

DOES DISTANCE MATTER? ADVANCING OUR UNDERSTANDING OF THE GEOGRAPHY OF INNOVATION

Marc D. Bahlmann¹

VU University Amsterdam

The Netherlands

Do not cite from this document. Work in progress.

Abstract

The purpose of this paper is to conceptually explore how different forms of proximity – namely geographical, relational, cognitive, and epistemic proximity – influence the transfer of tacit knowledge and information among entrepreneurs, and how they influence an entrepreneur's degree of innovativeness. The literature review reveals contrasting perspectives with respect to the role of proximity in facilitating knowledge flows among entrepreneurs. The paper concludes with emphasizing the necessity of adopting an integrative framework in order to understand innovation and tacit knowledge transfer from a cluster perspective, and suggests venues for research.

Key words: clusters, pipelines, entrepreneurship, (epistemic) proximity

¹ Correspondence: M.D. Bahlmann, De Boelelaan 1105, 1081 HV Amsterdam, Room 3A-17, Telephone: +31(0)20-59 83 660, e-mail: mbahlmann@feweb.vu.nl

1. INTRODUCTION

A central theme in cluster literature revolves around the question to what degree clusters, here defined as agglomerations of similar and related business activities, enhance entrepreneurs' creative and innovative capabilities (Bahlmann & Huysman, 2008). Put differently, being located in a local knowledge network is considered to intensify one's creativity, learning, and innovative capacities. As such, the spatial clustering of economic activities is supposed to enhance processes of interactive learning (Bathelt, Malmberg & Maskell, 2004), and subsequently to foster regional economic revitalization and intensified innovation. These learning processes are assumed to be spatially sticky due to their context specific nature. This implies that actors can only share new, creative ideas effectively when sharing a similar social context which is, to a large extent, assumed to be defined locally (Sole & Edmondson, 2002; Gertler, 2003). As such, it is considered advantageous for entrepreneurs to be located in a cluster, surrounded by similar and related entrepreneurs with whom they can interact (Bathelt *et al.*, 2004). In addition, the co-location of similar and related entrepreneurs is said to increase competition and rivalry, thus serving as a strong incentive for both innovation and product- or service-differentiation (Porter, 1990; 1998). Being located in a cluster enhances an entrepreneur's ability to constantly monitor and compare his/her offerings to that of his/her competitors.

Nevertheless, the above line of reasoning is increasingly met with a sense of unease, as recent studies argue that it is not the local knowledge network per se distinguishing successful clusters from unsuccessful ones. Clusters, it is argued, can distinguish themselves through building and maintaining so-called pipelines: "a variety of channels for low-cost exchange of knowledge with relevant hotspots around the globe" (Bathelt *et al.*, 2004:33; see also Saxenian, 2006). New creative input is considered to enter the cluster through entrepreneurs with ties to other 'knowledge hotspots' (i.e. clusters), enhancing the creativity of the entrepreneur involved as well as the creative and innovative capacity of the cluster as a whole (as a consequence of knowledge spillover effects and local network dynamics).

Personal ties between entrepreneurs spanning cluster boundaries are hypothesized to be crucial channels for the transfer of new, creative ideas, whereas local knowledge networks are hypothesized to mainly facilitate a 'local buzz' (Bathelt *et al.*, 2004). So on the one hand, being exposed to knowledge sources outside the cluster of residence, hence, is assumed to increase the knowledge heterogeneity of an entrepreneur's network, which subsequently positively impacts an entrepreneur's degree of creativity and innovativeness. Being exposed to local contacts, on the other hand, enhances the entrepreneur's ability to take stock of developments taking place locally, also referred to as local buzz (*ibid.*).

