

The spatial dimensions of innovation

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THE SPATIAL DIMENSIONS OF INNOVATION

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Abstract

This article takes a critical look at assumptions and ideas fundamental to theories of 'regional innovation systems' and 'learning regions'. First the original theories and their roots are presented briefly. Then a number of key concepts and assumptions will be discussed. After that two trends of development of the original theories will be discussed. One trend is the diversification of the notion of proximity. The other is the inclusion of the global or extra-local linkages in the models. The concluding part suggests a change in perspective in the study of innovation towards a focus on the actors of this process and their societal embeddedness on different scales. More exploratory methods of research would be useful for the creation of relevant scientific knowledge on social processes of innovation.

Keywords

Regions, innovation, learning, proximity, embeddedness, networks, institutions,
spatial development, firms, technology, knowledge, globalisation

Introduction

Ideas of ‘regional innovation systems’ and ‘learning regions’ among others, have gained increasing influence in regional studies and policies during the last one and a half decade. Politically the focus on the internal growth and innovation potentials of regions has necessarily resulted in considerable optimism concerning the ability of regions to solve problems of economic stagnation. Focus has to an increasing extent been on the creation of local institutions and networks in regional economic life.

This article takes its point of departure in scepticism towards the spatial or rather territorialized approaches to growth and innovation. In spite of their success, empirical evidence seems quite scarce (MacKinnon, Cumbers, & Chapman 2002), and theoretical reflection rather superficial (Moulet & Seika 2003). Other contributions also problematise the ideas behind regional innovation systems and learning region (Hess 2004; Bathelt 2003; Paasi 2002; Bathelt, Malmberg, & Maskell 2004; and others). My own research on Polish companies does not support ideas of regionally founded innovation dynamics (Lorentzen 2005b).

This article takes a critical look at assumptions and ideas fundamental to theories of ‘regional innovation systems’ and ‘learning regions’. First the original theories and their roots are presented briefly. Then a number of key concepts and assumptions will be discussed, namely place and region, embeddedness, innovation as a system, space and scale of innovation. After that two trends of development of the original theories will be discussed. One trend is the diversification of the notion of proximity. The other is the inclusion of the global or extra-local linkages in the models. The concluding part suggests a change in perspective in the study of innovation towards a focus on the actors of this process and their societal embeddedness on different scales. To enhance our knowledge of social processes of innovation more exploratory methods should be applied.

I Regional innovation systems and learning regions

The interest in *local* factors behind development, innovation and competitiveness have its roots in earlier developments.

Early industrial districts theory point at the external economies, which small firms can achieve by locating close to each other. Marshall pointed at the importance of personal contacts and the flow of information between firms (Marshall 1922).

Porter (Porter 1990) is the father of the 'cluster' concept. A 'cluster' is a geographically proximate group of interconnected companies, service providers and associated institutions in a particular field, linked by externalities that connect the constituent industries, such as common technologies, skills, knowledge, and purchased inputs. While 'clusters' were originally conceived at the national level, later work suggests that the relevant geographic unit varies by clusters and regions (Porter 2003:562). Particularly beneficial to regional development is the existence of 'traded' clusters, which are not resource dependent and not confined to the local market.

The approach of 'new industrial spaces' (Scott & Storper 1992) focuses on groups of small firms which specialise and draw on common external resources. Together the firms may achieve economies of scale as well as economies of scope. New production technology has enabled small firms to be extremely flexible internally as well as in relation to each other. The district as a whole is innovative and highly responsive to market changes, which make it competitive on the global market. The industrial district possesses a common pool of specialised skills, conventions, norms, values and common institutions. The district may possess regionally specific and even tacit knowledge which serve as a basis for specialisation and competition.

The French innovative milieu approach focus directly on innovation. Co-location, personal relations and networks are important because they determine the local capacity to respond to competitive pressures. The entrepreneur and innovator is the total milieu. An innovative milieu is a coherent system of firms and organisation which through communication and interaction create and share a common culture and approach to problems and situations. The milieu is able to search for new knowledge outside the milieu and to translate it into knowledge understandable to the milieu (Ache 2004). The local environment is more important than the individual firm.

The regional innovation system approach integrates insight from these theories. It focuses on knowledge. The core of the theories is the idea that the performance of an economy depends on the way companies, research institutions and the public sector interacts in relation to the production, creation and distribution of knowledge. Together these organisations constitute an infrastructure, which functions as a 'system of innovation'. A basic assumption is that innovation is basically an interactive process among economic actors. Spatial proximity between economic actors is advantageous because it facilitates the exchange of information. It is even a necessary condition for radical innovations involving the exchange of tacit knowledge (Oerlemans, Mees, & Moekema 2000).

