007; Ter Wal & Boschma, 2009; Arikan, 2009).

More recently, scholars have acknowledged the role of *non-local* networks and how they can be instrumental for knowledge spillovers and innovation (Tallman & Phene, 2007). However, most of the studies that tried to link non-local ties to knowledge spillovers in clusters have either been limited to conceptual works, mainly in economic geography literature (Glückler, 2007) or have looked at relationships between local clusters and non-local ties in a more substitutive rather than complementary and interactive fashion (Oettl & Agrawal, 2008; Zaheer, Lamin, & Subramani, 2009; Nanda & Khanna, 2010). In terms of non-local networks, one can draw only little from research on social networks as geography is a dimension rarely addressed explicitly. Some of the few exceptions are McEvily and Zaheer (1999) as well as Stuart and Sorenson (2003) who argue that "people almost always have more, more diverse, and stronger ties to contacts in the geographic region in which they reside. This suggests that the form of social capital most valuable in the resource mobilization process is to a large extent a geographically localized currency." (Stuart & Sorenson, 2003: 249).

By inference, diverse ties should be instrumental in innovation networks whereas stronger ties are

not (Reagans & Zuckerman, 2001). Therefore, the impact of geography on innovation remains ambiguous. Stuart and Podolny (1996) found geographically limited search behavior among Japanese semiconductor firms. McEvily & Zaheer (1999) find that firms in geographic clusters with fewer non-redundant ties (structural holes) acquire fewer competitive capabilities. More recently, Stuart and Sorenson (2009) investigated the formation of "distant ties" proposing a theory of "setting" which includes the places and times in which actors meet. They find that ties with distant partners are formed in settings that are either faddish or involve little risk. This is an important issue with regard to innovation networks, given that innovation typically involves elements of risk and uncertainty; in other words, there seems to be an inherent inconsistency relating to innovation networks that are spread out over the distance. However, we find a lot of evidence of MNCs that are spreading out their innovative activities across numerous subsidiaries (Birkinshaw & Hood, 1998; Cantwell & Mudambi, 2005; Lewin, Massini, & Peeters, 2009).

Bringing in an economic geography perspective, Bathelt (2005) argues that clusters rely on a mix of local and non-local transactions to innovate. Local ties are beneficial only up to a point – too much trust or very tight connections to a limited number of local customers can reduce the rate of innovation and lead to technological lock-in (Uzzi, 1997). In Bathelt's argument, non-local transactions are not supported by proximity and local networks; therefore, they only occur through purposeful and highly risky cooperation with non-local partners.

Based on our literature review, we find that the existing literature outlines studies on innovation networks have been carried out based on two dimensions: Organizational distance (e.g. Maskell, 2001; Romanelli & Khessina, 2005; Giuliani, 2007; Lewin et al., 2009; Contractor, Kumar, Kundu & Pedersen, 2010) and geographical distance (e.g. Allen, 1984; Birkinshaw & Hood, 1998; Almeida & Phene, 2004; Cantwell & Mudambi, 2005; Mudambi, Mudambi & Navarra, 2007) across which innovation networks could develop. The figure-1 below shows the framework in a diagrammatic manner:

Figure-1 about here

Further, we also find that little is known about the evolutionary nature of local and non-local networks throughout the evolution of clusters. In order to plug this gap, we undertook this study that investigates the role of both types of networks in the global IT cluster in Bangalore, India. In the next section we outline the methodology selected for the study, followed by a discussion of the findings and implications of the study.

Methods

A central aim of this paper is to investigate the evolution of innovation networks using a framework of geographical and organizational distance. Thereby, we can distinguish between local and non-local as well as intra-organizational and inter-organizational networks and the dynamics of interaction in the evolution of a global cluster. For this reason, we conduct a qualitative study in an attempt to explain hitherto unexplained role of network ties for knowledge transfer in the evolution of a cluster. This will not only foster integration of network theory and the cluster literature, but also facilitate developing a better understanding of clusters significantly involved in promoting global operations. Insights from this study are also expected to aid both MNCs and SMEs – particularly in knowledge-intensive industries (such as software) – decide where and how to locate in order to leverage network ties to developing clusters and which type of ties to access to benefit most from knowledge spillovers (Yang, Mudambi & Meyer, 2008). Using qualitative procedures, we explore the interaction between two types of network ties and cluster evolution in a longitudinal study. We chose a qualitative research design, because we are interested in *how* and *why* the relationship between different network types changes over time (Yin, 2003). We carried out qualitative interviews with employees in different organizations to cover a large variety of responses

ranging from middle management and top management of firms to government officials, and research and development (R&D) employees of firms to members of academic institutions. The data was collected between 2003 and 2008, across three different phases amounting to a total of 99 interviews. The interviews were not restricted to firms operating from Bangalore so as to get a feel of networks throughout IT industry in India as a whole. However, we examine the relationship between local and non-local networks in a case study of the Bangalore Information Technology (IT) cluster and our findings highlight one particular type of non-local network – Diaspora ties – as an important moderator of the effect of other network ties on knowledge transfer and cluster evolution.