The discussion above reveals two fundamental questions: given that the process of innovation and creativity is increasingly based on tacit interactions between actors (Gertler, 2003) located in different clusters, (1) under what conditions can the exchange of tacit knowledge successfully take place across cluster boundaries? And (2) are such non-local ties in fact crucial to entrepreneurial innovativeness? In theory, geographical proximity (i.e. being located in the same cluster) combined with some degree of cognitive proximity should be sufficient for the successful exchange of new ideas (Boschma, 2005). However, we know very little about knowledge flows across cluster boundaries over different types of ties, and the inherent interaction effects of knowledge heterogeneity. In the absence of geographical

proximity we propose the concept of *epistemic proximity*, here defined as the degree to which two actors (ego and alter) share a common understanding of the future of their environment in general, as an important enabler of the exchange of tacit knowledge across cluster boundaries.

This paper conceptually explores under what conditions of proximity the transfer of tacit knowledge can take place successfully across cluster boundaries, resulting in a set of propositions. In raising these issues, we move away from perceiving the cluster as a ‘bounded region’ from a knowledge perspective, and instead adopt a social network perspective to interpret and understand innovative dynamics at a regional level. Or, as Thrift & Olds put it, “the network serves as an analytical compromise, in the best sense of the word, between the fixities of the bounded region metaphor and the fluidities of the flows metaphor” (1996: 333).

2. THEORY AND PROPOSITIONS

2.1 The role of geographical proximity in the exchange of knowledge

Clusters are assumed to be of value because of the *inherent* and *exclusive* agglomeration benefits they offer to the entrepreneurs and firms that comprise such a cluster (Marshall, 1920). Agglomeration benefits that might accrue from being located in a cluster incorporate, among others, information and knowledge benefits (Amin & Cohendet, 2004) and superior access to financial capital. As such, clusters are considered to benefit its ‘residents’ in various manners, enabling the entrepreneurs and firms it houses to enhance their competitiveness and innovativeness.

Central to the ascribed importance of clusters to innovation and regional renewal lies the conviction that innovation stems from local interactions primarily (Oinas, 1999). Put differently, “intellectual breakthroughs must cross hallways and streets more easily than oceans and continents” (Glaeser, Kallal & Scheinkman, 1992: 1127). Closely linked actors are assumed to benefit from collective learning processes that are bound to a certain locality. The role of tacit knowledge, trust, and local institutions are stressed to have a significant effect on the process of accumulation of knowledge. As such, a high degree of geographical proximity among actors is, *a priori*, considered to stimulate and enhance mutual learning processes. Or, as Amin & Cohendet (2004: 90) assert, “learning and innovation are cast as regional properties, with spatial proximity and local belonging read as the vital economic asset for learning-based competitiveness.”

Recent contributions, however, have drawn attention to the importance of non-local contacts in the process of innovation (Gertler, 1995; Oinas, 1999; Owen-Smith & Powell, 2004; Bathelt *et al.*, 2004; Boschma, 2005; Saxenian, 2006; Tallman & Phene, 2007). From this perspective it is argued that non-incremental knowledge is more likely to reach entrepreneurs and firms, and as such a cluster, through one’s non-local connections, whereas local connections are superior in providing access to what has been conceptualized as ‘local buzz.’ This local buzz is said to encompass “specific information and continuous updates of this information, intended and unanticipated learning processes in organised and accidental meetings, the application of the same interpretative schemes and mutual understanding of new knowledge and technologies, as well as shared cultural traditions and habits within a

particular technology field, which stimulate the establishment of conventions and other institutional arrangements” (Bathelt *et al.*, 2004: 38).

