26. Geography of innovation, proximity and beyond

Alain Rallet and André Torre

INTRODUCTION

The localized nature of innovation has, for the last 40 years, been the object of much debate in the literature. However, it has been approached from different angles according to different schools of thought and types of policies chosen by local or national governments.

The 1970s and 1980s were marked by a renewed awareness of the importance of localized economic systems. The goal was initially to highlight the role of Marshallian externalities in the capacity of local networks of small and medium-sized enterprises (SMEs) to compete with large firms, the 'Third Italy' being a typical example of this productive configuration. In the Marshallian tradition, those productive systems rested on customer–supplier relations and, more generally, on externalities, that is to say, the 'industrial climate' that characterizes a territory ('the secrets of the industry are in the air', Marshall 1890).

The literature of those years on industrial districts (Becattini 1979; 1987; Becattini and Rullani 1995; Becattini et al. 2009) and innovative milieus (Camagni 1991; Maillat 1995) brought to light the complexity of localized systems by taking into account not only inter-industrial linkages, but also other components such as the labor market and an ad hoc culture, in the sense of Becattini. This led to a shift, in the literature on districts, from a concept of localized economic systems centered on production (industrial district) to one centered on innovation (technological district), while the research on innovative milieus focused from the very beginning on territorial mechanisms conducive to producing innovation. In this way, innovation was considered the product of territorial systems responding to specific characteristics, conceptualized in different ways depending on the approach (district, milieu, localized system of innovation, etc.) and covered by the all-encompassing concept of the cluster, which has been the theoretical reference point for local innovation policies for over 30 years.

In the 1980s, another approach to the geographical dimension of innovation emerged as a critique of the prior conception according to which innovation was the product of a territory that behaves like a system, with innovation policy intending to fill the gaps in this system (research, universities, high-technology industries, etc.) to improve its performance. According to this approach, innovation no longer is the product of a local system but that of a complex geography of both local and non-local relations between innovation actors. The idea, in this case, is to identify the role of geographical proximity and assess its relative weight in economic linkages generating innovation. This perspective, grounded in coordination mechanisms, is quite different from the previous approach. It is the perspective adopted by the Proximity School of thought in the 1990s (RERU 1993) and later by economic geography research, which generated much empirical research on the various dimensions of proximity and the localization of innovation processes

(Feldman 1994; Feldman and Massard 2002; Asheim and Gertler 2006; Boschma and Martin 2010; Torre and Wallet 2014; Shearmur et al. 2016). These studies suggest that geographical proximity plays a relative role and therefore that innovation policies should not only promote global connections but especially local synergies among local actors.

These approaches have greatly expanded our understanding on the role of innovation in localized systems and led to the implementation of active public policies. This chapter argues that new approaches are necessary today, because the existing ones either suffer from analytical shortcomings or have failed to take into account changes in the conception of innovation and in the organization of contemporary societies. Accordingly, the next section is devoted to the cluster-oriented approach, which highlights the systemic nature of innovation processes – seen as less and less technology-based – thereby moving closer towards a definition of industrial ecosystems. Then, we discuss the coordination-based approach, highlighting shortcomings in the analysis of the concepts of proximity and their coordination-related dimension. Finally, we discuss the need for a broader conception of innovation, and the necessity to look beyond its technological dimension by considering new forms and new sources of innovation, linked to social and organizational issues as well as environmental questions and the relation with local populations' desire to express themselves.

FROM CLUSTERS TO INDUSTRIAL ECOSYSTEMS

Whatever name they are given (district, milieus, etc.), and whatever form they may assume as instruments of public policy (technopoles, science parks, industrial clusters, competitiveness poles, etc.), local production and innovation systems seemed for a long time to be the types of organizations that best represented the relation between space, industry and innovation. Related approaches also helped better understand the nature of local interactions and configurations. They had the merit of placing SMEs, sometimes very small enterprises, at the heart of the analysis, and of showing that the resilience of local systems was based largely on their being part of a network. Starting with a review of the ever-deepening analysis of the concept of the cluster, its synonyms and derivatives, we then proceed below to a review of the concepts of industrial ecosystems and business ecosystems, the latest embodiment of clusters.