Case Study: Bangalore IT Cluster

IBM (along with other foreign firms) set up a subsidiary in India in 1951 to manufacture accounting machine plants in Mumbai. It soon also started sourcing manpower from Bangalore and other locations in India through this organization. Other hardware companies entered India around the same time. In 1970, the Indian government established a Department of Electronics, which was instrumental in formulating and implementing a new Software Export Policy in 1972 – primarily aimed at providing incentives to firms exporting software services in the form of skilled manpower, encouraging investments in software services. However, a shift in the regulatory policy of the Indian government in the late 1970s meant that most foreign companies, including IBM, left India, leaving unmet demand for IT products and services as well as a glut of engineering talent.

This hiatus ended when Texas Instruments (TI) opened a development center in Bangalore in 1985, primarily to leverage wage arbitrage and take advantage of the talent pool available in India. While sourcing work to Indian service providers, in form of body shopping, had been taking place in Bangalore since 1970s, entry of a well-respected MNC with a lab that aimed to produce complete software products offshore sent a strong market signal. TI began with low level software requirements and, over the years,

graduated to more complex R&D tasks, such as the design of the DSP chip.[1] TI set up its own satellite link to improve communications with the US, which helped smaller firms in the region by allowing them to utilize the excess bandwidth to communicate with clients in the US (Lateef, 1997). They demonstrated the usefulness of good satellite links and leased excess satellite capacity to many leading firms like Wipro and Infosys.[2] TI also reached out to educational institutions in the Bangalore area in an effort to tap into the local scientific talent directly. It was involved in curriculum development activities and funded laboratories, especially with the Indian Institute of Science (Athreye, 2005). Further MNCs followed TI: Nortel in 1989, STMicroelectronics in 1990, Motorola in 1991, and IBM returned to India in 1992. In a parallel development, two new defense laboratories, the Centre for Artificial Intelligence and Robotics and the Defence Avionics Research Establishment, opened in Bangalore in 1986; and the Centre for Airborne Systems followed in 1991. Bangalore had started emerging as a cluster for scientific and knowledge-intensive activities. In 1991, the Indian government initiated a slew of policy steps towards deregulating almost all industries, decontrolling the exchange rate, and reforming of capital markets. This served as a trigger for US-based clients to send development projects to offshore locations in India. Often, Indian employees in US-based companies provided connections or reassurances that led to outsourcing deals with Indian firms (Saxenian, 2006). Many MNC development centers in Bangalore were championed by Indian managers working in the United States, and many (e.g., IBM, Google Labs, Hewlett Packard) were set up by Indian employees of the MNCs who returned to India for the assignment or by Indians (e.g. Cisco, Oracle) with international management experience who had managed similar projects before.

In addition to managerial expertise, the Indian Diaspora also brought highly specialized skills and knowledge about US clients' practices, market players and technology advances to Bangalore. The few R&D centers in Bangalore that were engaged in high-level research (as opposed to product design and engineering) also employed a large number of US-trained PhD graduates, most of them Indian returnees.

1 It is only comparatively recently (in 2002) that TI has announced a collaborative R&D program with Wipro, Infosys and Sasken to work on the GSM standard.

2 This co-operation would probably have been impossible if TI had not been serving a captive parent market.

The rate of MNC entry grew rapidly throughout the 1990s, and most IT companies continued to choose Bangalore for at least one of their subsidiaries. Oracle entered in 1994, and Analog Devices in 1995; Philips set up its Innovation Campus in 1996; Cisco established a development center in 1998; and Intel, Hewlett Packard and National Instruments followed in 1999.

MNC subsidiaries accelerated technological innovation. Based on general satisfaction and trust accorded to the work being done in India, MNCs began to locate full-fledged R&D centers, which entailed a higher knowledge-intensity than development and maintenance centers, in Bangalore. Catering to the need for higher-skilled computer scientists, the International Institute of Information Technology (IIIT) was founded in Bangalore in 1999, with the aim of providing education at a similar level as the IITs.