Notwithstanding the importance of clusters for the exploitation of innovative ideas (venture capital, infrastructure, labour pooling, et cetera), this perspective moves away from perceiving clusters as the most prominent loci for the origination and discovery of innovative ideas. Rather, it is stressed that having access to both local *and* global sources of knowledge can significantly benefit entrepreneurs specifically, and the cluster in which they are located in general. The main argument with respect to the value of global pipelines to the development of an economic cluster involves the entrance of new knowledge developed elsewhere (i.e. systematic linkages to another knowledge hotspot). Firstly, entrepreneurs with ties to actors located in other clusters benefit directly from the knowledge obtained through these pipelines. Secondly, the knowledge that enters the cluster via these pipelines is likely to “spill over” to other actors located in the cluster, through the entrepreneur’s local knowledge network (Bathelt *et al.*, 2004). As Saxenian notes, “as lawyers, venture capitalists, investment bankers, entrepreneurs, managers, and other professionals travel between regions, they transfer technical and institutional knowledge as well as contacts, capital, and information about business opportunities and markets” (2006: 95). The flow of information across distant regions is facilitated by the social fabric spanning these regions. The proposition that entrepreneurs benefit from having access to both local and non-local sources of knowledge is hypothesized as follows:

Proposition 1a: an entrepreneur’s degree of innovativeness is associated with the relative share of non-local contacts in his/her social network (P1a).

However, the proposition put to our attention by Bathelt *et al.* (2004) that entrepreneurs need to establish both local and non-local contacts, implies that entrepreneurs need to establish some sort of balance in the composition of their knowledge and information network. Building on too many local contacts might result in an entrepreneur losing touch with important developments going on outside the cluster, which could be denoted as a case of overembeddedness (Uzzi, 1997). On the other hand, too little proximate contacts might hamper an entrepreneur in benefiting from the local buzz (Boschma, 2005). Hence, a balanced network composed of both local and non-local sources of knowledge appears most beneficial to the individual entrepreneur in terms of innovativeness. Therefore we propose the following:

Proposition 1b: entrepreneurial innovativeness is highest when an entrepreneur’s network is composed of both local and non-local contacts, and lowest when composed of either local or non-local contacts (P1b).

This perspective does not argue against the importance of geographical proximity for localized learning. It does question, however, the nature of the learning that is exclusively assumed to take place within cluster boundaries. More fundamentally speaking, it questions the necessity and importance of geographical co-location of actors in the process of mutual learning, especially when it involves new and innovative knowledge. This type of knowledge is said more likely to enter a cluster through inter-cluster contacts, despite of its tacit nature.

As such, this vision moves away from a number of assumptions pivotal to the geography-of-innovation perspective (Gertler, 2003). Instead of assuming that localised learning will automatically follow from high degrees of geographical proximity among actors, this perspective allows for other forms of proximity to enter the equation. By adopting a variety of types of proximity or ‘closeness’ (Amin & Roberts, 2008) in addition to geographical proximity, this stream of literature strives for a more precise understanding of local and non-local knowledge dynamics. These additional forms of proximity will be addressed below, and deal with the question how they facilitate inter-cluster knowledge exchange.

2.2 Relational proximity and the exchange of knowledge across cluster boundaries

The issue of relational proximity and its effect on knowledge transfer relates to the notion of *embeddedness*, which can be regarded a response to the traditional economic (utilitarian) perception of behavior. The utilitarian perception of behavior assumes that actors act in a rational, self-interested fashion, and in doing so, are not or modestly hindered by social relations. The embeddedness perspective, in contrast, accepts the notion of relations posing a serious constraint on behaviors and institutions (Granovetter, 1985). Granovetter basically argues that the “level of embeddedness of economic behavior is more substantial than is allowed for by formalists and economists” (1985: 482). Similarly, relations are still a prime source for people to turn to when in need of knowledge or information. Having ready access to the Internet or a company’s intranet doesn’t change this general tendency to turn to people for knowledge (Levin & Cross, 2004; Cross & Sproull, 2004).