(a) The Cluster-Based Approach – Constantly Refined and Put into Perspective

Local production systems are here referred to under the generic term of the 'cluster', which expresses the idea of businesses and organizations grouped together in a particular context, and which maintain close relations with one another without excluding distance relations with outside organizations. This concept and its multiple variations have undergone significant changes and developments over time. The first example is that of the concept of industrial districts, which emerged under the inspiration of Marshall's work and was later developed anew by Becattini's pioneering work (1987). The research on local production systems (Courlet and Pecqueur 1992) and innovative milieus (Aydalot 1986; Camagni 1991) brought new insights. Besides their theoretical objectives at the crossroad of industrial and spatial analysis, these works also aimed to address needs in terms of

conceptual and operative instruments which national and local governments often fail to tackle.

In this quest for conceptual and operative tools, an important shift has resulted from Michael Porter's work on 'clusters'. His work initially concentrated on the management side of clusters, but he soon broadened the scope of analysis, giving rise to a growing interest for other fields. This work aimed at gaining more insights into why some spatially concentrated clusters of firms were effective. On the one hand, an emphasis is placed on the interaction between actors, and, on the other, a managerial analysis helps identify the virtues of the winning configurations and, in so doing, provides more normative and action-oriented instruments. Porter (1998; 2003) argues that a cluster is 'a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities'. Initially, the concept was applied to success stories, with the iconic example of Silicon Valley. The tendency has since been to extend the concept towards systems that are less centered on high-technology activities or whose level of performance is weaker, and can serve as instruments of local or national economic policy.

A whole array of literature in both economic and management sciences developed along this line, but expressed different developments. The initial developments resulted in recognizing the relative and contingent nature of clusters, or, in other words, the diversity in the forms of productive groupings according to local characteristics or to the nature of firms' relations to their environment. This was marked by rising criticism of the cluster concept, which though 'trendy', was believed to lack clarity and innovativeness (Martin and Sunley 2003). The need to bring some order into this theoretical mess, but also to clarify the various forms of local action, then led to the development of different, more or less interesting and explanatory typologies (Lagendijk, Chapter 30, *this volume*). We discuss the main implications of these approaches in terms of innovation and interaction between actors below, apart from knowledge-based cluster approaches, buzz-and-pipelines and so on (Maskell 2001; Bathelt et al. 2004).

Gordon and McCann (2000) produced an analytical typology of clusters built around three main categories according to the theoretical foundations on which local systems were built. The first two categories, economic in nature, and of neoclassical inspiration, are based on the idea that agglomeration economies and industrial complexes are the bedrock of the development of these groupings. Regarding agglomeration phenomena, the emphasis is placed upon economies of scale and of scope in the provision of services, as well as on the effectiveness of technology transfer, to explain why the process of spatial concentration does not necessitate interaction or strategies of cooperation between the local actors. With regard to the industrial systems approach, on the contrary, the savings on transaction costs generated through local interactions have contributed the most to the success of the process of clustering. Finally, the third category, based on social networks and more sociological in nature, focuses primarily on cooperative relations between local actors, as well as on the establishment of trust between producers or innovators. Another aspect is related to the quality of the institutional and governance mechanisms, which affects the competitiveness of many successful local systems.

In a different perspective, many classifications have been inspired, more or less successfully, by Markusen's work (1996), which identifies inductively the existence of different forms of local production systems, using concrete examples. Despite their

differences, all these classifications point to the contingent nature of clusters and their extreme variability in time and space, as does the typology developed by Torre (2008).

But other classifications consider, on the contrary, that external relations can play an important part in clusters with low levels of localization and partly explain their functioning. For example, Hamdouch and Depret (2010) argue that inter-organizational and interpersonal networks are the basis for the formation of clusters, be it through the varying degrees of openness of the systems to outside actors or the relatively competitive or network nature of the relations they develop. On the one hand, a cluster understood as a localized comparative advantage distinguishes itself by its low degree of geographical openness and the essentially formal and competitive nature of the relationship, as in the case Silicon Valley. On the other hand, a system that is spatially organized according to the location of its value chain components is less dependent on the geographical proximity of its actors, although they are also characterized by competitive, and even coopetitive, relations (a mix of cooperation and competition) between productive actors. Finally, clusters as socially and spatially embedded or multiscale networks are primarily founded on a network-based rationale, with activities and interactions more or less locally embedded and more or less open to the outside.