Growth was still driven by lower-skilled work. In the late 1990s, demand for software engineers in the US and other industrialized countries spiked amidst fears of the Y2K[3] problem. Legions of software programmers were hired across the world to convert the date structure in various applications from a two-digit to a four-digit format. Bangalore continued to be a large source of labor during this virtual pandemic as local software engineers were known to be skilled at coding for legacy systems, which were the focus of the greatest Y2K fears. Local engineering colleges (mostly private) continued supplying large number of graduates in computer science. By 1999, almost half of all engineering colleges and over half of all engineering students in India were located in the southern states (Arora, Arunachalam, Asundi & Fernandes, 2001), even though only about one fifth of the Indian population lived in these states.

After 2000, software MNCs continued to build their presence in India while several firms from non-IT sectors also set up centers to develop embedded software for their products, (e.g., General Motors' technical center operations began in 2003; ABB set up an IT lab in 2002). IBM and Microsoft, which had already established Indian development centers, both opened research centers in Bangalore in 2005. Other software and hardware companies, e.g., Bell Labs (Lucent-Alcatel), Cisco, DELL and Google set up

3 Y2K refers to the year 2000.

subsidiaries between 2000 and 2007. As Bangalore's reputation grew and business practices were adapted to global standards, entry into its IT cluster became much easier for foreign MNCs. In late 2005 and early 2006, new international R&D centers in India were being announced at a rate of one to two per month[4]; and the majority of these centers were located in Bangalore. MNCs had opened over 100 such centers in India by the end of 2006 (across all industries). In the financial year 2006-07, MNCs announced new investments of over USD 10 billion in the Indian IT and ITeS sector to be placed within the next few years (NASSCOM). Eventually, Cisco shifted many of its senior executives to the newly established "headquarter East" (Cisco, 2006) in Bangalore.

Findings and discussion

In many of the examples above, MNCs initially set up subsidiaries in Bangalore to support activities in their headquarter location or elsewhere. Texas Instruments' subsidiary was set up to program development tools for internal use. Most other early subsidiaries carried out software testing and maintenance, or clearly defined sub-projects that were later integrated into new products elsewhere. The subsidiary in each of these cases tapped into Bangalore's local talent pool, but was required to learn headquarter processes and practices. In some cases, global practices were "over-adopted" in Bangalore, as evidenced by hyper-punctuality in some subsidiaries. Most knowledge flows were directed towards Bangalore. These knowledge flows were predominantly internal to the MNC.

Over time, some external knowledge dispersed within the broader cluster. For example, employees carried with them knowledge of global IT-industry business practices as they switched jobs, and MNCs collaborated with Bangalore's engineering colleges to train students on firm-specific IT platforms. As MNC subsidiaries grew, they also interacted more with local service providers, leading to a small degree of adoption of local practices, (although in most cases local firms adapted more). Local

4 From news reports and company press releases acquired through a targeted Google News alert.

market or technical knowledge remained of little importance to the product innovation carried out abroad.

Some MNCs experimented early on with local product innovation. They typically faced two different challenges. Where a Bangalore-based subsidiary was tasked with product innovation for distant, Western markets, developers felt at a distinct disadvantage. Interviewees mentioned both a lack of production knowledge and a lack of customer contact, which would provide deep tacit knowledge of market demand. On the other hand, some firms, tasked their Bangalore-based subsidiaries with local-market innovation. In these cases, interviewees spoke about the difficulty of explaining local circumstances to HQ and of the inadequacy of company strategies for local conditions. Knowledge needs increased at this stage, but were blocked by remaining organizational and geographical distance. In typical cases, local-market innovation was attempted before a subsidiary was integrated enough into the MNC to understand how best to adapt intra-company knowledge. If the subsidiary survived related "failures", the result was often an increased understanding of internal knowledge by the subsidiary and an increased understanding of local technical and market knowledge by headquarters.

MNCs that successfully created two-way knowledge flows were able to move product innovation into the subsidiaries, integrating local (cluster-based) knowledge and internal (dispersed) knowledge. A variety of models evolved.

Emerging pattern of innovation network evolution

Based on our results, we find the evolution of innovation networks following a pattern. Since our analysis was based on tracing the innovation networks based on the organizational and geographic distance, we find that the evolution of the innovation networks takes place cutting across the different cells of the conceptual framework outlined in the conceptual framework earlier in the following manner.