The embeddedness perspective is known for its seminal distinction between weak ties (low relational proximity) and strong ties (high relational proximity). Central is the effect of tie-strength on (knowledge and information) diffusion. This debate heavily relies on Granovetter’s (1973; 1983) ideas concerning the strength of weak ties. Essential to Granovetter’s argument is the notion that “whatever is to be diffused can reach a larger number of people, and travels greater social distance (...), when passed through weak ties rather than strong” (1973: 1366). The fundamental assumption prior to this notion is that the actors to whom one is weakly connected, will probably move in different social circles compared to one’s own, and thus will have access to different kinds of information (Granovetter, 1973; 1983). Or, as Burt (1992: 47) emphasizes, “contacts strongly connected to each other are likely to have similar information and so provide redundant benefits.” Weak ties, hence, can for instance form a crucial bridge between two densely structured social networks (Granovetter, 1983), and are consequently argued to be of importance in obtaining new information (for instance regarding business opportunities).

Whereas weak ties are valuable in that they provide access to new information and knowledge, according to Granovetter (1983) strong ties have their advantages as well. Strong ties are usually more willing to help and generally are more easily available. At the same time strong ties are more time consuming and as such may constitute a constraint, ever more because they involve a degree of reciprocity, and may lead to network inertia (Hansen, 1999).

From the embeddedness perspective innovative, new ideas are more likely to reach the focal entrepreneur through weak ties because such relations are more likely to move in social circles different from one’s own (Rogers, 1995). Irrespective of the role of geography in the relation between relational proximity and knowledge transfer, it would make sense to

hypothesize that new ideas are more likely to reach an entrepreneur through weak ties rather than through strong ties.

Proposition 2a/b: an entrepreneur's degree of innovativeness is associated with the relative share/ number of weakly tied contacts in his or her social network (P2a/b).

The hypotheses above do not take into account the role of geographical proximity in the exchange of knowledge between two actors. In the field of economic geography it is assumed that a relationship not facilitated by geographical proximity lacks a necessary degree of trust and context for the interaction to be effective (Bathelt *et al.*, 2004; Boschma, 2005). In addition, earlier evidence suggests that strong ties involve a higher degree of information exchange (Hansen, 1999; Uzzi, 1996; 1997). Therefore, inter-cluster interactions are, due to a lack of geographical proximity and the subsequent lack of context and trust, considered only possible and effective when formalised and well structured (Owen-Smith & Powell, 2004; Gertler & Levitte, 2003). This would lead us, in contrast to P2a/b, to propose the following:

Proposition 2c: an entrepreneur's degree of innovativeness is associated with the relative share of strongly tied, non-local contacts in his or her network (P2c).

Proposition 2: Higher relational proximity between ego and alter increases the likelihood of tacit knowledge flows d) within cluster boundaries and e) across cluster boundaries (P2d/e).

2.3 Cognitive proximity and the exchange of knowledge across cluster boundaries

In essence, it is considered advantageous for an actor to have access to a diverse set of knowledge sources that vary in the expertise they possess (Rodan & Galunic, 2004). The variety of knowledge, know-how, and expertise available through one's network has also been referred to by the concept of 'knowledge heterogeneity' (*ibid.*). The central idea is that being exposed to a large variety of knowledge should enhance an entrepreneur's creativity and ability to generate new, innovative ideas. As such, the idea of knowledge heterogeneity and its impact on an actor's creativity and idea generation capabilities in many respects relates to Schumpeter's (1934) view of innovation, which recognizes the innovative value of novel combinations of concepts or products previously in existence.

So knowledge heterogeneity among an entrepreneur's contacts contributes to a firm's creativity and innovative capabilities (Baum, Calabrese, & Silverman, 2000; Zaheer & Bell, 2005), for it enables the entrepreneur to learn about new or different knowledge. Inter-cluster knowledge interactions, which by definition take place across both organizational and cluster boundaries, should enhance the knowledge heterogeneity in an entrepreneur's network because inter-cluster contacts allow the focal entrepreneur to tap into different knowledge hotspots (Bathelt *et al.*, 2004). The difference in knowledge between ego and alter might give rise to the problem of too much cognitive distance, though.