The 'regional innovation system' approach claims that the 'region' is an efficient level for communication and knowledge sharing. The trust and networks arising from participation in local networks and associations facilitate the communication of tacit knowledge for innovation (Braczyk, Cooke, & Heidenreich 1998; Cooke & Morgan 1998). The existence of localised learning networks explain the emergence of new and competitive regions. The social capital of such networks is what makes firms, associations and public agencies engage in processes of self-organised, interactive learning (Simmie 1997). When this process is perpetuated the region is a 'learning region'.

The innovation system and regional learning approaches are based on a series of assumptions related to the scale and dynamic of innovation. The following section will discuss the basic notions and the role of the region, the question of embeddedness, innovation as a system, and the spatial scale of innovation.

II The basic assumptions

Place and region

It is not clear in the different contributions what a region is and in what sense regions are important. 'Region' can of course be a practical, administrative or statistical area, like a county or a province. Critical approaches, however, suggest that regions are *social constructs*. In the regional building process structures of rule, power and trust emerge as a result of 'historically contingent practices in which actors produce and give meaning to more or less bounded material and symbolic worlds' (Paasi 2002:804). Regions become social facts since

they can generate action as long as people believe in them. Regions thus are *spaces of action and publicity*. They may affect the distribution of resources and the life of the people in the region (Paasi, 2002:806). The region contains social practices of social agents, and can in itself be an institutional agent. Regional action can be reproductive, resistant or transformative. This view is open to different spatial scales of social practices and agency, as many social practices are not bound by specific locations. It is important to distinguish between ‘place’ and ‘region’. Place is understood contextually in relation to ethnicity, class, gender, identity and so on and denotes the *location* of these social relations, while region is a *space of action and publicity*, a constructed institutional structure. This implies that ‘industrial spaces’ or a ‘learning regions’ would represent spaces of economic interaction and agency at *different* spatial scales.

Embeddedness and region

The role of the region in theories of regional innovation systems and learning regions is based on the embeddedness argument. This argument is not clear either, as the literature on embeddedness differs in relation to scale and focus (see also Hess 2004). The notion of embeddedness was first introduced by Polanyi (Polanyi 1944). For Polanyi it is the exchange, or type of economy, that is embedded in or disembedded from society. The central issue is the institutionalisation of the economic processes. Market societies to a varying extent are ‘embedded’ systems, which are connected with and influenced by non-economic institutions (Polanyi 1957). A main point is that markets are so to speak socially constructed and governed.

The idea of the social embeddedness of the economy is taken further by Whitley (Whitley 1992) in the notion of the ‘business system’ which is a kind of economic coordination and control system formed by the institutional environment. The firm is embedded in the business system, which is again embedded in the institutional environment. The business system is socially embedded in its *home territory* and retains its characteristics even during internationalisation and globalisation.

When discussing embeddedness Granovetter (Granovetter 1985) focuses on actors and networks of interpersonal relationships. He claims that there are network relations both within

and between firms regardless of the organisational form of the firm (Granovetter 1985). He stresses the role of concrete *personal* relations and structures and argues that there is a *network structure relationship between actors in all societies*. Transactions of all kinds are rife with social connections (Granovetter 1985:491).

Embeddedness is thus understood as institutional aspects of economic relations and as personal relations within and between firms. Apart from Whitley's focus on the home territory, the role of territoriality is absent in the embeddedness literature.

Geographical embeddedness

Since the beginning of the 1990s geographers have adopted the notion of embeddedness. (Dicken & Thrift 1992) suggest that 'business organisations are...produced through a historical process of embedding which involves an interaction between the specific cognitive, cultural, social, political and economic characteristics of a firm's 'home territory' ... (Dicken & Thrift 1992 quoted in Hess 2004:173). There is no specific reference to the scale on which the processes take place.

However scale became the focal point of subsequent contributions, which focus on *local* networks and *localised* social relationships as the spatial logic of embeddedness. The argument goes like this (Hess 2004:174): 1. external economies are important for localised production systems 2. The regional cultures and local institutions have a positive impact 3. Trust among business partners arise from spatial proximity

This leads to the idea of 'institutional thickness', proposed by Amin and Thrift (Amin & Thrift 1994): strong institutional presence, high levels of interaction, defined structures of domination and/or patterns of coalition, a mutual awareness of being involved in a common, regional enterprise is seen as preconditions for regional development. This view gained great influence on the work of regional geography in the 1990s.