The seeds of innovation networks were sown in the first phase of the evolution of Bangalore cluster. The prominent ties were those between the headquarters and the MNC subsidiary in Bangalore. We find this set of ties as characterized by *non-local* and *intra-organizational* ties. This would clearly constitute the top left quadrant of the 2x2 matrix of geographical vs. organizational distance. Innovation in this phase emerged in form of creative processes adopted by the headquarters while trying to start in a new regional setting India – one that was characterized by lack of institutional mechanisms to a large extent. Although primary data on this phase of development was sparse, the secondary literature on the Bangalore IT cluster had clear indications of difficulties faced by headquarters and the prevailing dominance of headquarter role in the day-to-day operations of subsidiaries. This leads us to infer that the innovation networks in this phase were geographical spread across national boundaries, yet internal to the organizational boundary of the expanding multinationals.

In the next step, these innovation networks were seen to develop in form of strengthening of internal networks within subsidiary teams. Innovation networks developed in form of more *local* ties, however remaining as *intra-organizational* as before because of the focus being on the subsidiary. This can be termed as phase B of the evolution. From our analysis of the data, it was clear that innovation networks, in this phase of development, were driven by the investments in setting up internal systems and team-based processes. The subsidiaries also exhibited a larger absorptive capacity, thus enabling innovation-breeding internally using local and intra-organizational network ties.

The next step of development of innovation networks was seen to be surpassing organizational boundaries, thus moving leftwards within the framework – in form of *local* yet *inter-organizational* ties. This phase C witnessed a prominence of innovation networks that involved the subsidiary and the local stakeholders in the environment viz. suppliers, educational institutes, competitors and customers. These innovation networks were found to be similar to those outlined by Powell et al (1996) in case of bio-technology firms. Our data analysis suggests that the innovation networks, in this phase, were fuelled by

collaborative research, employee and knowledge turnover, competitive benchmarking, and geographical proximity.

In the final step, the innovation networks that were established by MNCs and grew within Bangalore region – primarily started going back to their roots – in form of non-local ties. Insofar, these ties that linked backed the innovation from subsidiary to the headquarters, brought along the inter-organizational ties that subsidiary had developed. This led to a full-development of innovation network that had *non-local* and *inter-organizational* ties. This phase, in our data analysis, was clearly characterized by the innovation networks that spanned from headquarters of multinationals to the educational institutes, competitors, suppliers and customers in and around Bangalore and elsewhere in India.

This cycle of development of innovation networks is captured in the figure 2 as under:

Figure-2 about here

Conclusions

This study contributes to innovation networks literature by combining social networks and innovation in MNC subsidiaries. We believe that this enables us to see a more fine-grained picture of network effects for knowledge transfer based on a contingency argument.

Based on our qualitative research, we argue that both local and non-local networks played their role for knowledge spillovers in the evolution of the Bangalore cluster. We find changing patterns of interaction between local and non-local networks on one hand and intra-firm and inter-organizational on the other. An important theoretical contribution is that innovation networks benefit from knowledge spillovers through local, inter-organizational interaction of MNC subsidiary and the environment, which

eventually is passed on internally to the firm, yet across the distance back to MNC headquarters.

The results of our study also point to some limitations and possibilities for future research. Being an exploratory study, our paper aims at theoretical insights rather than statistical generalization. This is an inherent limitation in the methodology and can be overcome through a large-scale study of innovation networks that have evolved over the years through subsidiary-environment interaction in clusters. Apart from that, the framework of the interaction effect of geographical and organizational distance remains to be tested for existence in other contexts similar to the Bangalore IT cluster.