Combining the input of heterogeneous agents, located in clusters different from one's own, is a difficult task especially given the tacit nature of the knowledge in question. Simple access

to this knowledge, through either strong or weak ties, may not suffice. Instead, the effective transfer of knowledge requires a certain degree of cognitive proximity (Boschma, 2005). More specifically, a certain amount of absorptive capacity is necessary for the effective exchange of knowledge to take place (Cohen & Levinthal, 1990), for a high degree of absorptive capacity enhances one's ability to identify, interpret, and utilize new knowledge and information. As such, the degree of cognitive proximity between ego and alter is likely to influence the amount of learning taking place between them. Overall, this suggests the following:

Proposition 3a: the amount of learning taking place in a given inter-cluster relationship has an inverted U-shaped relation with the level of cognitive proximity between ego and alter (P3a).

Proposition 3: higher cognitive proximity increases the likelihood of tacit knowledge flows b) within cluster boundaries and c) across cluster boundaries (P3b/c).

However, as mentioned earlier, entrepreneurs are considered to benefit from a certain amount of knowledge heterogeneity in their network. Especially when it comes down to innovation and the implementation of new ideas (Rodan & Galunic, 2004). Therefore, we additionally propose the following:

Proposition 3d: entrepreneurial innovativeness is highest when an entrepreneur's network is characterized by a high degree of knowledge heterogeneity (P3d).

2.4 Epistemic proximity and the exchange of knowledge across cluster boundaries

Epistemic proximity involves the extent to which ego and alter share a similar world view. The more similar this shared understanding of reality, the higher the amount of epistemic proximity between ego and alter. This concept might be a powerful substitute for geographical proximity because it bridges the contextual and cultural gap associated with interactions not facilitated by geographical proximity.

Epistemic proximity differs conceptually from cognitive proximity in the sense that the latter deals with cognition and knowledge background while the former deals with a belief system. One's epistemic understanding of reality can be viewed as the result of a personal sensemaking process (Weick, 1995) influenced by one's physical and social environment. To become concrete, it involves an actor's view of the current state of the industry as well as in what direction the industry *should* develop (Faulconbridge, 2006; Blanc & Sierra, 1999). As such, it involves a personal attitude towards reality mediated by one's social environment.

The value of epistemic proximity in facilitating inter-cluster interactions might take form in two ways. First, sharing a certain degree of epistemic proximity with a given alter can influence the ease of communication between ego and alter, for negotiating a shared world view as a consequence of institutional and cultural differences is unnecessary. As such, ego and alter already share a similar understanding of reality, providing them with a similar context to discuss certain issues. Second, it is likely that sharing a similar epistemic

understanding of reality with any given alter creates a certain amount of trust between ego and alter, again mitigating the effects of inherent cultural and institutional differences. Therefore, the following is proposed:

Proposition 4a: the amount of learning taking place in a given inter-cluster relationship has an inverted U-shaped relation with the level of epistemic proximity between ego and alter (P4a).

Proposition 4: higher epistemic proximity increases the likelihood of tacit knowledge flows b) within cluster boundaries and c) across cluster boundaries (P4b/c).

Second, and analogue to the concept of knowledge heterogeneity (P3d), an entrepreneur might benefit from having access to various epistemic realities, meaning that he or she has a network composed of alters with both similar and different belief systems to that of the entrepreneur. Having access to, or more fittingly, being exposed to different epistemic backgrounds increases the likelihood that the entrepreneur in question is exposed to different ideas and modes of thinking.

Proposition 4d: entrepreneurial innovativeness is highest when an entrepreneur's network is characterized by a high degree of epistemic heterogeneity (P4d).

3. CONCLUSION

Understanding how knowledge can be successfully exchanged across cluster boundaries is important, for knowledge developed elsewhere (i.e. outside one's cluster of residence) is likely to be different from knowledge available within cluster boundaries (Bathelt *et al.*, 2004). Entrepreneurial ties to other 'knowledge hotspots' may be powerful carriers of new and creative ideas. This paper conceptually explored the conditions under which tacit interactions across cluster boundaries can succeed.