The literature on global production networks (Dicken 2003) shows firms are embedded in global networks. Globalisation can be seen as a process embedding firms in global networks on different spatial scales (Hess 2004:175).

A coherent notion of embeddedness results from the combination of the insights above.

- *Societal* embeddedness relating to the cultural formation of an *actor*
- *Network* embeddedness describes the network of actors in which a person or an organisation is involved. This is the result of trust building between *network agents*.
- *Territorial embeddedness* is the extent to which an actor is anchored in particular territories or places. Local government policies may function to embed parts of larger (global) networks in particular cities or regions (Hess 2004:180).

In the words of Hess it is ‘the simultaneity of societal, network and territorial embeddedness that shapes networks and the spatial-temporal structures of economic action’ (Hess 2004:181).

In sum geography, or region, is not the core in relation to embeddedness. Following the literature, embeddedness relates to systems, persons, firms and networks. Social and economic systems are embedded in each other, persons are embedded in networks, firms or organisations are embedded in societies, and networks are embedded socially.

Innovation as a system in space and scale

The origin of the spatial dimensions of innovation is the notion of ‘national systems of innovation’, suggested by Nelson (Nelson 1993) and by Nelson and Rosenberg (Nelson 1993; Nelson & Rosenberg 1993) claiming that the nation state provides a basis for economic specialisation and knowledge creation in production. The idea of a spatial boundary for innovation processes has been taken further down the scale by Cooke et al (Cooke, Uranga, & Extelbarria 1997), who argue that there is such a thing as a subnational, regional innovation system, sectoral level (Breschi & Malerba 1997), technological level (Carlsson & Stankiewicz 1991), and the most recent, a metropolitan level (Fischer & Snickars 2001).

Innovation means the introduction of new products, processes, organisation and management forms. There is a common understanding of innovation as an interactive process involving a number of actors.

The idea that economic innovation processes can be connected to certain territorial scales is based on the perception of innovation as a 'system'. A 'system' is defined through its potential to reproduce its basic structure and capability to actively maintain a distinction between the interior and the exterior. A shared set of interpretations and values is created which allows for a *boundary* to be drawn between the internal and the external (Bathelt 2003).

The argument of the national systems of innovation goes like this: Within the system agents can rely on shared rules and routines, which help them to deal with uncertainties. These are the social institutions. A joint institutional framework enables users and producers to discuss and solve problems of common interest. Important institutions are created and regulated at the level of the nation state. The common rules imply an affinity among firms which serve as a lever of interactive processes of knowledge creation and innovation.

National patterns of innovation develop on the basis of existing patterns of specialisation (See also Porter 1990). The institutional framework shapes the direction of the innovation process, and the social and cognitive affinity among the agents of a nation provides a basis for specialised communication and interaction between them. Through its institutions the nation state helps national industries to compete globally (Bathelt, 2003:769).

Cooke et al. (Cooke, Uranga, & Extbarria 1997) argue that well known localised production configurations such as industrial districts, clusters and innovative milieux have gained importance *because* of globalisation. There is a need for close cooperation among regional actors as well as a need for regional universities, industry associations and technology transfer organisations. This makes regional industries competitive.

In brief the argument goes that the innovation process can 1) be conceptualised as a system, and 2) that this system is territorialized. This argument is questionable for the following reasons.

The idea of innovation as a system implies that innovation takes place as routinised practices within certain systemic borders. Against this idea it can be argued that routine is on the contrary to the detriment of innovation because innovation involves creativity which again is

likely to require changing and varied impulses, inputs and experiences. Cooperation partners change as do forms of cooperation, and borders of cooperation are dissolved in the process of globalisation, if they ever existed. It is therefore not possible to define actors and routines of the system, nor is it possible to define its borders.

The second assumption, that the innovation process can be considered as territorialized, implies that the agents and institutions involved in the innovation process belong to a certain territorial area like the nation, the province, county or other local area. There seems to be no argument why the ongoing institutional and economic globalisation and the development of time-space compressing technologies should not lead to a globalisation of the relations involving interactive innovation. Why should individual firms not search for knowledge and partners on a global scale? While specific processes of innovation are of course localised they are not likely to be confined to certain territories.

Region and innovation

An early example of the local/regional focus in innovation studies is GREMI (Carmagni 1991), a French research group which suggests the notion of a *local milieu* as an operator between markets and organisations. The milieu is a synergy space and a cooperation space of inter-firm networking. The milieu can be understood both as an actor and as a network.