Figure 1. Relationship between Geographical and Organizational Distance

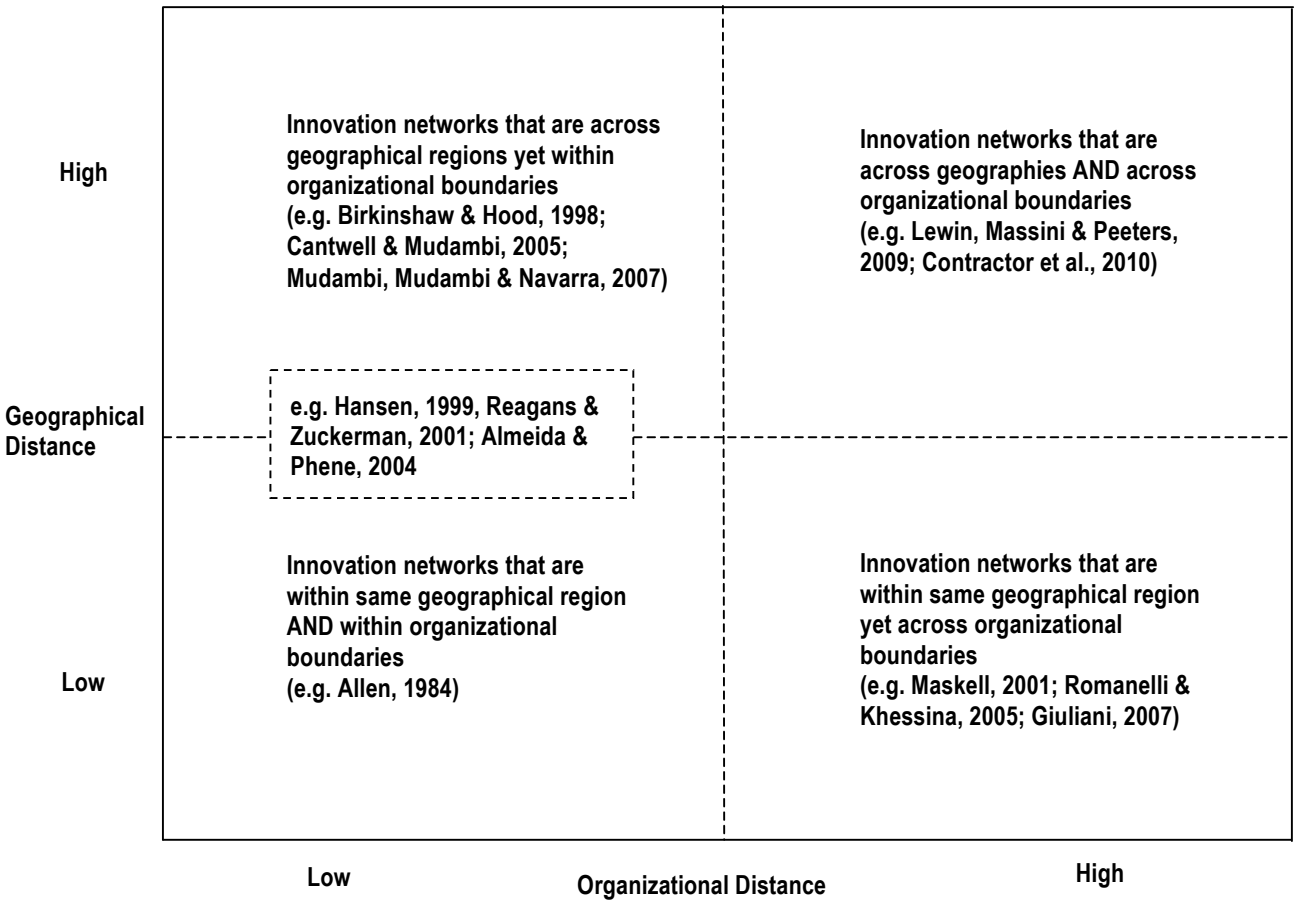
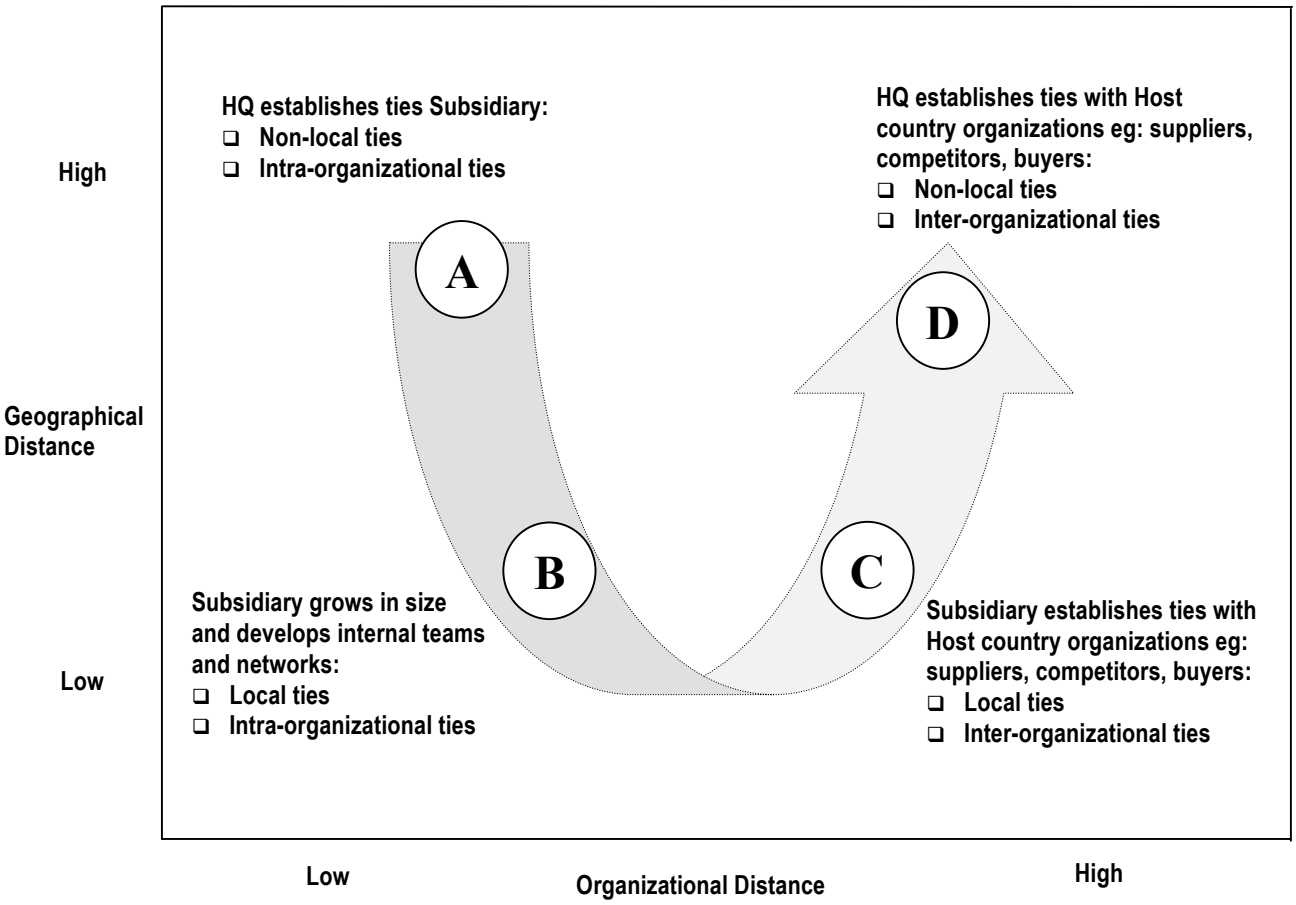