In the absence of geographical proximity, other forms of proximity are considered to play a decisive part in the effectiveness of inter-cluster interactions. More precisely, other forms of proximity are hypothesized to act as powerful substitutes to geographical proximity (Boschma, 2005), making it an interesting issue to assess what combination of different forms of proximity is necessary in the exchange of knowledge and learning across cluster boundaries. The characteristics of the relationship between ego and alter in terms of relational, cognitive, and epistemic proximity are considered to either reinforce or mitigate the importance of geographical proximity in the transfer of knowledge.

In addition, this paper explored how various forms of proximity relate to the concept of innovation. As such, the assumed relationship between geographical proximity and innovation is challenged as well. At the very least, our understanding of innovation processes within and between clusters should be enriched by the inherent effects of the relational, cognitive, and epistemic aspects of knowledge sharing and innovation processes.

More fundamentally speaking, this paper invites the reader to critically reflect on some of the pivotal assumptions central to cluster thought. Does it make sense to apply cluster boundaries when studying knowledge flows crossing these boundaries? In other words, to what extent are cluster boundaries (as well as the cluster phenomenon itself) social constructions of our sensemaking minds (Weick, 1995), and more importantly, to what extent do these socially constructed cluster boundaries obscure our understanding of micro-level phenomena such as knowledge exchange among entrepreneurs? Is our language-in-use, the theories we apply, and the hypotheses we construct influencing what we observe even before the actual observation takes place? Are we, in fact, entrapped in this socially constructed reality, to speak with Burrell & Morgan (1979)? And what alternative explanations or paradigms might release us from the constraints associated with this entrapment?

In line with Boschma (2005), this review recognizes the importance of empirical research in order to resolve for the apparently contrasting perspectives on knowledge transfer and learning across cluster boundaries. The propositions presented in this paper provide concrete venues for approaching the effect of each form of proximity on innovation and learning/knowledge exchange. In addition to the propositions proposed in this paper, however, an interesting venue for future empirical research in this matter involves how different forms of proximity interact in the process of learning and innovation.

In all, this paper can be considered a contribution to unveiling the black box of local and non-local knowledge flows and innovation. Whereas in the recent past the topic of tacit knowledge generation resulted in debates emphasizing either the role of geography or the role of relations (Amin & Roberts, 2008), this paper tries to adopt a more holistic perspective. Thus, it recognizes and emphasizes the need to move away from overly polarized standpoints on the geography of innovation.

REFERENCES

- Amin, A. & Cohendet, P. (2004). *Architectures of knowledge. Firms, capabilities, and communities*. New York: Oxford University Press.
- Amin, A., & Roberts, J. (2008). Knowing in action: beyond communities of practice. *Research Policy*, doi: 10.1016/j.respol.2007.11.003.
- Bahlmann, M.D. & Huysman, M.H. (2008). The emergence of a knowledge-based view of clusters and its implications for cluster governance. *The Information Society*, 24(5), 304-318.
- Bathelt, H., Malmberg, A. & Maskell, P. (2004). Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography*, 28(1), 31-56.
- Baum, J.A.C., Calabrese, T., & Silverman, B.S. (2000). Don't go at it alone: alliance network composition and startups' performance in Canadian biotechnology. *Strategic Management Journal*, 21, 267-294.
- Blanc, H. & Sierra, Ch. (1999). The internationalisation of R&D by multinationals: a trade-off between external and internal proximity. *Cambridge Journal of Economics*, 23, 187-206.
- Boschma, R.A. (2005). Proximity and innovation: A critical assessment. *Regional Studies*, 39(1), 61-74.
- Burrell, G., & Morgan, G. 1979. *Sociological paradigms and organizational analysis*. London: Heinemann.
- Burt, R.S. (1992). *Structural holes: The social structure of competition*. Cambridge, MA.: Harvard University Press.
- Cohen, W.M. & Levinthal, D.A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 35, 128-152.
- Cross, R. & Sproull, L. (2004). More than an answer: Information relationships for actionable knowledge. *Organization Science*, 15(4), 446-462.
- Faulconbridge, J.R. (2006). Stretching tacit knowledge beyond a local fix? Global spaces of learning in advertising professional service firms. *Journal of Economic Geography*, 6, 517-540.
- Gertler, M.S. (1995). 'Being there': proximity, organization, and culture in the development and adoption of advanced manufacturing technologies. *Economic Geography*, 71, 1-26.
- Gertler, M.S. (2003). Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there). *Journal of Economic Geography*, 3, 75-99.
- Gertler, M.S. & Levitte, Y.M. (2003). *Local nodes in global networks: the geography of knowledge flows in biotechnology innovation*. Paper presented at the Druid Summer Conference 2003 on Creating, Sharing, and Transferring Knowledge. The Role of Geography, Institutions and Organizations. June 12-14, Copenhagen (Denmark).
- Glaeser, E., Kallal, H. & Scheinkman, J. 1992. Growth in Cities. *Journal of Political Economy*, 100(6), 1126-1152.
- Granovetter, M.S. (1973). The strength of weak ties. *The American Journal of Sociology*, 78(6), 1360-1380.
- Granovetter, M.S. (1983). The strength of weak ties: A network theory revisited. *Sociological Theory*, 1, 201-233.