Within the network firms tend to develop new functions of searching, screening, transcoding, selecting and control information which enable the milieu as such to become innovative. The milieu receives external inputs to avert the dangers of 'lock in'. In this approach spatial, geographic proximity seems '*automatically*' to generate innovation, leading to growth. This is a systemic approach which stresses the routines and the borders of the system, and the system as territorialised.

The argument of the particular role of the local territory/the region is developed further with arguments related to *certain kinds of knowledge* in the innovation process. Tacit knowledge and skills are said to be particularly important to innovation, because the creative process leading to innovation in its initial phases involves intuition and imagination which cannot be communicated in a codified and explicit way. The partners involved in innovation therefore have to understand each other very well, even intuitively. Only partners belonging to the same

social, cultural and institutional environment are able to understand each other so well. This implies that they have to belong to the same geographical (regional) locality (Cooke & Morgan 1998).

This argument is not very well grounded empirically. They argue that the studies of innovative clusters are exclusively made in high tech industries (MacKinnon, Cumbers, & Chapman 2002). The most well known study is probably the study of Saxenian (Saxenian 1994) of Silicon Valley and Route 128. In this study Saxenian argues that the comparable success of Silicon Valley can be ascribed to cooperative network arrangements which enabled collective learning. This and other empirical studies focus on the *mechanisms* by which knowledge is disseminated within a particular local milieu: staff turnover, the formation of new firms, the development of career trajectories and more informal exchange. This latter is what some authors label 'local buzz' (Bathelt, Malmberg, & Maskell 2004). It is however a question why these knowledge dissemination mechanisms should be confined to a specific local space? Specialists are recruited world wide and make international careers. Foreign investors play a considerable role in the foundation of new firms and affiliates, and news can be exchanged between agents in different fora, which are not only local, but national and international.

Learning regions

Ideas of particular territorialised innovation systems developed into ideas of 'learning regions' in which not only general societal mechanisms but specific networks, organisations and processes came into focus.

The literature on learning regions share a number of key propositions.

New forms of agglomeration emerge along with globalisation. They are based around knowledge creation. The agglomerations can derive considerable advantages from this knowledge if it is tacit as well as specialised. Such non-material advantages are to an increasing extent located in regions, in the social relations between firms and institutions. The key source of learning is related to these relational assets. The agglomerations become clusters of specialists and related industries. In the cluster the importance of geographical proximity is related to the need to access and transfer tacit knowledge through close

interpersonal and inter-firm relations. Cumulative learning processes take place over time among a community of firms in a locality (collective learning), to the extent that inter-firm relations are continuous and stable. Trust arises from stable and continuous inter-firm relations, and trust between actors is considered critical to collective learning activities. High levels of trust are generated through geographical proximity between firms. (See also MacKinnon, Cumbers, & Chapman 2002:301).

In sum closely cooperating firms is the core in ideas of learning regions. The question is if this is more than a normative proposition or if there are empirical or logical support for the idea?

The basic question is what makes private firms in a competitive market environment want to embark processes of collective learning with other firms? In a competitive economy secrecy is a parameter of competition. The theories underplay the problem of building and sustaining trust among firms under competitive pressures. It is not clear at all under what conditions private companies would be willing to share knowledge with other companies, and what type of knowledge they are willing to share (See also MacKinnon, Cumbers, & Chapman 2002:302).

A second question which is unsolved in the theories is whether the suggested innovative networking and knowledge sharing activities represent *a viable path for all kinds of firms*. What would the following differences imply to inter-firm cooperation and regional learning: branch affiliation, size of firm, organisational form, ownership, technological level, degree of internationalisation? As empirical work has focused on learning in specific high tech *branches*, it seems difficult to generalise into an idea of learning *regions*.

In addition there is a series of common issues in the regional innovation system and regional learning theories worth mentioning. The notion of the 'region' as it is used in the theories is quite unclear. 'Region' is used without definition but is taken to mean both the institutional structure and the locality or the place of production and innovation. It even assumes that the 'region' has got a strong governance structure of its own, as well as integrated economic structures, or complete value chains. Few subnational 'regions' have got such integrated

economic structures, however, and most of the important institutions of innovation exist on the national level (see also Bathelt 2003; Bathelt, Malmberg, & Maskell 2004).

Regional innovation systems and learning regions theories ignore macro-economic and institutional issues of great importance to innovation. What is the role of *macro-economic conditions* to innovation and networking? It could be suggested that, depending on the economic conjunctures, there would be major differences in the innovative behaviour of firms and in the functioning of the societal mechanisms enabling the diffusion of knowledge in the economy, due to differences in levels of investment, labour market dynamics and general expectations to the market.