Figure 2. Evolution of Innovation networks across geographical and organizational boundaries



REFERENCES

Ahuja, G. 2000. Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative Science Quarterly*, 45: 425-455.

Alcácer, J. 2006. Location choices across the value chain: How activity and capability influence collocation. *Management Science*, 52(10): 1457–1471.

Alcácer, J., & Chung, W. 2007. Location strategies and knowledge spillovers. *Management Science*, 53(5): 760–776.

Allen, T. 1984. *Managing the Flow of Technology.* Cambridge, Mass.: MIT Press, 1984.

Almeida, P., & Kogut, B. 1999. Localization of knowledge and the mobility of engineers in regional networks. *Management Science*, 45(7): 905–918.

Almeida, P., & Phene, A. 2004. Subsidiaries and knowledge creation: The influence of the MNC and host country on innovation. *Strategic Management Journal*, 25(8–9): 847–864.

Arikan, A. 2009. Interfirm knowledge exchanges and the knowledge creation capability of clusters, *Academy of Management Review* 34(4): 658-676.

Arora, A., Arunachalam, V. S., Asundi, J., & Fernandes, R., 2001. The Indian software services industry. *Research Policy*, 30(8), 1267-1287.

Athreye, S. 2005. The Indian software industry and its evolving service capability. *Industrial and Corporate Change,* 14(3): 393-418.

Baptista, R., & Swann, P., 1998. Do firms in clusters innovate more? *Research Policy*, 27(5): 525-540.

Bathelt, H., 2005. Cluster relations in the media industry: Exploring the 'Distanced Neighbour' paradox in Leipzig. *Regional Studies*, 39(1), 105 - 127.

Bell, G., 2005. Clusters, networks, and firm innovativeness. *Strategic Management Journal* 26(3); 287-95.

Bell, S., Tracey, P., & Heide, J. 2009. The organization of regional clusters, *Academy of Management Review* 34(4): 623-642.