- Granovetter, M.S. (1985). Economic action and social structure: The problem of embeddedness. *The American Journal of Sociology*, 91(3), 481-510.
- Hansen, M.T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organizational subunits. *Administrative Science Quarterly*, 44(1), 82-111.
- Levin, D.Z. & Cross, R. (2004). The strength of weak ties you can trust: the mediating role of trust in effective knowledge transfer. *Management Science*, 50(11), 1477-1490.
- Oinas, P. (1999). Activity-specificity in organizational learning: Implications for analysing the role of proximity. *GeoJournal*, 49, 363-372.
- Owen-Smith, J., & Powell, W.W. (2004). Knowledge networks as channels and conduits: the effects of spillovers in the Boston biotechnology community. *Organization Science*, 15(1), 5-21.
- Polanyi, M. (1967). *The tacit dimension*. London: Routledge & Kegan Paul Ltd.
- Porter, M.E. (1990). *The competitive advantage of nations*. New York: The Free Press.
- Porter, M.E. (1998). Clusters and the new economics of competition. *Harvard Business Review*, November-December, 77-90.
- Rodan, S. & Galunic, C. (2004). More than network structure: How knowledge heterogeneity influences managerial performance and innovativeness. *Strategic Management Journal*, 25, 541-562.
- Rogers, E. (1995). *Diffusion of Innovations*. Free Press: New York.
- Saxenian, A. (2006). *The new argonauts. Regional advantage in a global economy*. Cambridge: Harvard University Press.
- Schumpeter, J.A. (1934). *The theory of economic development. An inquiry into profits, capital, credit, interest, and the business cycle*. Cambridge: Harvard University Press.
- Shane, S. (2000). Prior knowledge and the discovery of entrepreneurial opportunities. *Organization Science*, 11(4), 448-469.
- Sole, D. & Edmondson, A. (2002). Situated knowledge and learning in dispersed teams. *British Journal of Management*, 13, S17-34.
- Tallman, S. & Phene, A. 2007. Leveraging Knowledge Across Geographical Boundaries. *Organization Science*, 18(2), 252-260.
- Thrift, N. & Olds, K. (1996). Refiguring the economic in economic geography. *Progress in Human Geography*, 20, 311-337.
- Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. *American Sociological Review*, 61, 674-698.
- Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, 42(1), 35-67.
- Weick, K. E. (1995). *Sensemaking in organizations*. California: Sage.
- Zaheer, A. & Bell, G.G. (2005). Benefiting from network position: firm capabilities, structural holes, and performance. *Strategic Management Journal*, 26: 809-825.