Further what is the role of *institutions* on different scales for innovation and learning? On what level are important regulations made (trade, R&D, labour market, sectoral policies)? Regulations are mostly developed on national and international scales. Local level regulations are usually implementations of regulations made on other scales (land-use planning and business support initiatives). Left for the local scale is local culture, traditions of craft, and some social networks. The relative importance of these institutional levels to innovation and learning is still unsolved, in spite of the dominating focus on local networks and institutions as for example in Cooke and Morgan (Cooke & Morgan 1998).

III Developing the local and the global

Proximity and innovation

This section will look at recent contributions related to proximity and to the role of the global level in an innovation perspective.

Two assumptions underlie the view that proximity is important to innovation: 1) Interaction is a precondition for innovation and 2) cooperation is better, the closer the actors are to each other. Underlying both is of course assumption that firms do in fact interact on innovation. The focus on proximity is related to a personalised (as opposed to societal) view of embeddedness. In the debate proximity has been developed to mean different things.

Geographic proximity expresses the kilometric distance that separates two units in geographic space. It is relative in terms of the cost and time of transport and in the perception of individuals. Geographic distance represents a constraint on the actors to develop their actions (Torre & Rallet 2005). *Organised* proximity is the ability of an organisation to make its members interact. The interactions are facilitated by rules and routines of behaviour that they follow. Geographical proximity alone cannot create synergies and interaction but it facilitates it, while organised proximity can exist without geographical proximity (Torre & Rallet 2005:51). It is therefore not the geographical proximity as such, which explains the emergence of synergies. The geographic proximity is a result of the territorialisation of social networks, for example of people from the same university or the same social and family network. Local development policies may also stimulate synergies between actors (Torre & Rallet 2005).

Social networks are not necessarily permanent nor do they need face to face relations on a permanent basis, as learning region theories claim. There is an increasing mobility of men, information and goods, facilitated by the time-space compression technologies and caused by among other things the new ways to work by travelling (experts, salesmen, researchers). This implies that social networks may share knowledge, even tacit knowledge, over long distances. If actors share rules and representations, their organisation represents a mechanism of long-distance coordination or organised proximity. If geographic proximity is needed for some reason, short visits may suffice to share crucial knowledge or solve problems. This is what the authors call '*temporary* geographic proximity' (Torre & Rallet 2005). The need for co-localisation is therefore far less than territorialized innovation theories assume. There may be other reasons for location in certain places, as for example market development or proximity to research environments.

Torre and Rallet thus add both time and scale dimensions to the proximity concept while focusing on the social network and the way this is organised and located in space.

A multiplicity of proximities

Proximity, like embeddedness, is a notion which has been developed to include still more dimensions. In relation to embeddedness quite a few mechanisms and dimensions have been

suggested. DiMaggio suggests cognitive, cultural, structural and political embeddedness mechanisms (DiMaggio 1990). Halinene and Törnroos (Halinen & Törnroos 1998) add technological, market, temporal and spatial dimensions to the concept. A parallel development can be seen in relation to proximity.

A recent example is Boschma (Boschma 2005) who develops a model of proximity including five dimensions, namely *cognitive, organisational, social, institutional and geographical* proximity.

In more detail the content of the five proximities suggested by Boschma is the following: *Cognitive* proximity denotes the distance in competencies needed to transfer knowledge between firms. There is a minimum level of knowledge under which firms are incapable to bridging their knowledge. In the other extreme, too little cognitive distance means lack of sources for novelty, or technological 'lock in' (Boschma 2005:63). The point is that firms need to be into the same technology field to be able to benefit from each others knowledge.

Organisational proximity is defined as the extent to which relations are shared in an organisational arrangement within or between organisations. Organisational arrangements are needed to control uncertainty and opportunism. Open and flexible organisational arrangements enable the inclusion of new channels and new knowledge while hierarchic arrangements do not (Boschma 2005:65). The idea is basically that the type of organisation matters to knowledge diffusion.

'*Social proximity*' is defined as socially embedded relations between agents at the micro level. Relations between actors are socially embedded when they involve trust based on friendship, kinship and experience. The social dimension of economic relationship has a positive influence on the performance of the firm until a certain level (Boschma 2005:66). The point being that friendship among staff members make things easier until a certain point.

Institutional proximity is in the model of Boschma (Boschma 2005:67) associated with the institutional framework at the *macro* level. He follows Edquist when defining institutions Edquist 1997 as sets of common habits, routines, established practices, rules or laws that regulate the relations and interactions between individuals and groups. They reduce

uncertainty and lower transaction costs. The point is that not all institutions are equally good at enabling knowledge transfer, interactive learning and innovation.