Birkinshaw, J., & Hood, N. 1998. Multinational subsidiary development: Capability evolution and charter change in foreign-owned subsidiary companies. *Academy of Management Review*, 23(4): 773-795.

Birkinshaw, J., & Hood, N. 2000. Characteristics of foreign subsidiaries in industry clusters. *Journal of International Business Studies*, 31(1): 141–154.

Brass, D. J., Galaskiewicz, J., Greve, H. R., & Tsai, W. 2004. Taking stock of networks and organizations: A multilevel perspective. *Academy of Management Journal*, 47(6): 795-817.

Breschi, S., & Lissoni, F. 2001. Knowledge spillovers and local innovation systems: A critical survey. *Industrial and Corporate Change*, 10(4): 975–1005.

Burt, R., 1992. *Structural Holes: The Social Structure of Competition*. Cambridge, MA: Harvard University Press.

Canina, L., Enz, C. A., & Harrison, J. S. 2005. Agglomeration effects and strategic orientations: Evidence from the US lodging industry. *Academy of Management Journal*, 48(4): 565–581.

Cantwell, J., & Mudambi, R. 2005. MNE Competence-Creating Subsidiary Mandates, *Strategic Management Journal*, 26(12): 1109-1128.

Coleman, J. 1988. Social Capital in the Creation of Human Capital, *American Journal of Sociology* 94: 95-120.

Contractor, F., Kumar, V., Kundu, S., & Pedersen, T. 2010. Reconceptualizing the Firm in a World of Outsourcing and Offshoring: The Organizational and Geographical Relocation of High-Value Company Functions, *Journal of Management Studies* 47(8): 1417-1433.

Dolfsma, W. & van der Panne, G. 2003. The Odd Role of Proximity in Knowledge Relations – High-tech in the Netherlands, *Journal of Economic and Social Geography*, 94(4): 453-462.

Ellis, P. 2000. Social Ties and Foreign Market Entry. *Journal of International Business Studies*, 31(3), 443-469.

Folta, T. B., Cooper, A. C., & Baik, Y.-S. 2006. Geographic cluster size and firm performance. *Journal of Business Venturing*, 21(2): 217–242.

Frost, T., & Zhou, C. 2005. R&D co-practice and 'reverse' knowledge integration in multinational firms. *Journal of International Business Studies*, 36(6): 676–687.

Gargiulo, M., & Benassi, M. 2000. Trapped in Your Own Net? Network Cohesion, Structural Holes, and the Adaptation of Social Capital. *Organization Science*, 11(2), 183-196.

Giuliani E. 2007. The selective nature of knowledge networks in clusters: evidence from the wine industry. *Journal of Economic Geography*, 7(2): 139-168.

Glückler, J. 2007. Economic geography and the evolution of networks. *Journal of Economic Geography*, 7(5): 619 - 634.

Granovetter, M. 1973. The Strength of Weak Ties, *American Journal of Sociology*, 78(6): 1360-80.

Gulati, R., & Higgins, M. C. 2003. Which ties matter when? The contingent effects of interorganizational partnerships on IPO success. *Strategic Management Journal*, 24(2): 127–144.

Hansen, M. 1999. The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, 44(1): 82–111.

Hitt, M., Lee, H.-U., & Yucel, E. 2002. The importance of Social Capital to the Management of Multinational Enterprises: Relational Networks Among Asian and Western Firms. *Asia Pacific Journal of Management*, 19(2-3): 353-372.

Lateef, A. 1997. *Linking up with the global economy: A case study of the Bangalore software industry*, New Industrial Organization Programme, DP/96/1997, Geneva: International Labor Organization.

Lewin, A., Massini, S., & Peeters, C. 2009. Why are companies offshoring innovation? The emerging global race for talent. *Journal of International Business Studies*, 40: 901-925.

Leydesdorff, L, Dolfsma, W., & van der Panne, G. 2006. Measuring the Knowledge Base of an Economy in terms of Relations among 'Technology, Organization, and Territory, *Research Policy*, 35(2): 181-199.

McCann, B., & Folta, T.B. 2008. Location Matters: Where We Have Been and Where We Might Go in Agglomeration Research. *Journal of Management*, 34(3): 532-565.

Maskell, P. 2001. Towards a knowledge-based theory of the geographical cluster. *Industrial and Corporate Change*, 10(4): 921–943.

McEvily, B., & Zaheer, A. 1999. Bridging ties: A source of firm heterogeneity in competitive capabilities. *Strategic Management Journal*, 20(12): 1133–1156.