Finally *geographical proximity* refers to the spatial or physical distance between economic actors, both in its absolute and its relative meaning (Boschma 2005:68). Short distances enable people to meet and exchange different kinds of information and tacit knowledge. Geographic proximity combined with some level of cognitive proximity is sufficient for interactive learning to take place. Geographic proximity can be substituted by some other form of proximity, social organisational or institutional (Boschma 2005:69). The point is that geographical proximity is neither a sufficient nor a necessary condition (Boschma 2005:70).

In the model of Boschma the different proximities have influence on each other and may substitute for each other: Social proximity may decrease the cognitive distance between partners over time. Organisational proximity may compensate for lack of social proximity and lack of trust. Finally geographic proximity is likely to stimulate both social interaction and trust building. The proximities may be 'too much' or 'too little' to stimulate interactive learning. Solutions to problems of 'too much' or 'too little' proximity consist in changing the 'dose' of proximity or to substitute one proximity for another.

In sum Boschma suggests new dimensions of proximity while reducing the importance of scale and co-location of actors in innovation.

Three fundamental problems make Boschma's model highly problematic. When developing his model, the suggested five notions of proximity undergo a kind of 'standardisation' as a point of departure for quantification (too much, too little) and substitution. This exercise in simplification for the sake of modelling has gone so far, that rich social dynamics become one-dimensional and stylized. The quantitative approach is in Boschma's model transferred into fields where simplification and measurement turns meaningless. Not much is understood by 'social relations', 'competencies', 'institutions' and 'organisations' if measured by a simple scale.

Another serious problem is that the term 'proximity' is not consistently applied in the model. Thus not all five dimensions of proximity in the model refer to distance between actors. Some of the dimensions refer to the quality of institutional or organisational arrangements as enabling conditions for interaction between actors. And finally, the kind and level of actors is not at all clear in the model.

The global and the local

While the proximity approaches modify the role of co-location other authors more specifically work on the different roles of spatial scales in relation to innovation and learning.

Under the catchy headline of 'local buzz and global pipelines' Storper and Venables suggest a functional difference between local and global connections (Storper & Venables 2002). This idea has later been developed further by Bathelt et al (Bathelt, Malmberg, & Maskell 2004).

Not unlike the theories of 'innovative milieu' and 'learning regions' the authors claim that firms in a cluster may develop a shared knowledge base, which represent a source for continuous production of new knowledge and innovation (Bathelt, Malmberg, & Maskell 2004). Knowledge is embedded in the local environment and diffused spontaneously through '*local buzz*'. In order to benefit from local buzz one has to be present, to meet and chat in organised and unorganised meetings. This is the reason why firms have to locate in geographic proximity of each other.

However, like the 'innovative milieu' theories, the authors argue that firms need to source knowledge from other clusters as well. If firms rely exclusively on the local knowledge base they run the risk of technological lock-in. Knowledge sourcing from non-local sources has to be organised in networks or partnerships. This is the '*global pipeline*'. The development of such partnerships is costly and takes time (Bathelt, Malmberg, & Maskell 2004).

With a focus on large urban agglomerations Simmie (Simmie 2003) is following the same track. Firms locate in large urban agglomeration because of the pool of technical knowledge. This knowledge is disseminated through labour mobility. However it is unusual to find all the

knowledge required as basis for innovation within a single regional economy. Extra-regional knowledge sourcing is necessary. Support for this view Simmie finds in a survey covering the years 1998 to 2000. The firms as a whole relied more on national sources than on local sources (Simmie 2003:617). The most innovative firms of the survey used more external (extra-regional) sources of information than the less innovative firms did. On the regional level the survey showed that the regions with the greatest concentration of knowledge capital and resources in terms of R&D expenditures in businesses and governments (i.e. input indicators to innovation) are also those with the strongest export performance. Based on these observations Simmie suggests the idea of the most innovative regions as *nodes and gateways* for the exchange and trading of leading ideas. The role of regions in this model is to concentrate and circulate knowledge within and between regions (similar to the 'innovative milieu' idea). The most open, trading regions with the strongest export base will gain competitive advantages in a cumulative cycle, because they will be the first to receive new knowledge and because of the large quantity of knowledge they receive (Simmie 2003:614).

A similar picture is described by Scott and Storper (Scott & Storper 2003), who focus on the role of large city regions. They consider city regions locomotives of the national economies within which they are present. The big agglomerations compete with others in the markets of their specialisation. They are *linked* together via long distance *commodity chains*. More peripheral areas are often linked to the big agglomerations by wider commodity chains. The trade flows within and between agglomerations and between agglomerations and peripheral areas are expanding with globalisation.

In the globalised economy, *regions* are tied together internally by *human and organisational interdependencies*. They are sources of positive externalities freely available to local firms. These include information flows, learning processes, craft or design traditions and business network formation, which can be supported by intervention of different kinds, based on the involvement of local stakeholders (see also Morgan & Nauwelaers 1999).

Also Sternberg (Sternberg 2000) considers the role of the local and the global. With a focus on small businesses the author suggests that the integration of a region and its intraregional networks into international and global networks plays an essential role in the continual renewal of such networks. Actually, the true strength of such a network can be found in its

ability to provide ties to global networks (Sternberg 2000:394). Without these ties the small and medium sized enterprises would be at a disadvantage in the innovation process and have little access to global knowledge resources. The region is thus of great importance to them (Sternberg 2000:393). A survey from 1998 seems to support this view (Arndt & Sternberg 2000). The survey provides evidence of extra-regional networking. The national level is the most important level, while less than 10% of the businesses cooperated internationally. The authors find evidence, that the region has particular importance for SMEs. The smaller the business the higher the share of intraregional linkages (Arndt & Sternberg 2000:474). And they find that firms that did not cooperate were less successful than other firms. Based on this the authors suggest a causal relationship between networking activities on the one hand and growth and technological development of the firm on the other.

Finally Rutten (Rutten 2003) adds a dynamic perspective to the ideas that individual firms need both local and global networks. Not only does he suggest that different tasks are accomplished by individual firm in different spatial networks, from the local to the global. His empirical study indicates that the spatiality of the network depends on the phase of innovation. Basic research is performed at a global scale, new concept developments is done on a local scale. Engineering is performed in collaboration with suppliers on a regional scale, and production takes place on a global scale. The idea of coupling tacit knowledge exchange with geographical proximity is maintained but specified to the development phase of innovation.

While the 'region' in the former contributions serves as a mediator between the firm and the global, in Rutten's view every spatial scale represents a possible network and a source of knowledge.

The global and the local – discussion

The global-local contributions develop theoretical perspectives on the role of the global while maintaining a firm foothold in the regional innovation system/learning region approaches. They share a series of questionable assumptions which shall briefly be touched upon below:

Firms are prepared to share knowledge with other firms. This assumption was briefly discussed above. The question which is not solved in the contributions is again, what it is that

makes private firms in a competitive environment wish to share knowledge with other firms? The answer seems to be that they do it because they have to make the functional model work. In the real world, however, knowledge is a competitive asset. The more specialised and difficult to imitate this knowledge is the better is the situation for the firm. Firms in a competitive environment are likely to keep their secrets, while some degree of knowledge sharing with suppliers or customers is common and not new. The provision of partial knowledge may even be part of the product.

The sharing of knowledge in the cluster/region is easy, spontaneous and costless. Most practitioners will know that the sharing of knowledge is a time consuming and thereby costly process. Theoretically this can be illustrated by the concept of the knowledge conversion process by Nonaka and Takeuchi (Nonaka & Takeuchi 1995). In their model time and personal on different levels have to be dedicated to knowledge converting activities. Knowledge conversion has to be planned as well as paid for. The 'local buzz', or the professional gossip of employees may be 'free and spontaneous' seen from the perspective of the firm. But is it a reliable and substantial input into the innovation process of a firm? Also labour mobility and the creation of spin off firms are not spontaneous and costless, although it is a social mechanism outside the firm. The recruitment of experts and the foundation of firms are costly as well.

There is such a thing as a shared knowledge base. Firms contribute and benefit from the shared knowledge base. The knowledge base is supposed to consist of the sum and the synergy of the knowledge of the firms in the cluster. A shared knowledge base may have existed earlier on locations specialised in particular branches of industry, with labour turn over and local training facilities. It is difficult to imagine such a shared knowledge base today with the differentiation and specialisation dynamics of globalisation. This means that firms are specialised and need different types and combinations of knowledge, and accordingly that they need to differentiate their knowledge sourcing. And referring to the first point made, firms do not have readily access to the knowledge of other firms. Examples of joint projects among firms should not lead to conclusions about the existence of a generalised knowledge base.