Menzel, M.-P., & Fornahl, D., 2010. Cluster life cycles—dimensions and rationales of cluster evolution, *Industrial and Corporate Change*, 19(1):205-238.

Mudambi, R., Mudambi, S., & Navarra. P. 2007. Global innovation in MNCs: The effects of subsidiary self-determination and teamwork, *Journal of Product Innovation Management*, vol.**24**(5), pp.442-455.

Nanda, R., & Khanna, T. 2010. Diasporas and domestic entrepreneurs: Evidence from the Indian software industry, *Journal of Economics and Management Strategy* 19(4): 991-1012.

Oettl, A., & Agrawal, A. 2008. International labor mobility and knowledge flow externalities. *Journal of International Business Studies*, 39(8): 1242-1260.

Parkhe, A., Wasserman, S., & Ralston, D. A. 2006. New Frontiers in Network Theory Development. *Academy of Management Review*, 31(3), 560-568.

Peng, M. W.,& Luo, Y. 2000. Managerial ties and firm performance in a transition economy: The nature of a micro-macro link. *Academy of Management Journal*, 43(3): 486-501.

Phene, A., & Almeida, P. 2008. Innovation in multinational subsidiaries: The role of knowledge assimilation and subsidiary capabilities. *Journal of International Business Studies*, 39(5): 901–919.

Porter, M. 1990. *The competitive advantage of nations*. New York: Free Press.

Powell, W.W., Koput, K.W. & Doerr, L.S. 1996. Interorganizational collaboration and the locus of innovation: Networks of learning in Biotechnology. *Administrative Science Quarterly, 41*: 116-145.

Reagans, R. & Zuckerman, E. 2001. Networks, diversity, and productivity: the social capital of corporate R&D teams, *Organization Science*, 12(4): 502-517.

Romanelli, E., & Khessina, O. M. 2005. Regional industrial identity: Cluster configuration and economic development. *Organization Science*, 16(4): 344–358.

Rowley, T., Behrens, D., & Krackhardt, D. 2000. Redundant governance structures: An analysis of structural and relational embeddedness in the steel and semiconductor industries. *Strategic Management Journal*, 21(3): 369–386.

Saxenian, A. 2006. *The New Argonauts: Regional Advantage in a Global Economy*. Cambridge, MA: Harvard University Press.

Stuart, T., & Podolny, J. 1996. Local search and the evolution of technological capabilities. *Strategic Management Journal*, 17(7): 21–38.

Stuart, T., & Sorenson, O. 2003. The geography of opportunity: Spatial heterogeneity in founding rates and the performance of biotechnology firms. *Research Policy*, 32(2): 229–253.

Sorenson, O., & Stuart, T. 2008. Bringing the Context Back In: Settings and the Search for Syndicate Partners in Venture Capital Investment Networks. *Administrative Science Quarterly* 53 (2): 266-294.

Tallman S., Jenkins M., Henry N., & Pinch S., 2004. Knowledge, clusters, and competitive Advantage. *Academy of Management Review*, 29: 258-271.

Tallman, S., & Phene, A. 2007. Leveraging knowledge across geographic boundaries. *Organization Science*, 18(2): 252–260.

Ter Wal, A. L. J., & Boschma, R. A. 2009) Applying social network analysis in economic geography: framing some key analytic issues. *The Annals of Regional Science*, *43*(3), 739-756.

Uzzi, B. 1997. Social Structure and Competition in Interfirm Networks: The Paradox of Embeddedness.

Administrative Science Quarterly, 42(1): 35-67.

Walker, G., Kogut, B., & Shan, W. 1997. Social capital, structural holes and the formation of an industry network. *Organization Science*, 8(2): 109–125.

Yang, Q., Mudambi, R., & Meyer, K., 2008. Conventional and reverse knowledge flows in multinational corporations. *Journal of* Management 34(5): 882-902.

Yin, R. K. (2003). *Case study research : design and methods*. Thousand Oaks, CA.: Sage.

Zaheer, S., Lamin, A., & Subramani, M., 2009. Cluster capabilities or ethnic ties? Location choice by foreign and domestic entrants in the services offshoring industry in India. *Journal of International Business Studies*, 40(6): 944-968.

Zhao, Z. J., & Anand, J. 2009. A multilevel perspective on knowledge transfer: evidence from the Chinese automotive industry *Strategic Management Journal*, *30*(9), 959-98.