Local knowledge has a particular role to play because it is tacit and close. The discussion of proximity showed that geography is not decisive for the exchange of tacit knowledge. Social and professional affinity is more relevant for the sharing of knowledge, whether tacit or not. The permanent co-location of members of a professional network is not decisive for knowledge exchange.

Knowledge networks among firms is a cause of success. The question seems to be if success is rather the cause of networking? The firms that do networking seem to share the following characteristics: They operate on the basis of high-tech; they have highly educated staff; they are located in urban agglomerations; they are not small; they spend money on knowledge sourcing and or research and development. The firms that do not network share the following characteristics: they operate on the basis of simple technologies; they have low skilled labour; they are located in less central places; they are small; they do not spend money on knowledge sourcing and R&D.

Alternative causal relationships could be suggested in from this picture:

High tech firms are often successful firms. They are search based and do knowledge sourcing as part of daily operations. Highly educated staff has knowledge sourcing as part of their job description. Highly educated staff finds it fun to develop projects with colleagues from other firms. Successful firms can afford to locate in towns. They locate where the labour force is – in towns - and can afford joint projects with universities.

Firms in simple technologies are able to do gradual innovation by themselves. Their staff is dedicated to production, not to development. There is no separate R&D department and no staff dedicated to knowledge sourcing. They have a cost focus and economise on housing and wage costs.

A network is a region is a network. Often the contributions apply the notions of network or cluster and the notion of region at random. There is no reason to suggest that existence of a localised network should imply that the region as a whole is a networked or a learning region, nor that it ought to be.

IV Conclusion: From knowledge sharing to knowledge sourcing

This article has summarised the development in regionally focused innovation theories and discussed a series of weaknesses in them. Basic notions like 'region', 'systems of innovation', and 'proximity' have been examined critically, and it has been argued that these notions are hardly adequate to grasp social processes of innovation in a complex, globalised and socially divided economy. It has also been argued that the possibility to generate relevant scientific knowledge on the topic suffers from the over-simplifications made of complex social processes. The functional models of innovation tend to be focused on the internal logics of the model and on normative prescriptions.

As an alternative research strategy it is suggested here to leave the search for simplifications and functional relationships in models and approach the reality of the actors of innovation by more explorative methods of study (Lorentzen 2005a).

As a starting point for such research ideas of innovation, space, and the embeddedness of innovation actors would serve as a starting point for such research. Innovation is produced by individual or networked actors as a competitive strategy in the global competition. The search for and combination of knowledge is not a basically systemic endeavour, although it might of course follow some routines. It is subject to chance and personal passion and friendships. The process and its actors are embedded in societal structures at different scales which form the overall direction of innovation. Innovation thereby becomes path dependent. The process changes, the routes change, and new actors become involved.

The spatial extension and patterns of innovation dynamics is likely to differ from branch to branch. Also the pressures to innovate are not equal in all branches. The core of the process of innovation in a competitive economy is the search for knowledge by individual firms, their *knowledge sourcing*. One of several possible strategies of knowledge sourcing is to establish more or less permanent networks, but the role of networks in the innovation of firms should not be overestimated.

To grasp the societal dimensions of innovation it is suggested to apply notions of embeddedness as an alternative to the problematic notion of 'proximity'. 'Embeddedness' denotes simultaneously the *actors* and the societal *structure* in which they are embedded, and it allows for different spatial scales. It is probably useful to consider such aspects of

embeddedness, which have already been suggested above: the *social* embeddedness, the *organisational* embeddedness, the *institutional* embeddedness as well as the *technological* and *professional* embeddedness. Finally it seems justified to discuss time and distance aspects in terms of *accessibility* to knowledge sources, which includes not only kilometric issues, but also infrastructural (e.g. airport, the internet) and institutional (e.g. international fairs, magazines, homepages) conditions to knowledge sourcing.

Accessibility to knowledge is one aspect of innovation, the abilities of the actors to apply the knowledge is another. The *capabilities* of the actors to apply new knowledge is related to their internal characteristics in terms of organisation, knowledge and other resources. Too little has been said until now about the huge differences among firms and organisations in this respect.

It has been argued in this article that the place and space of innovation processes cannot be expected to follow the institutional structures of particular territories (regions). Firms embarking processes of knowledge sourcing are of course embedded in institutional structure of specific regions or nations, but the social process of knowledge sourcing and innovation is not. The institutions of innovation are different and exist on various scales (national and international branch organisations, international fairs, expert groups, research programmes, international production chains). Therefore professional networks may exist on different geographic scale. The region as a structure of power may pursue policies which influence the climate or material foundations for innovation in a certain area, but it does not represent any kind of boundary to the social relations of innovation.

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