Thus, the requirements of cluster definitions have gradually loosened, with the increasingly explicit consideration given to relations with non-local actors and a growing tolerance of diversity in internal relations. The idea of a purely local system is undermined by the inclusion of different types of linkages, built by companies or laboratories of all sizes, either locally or via pipelines oriented towards other territories or countries (Bathelt and Schuldt 2008). These changes correspond to a rapid extension of the concept to cases that are not necessarily characterized by high-technology activities (the most famous example being that of a wine cluster in Chile (Giuliani and Bell 2005), as well as to the emergence of various types of local systems (Giuliani, Chapter 22, *this volume*; Lundvall, Chapter 29, *this volume*).

Analytically speaking, many variations of the original definition have emerged; variations which extend both the scope of action and the characteristics of clusters, away from the initial blueprint of the concept. One example is that of local production arrangements, analytical concepts and economic policy tools, such as in Brazil rural areas. The term 'arrangement' here refers to a rationale of relationships that cannot quite be considered systemic because, in some cases, the interactions in those systems are still in the emerging stage. Thus, local production arrangements are defined, in broad terms, as concentrations of economic, political and social agents, located in the same territory, with a focus on a specific set of interrelated economic activities. These links may be weak or may need to be reinforced in territories where activities are dispersed (Cassiolato et al. 2003). The concentration and clustering of small firms, in particular, are important dimensions and, in some cases, play a more important role than interactions.

(b) Industrial and Business Ecosystems: The Latest Offshoots from Clusters

The original concept of clusters has now been extended much further, to the point where it sometimes includes fields other than just the industrial sphere, as in approaches centered on industrial and business ecosystems. Indeed, the organization and functioning of new local production and innovation systems must now involve the participation of actors;

participation based on both local and global environmental and societal issues. Thus, the growing complexity of issues and interactions between stakeholders requires new forms of governance that can take account of both the more traditional productive and technological dimensions and the environmental issues – such as those pertaining to the energy transition – and which must involve greater participation of local populations to be successful.

The business ecosystems approach, which has had some success in recent years, particularly in management science, has some similarities with the cluster approach, in that it goes beyond the context of the firm and considers the networks of complex exchanges and interactions in which industrial actors are embedded (refer, for example, to Thorelli 1985 for an approach that goes beyond the Williamsonian dichotomy between market and hierarchy). The definition of the ecosystem refers to 'an expanded environment in which different types of actors with specific skills are likely to participate in varying degrees in a collective process of value creation steered by a company' (Moore 1993). It also refers to a firm's ability to have some measure of control over its economic environment (Teece 2007), through networks of reciprocal trust and exchange, but also through the implementation of a coopetitive process (Brandenburger and Nalebuff 1996), combining different types of relationships within a system of interactions.

The primary objective of this type of ecosystem is the creation of value within the firm and with actors outside the firm. This involves developing an open innovation model, through which the company is able to exploit external innovations and combine them with its own technology creation capacities, by exploring and exploiting opportunities in the field. The principle of open, or systemic, innovation rests on a network structure, which involves interaction with a large number of actors (firms, laboratories, training institutions) and can manifest itself at a local level (see further down). Intermediaries then play a central role in aligning the interests, cognitive maps, rationalities, knowledge, know-how and skills of the different actors, and in filling the remaining structural gaps.

These systemic and relational characteristics of the business ecosystems approach largely echo those of clusters, especially as the relations involved can occur at the local level (though without neglecting linkages with actors outside the territory), but also since the structures of interaction, which often play a central role, call for a different way of seeing the boundaries of the firm and the way it coordinates activities with partners. There are invariants common to both approaches, such as networks, modes of coordination, cooperation and competition, value chains, intermediaries, the myths around innovation and so on (Teece 2007), even though analyses of firms' strategies and especially of their links with industrial consumers have received a central role, and the principles of co-evolution are brought to the forefront of the analysis. The local dimension is also frequently highlighted if only to extol the opportunities of interfaces or the role of gatekeepers.

This conception is close to the industrial and productive notion of clusters, to which rather cosmetic adjustments and refinements are sometimes made. But the industrial ecosystem approach calls for a much more important conceptual and analytical leap by integrating dimensions related to environmental protection and to the recycling of production outputs, with the more ambitious objective of redefining the analysis in terms of territories and their functioning. Indeed, while traditional industrial systems are characterized by a succession of processing operations including the use of raw materials,

the commercialization of products and the storage of waste, the concept of industrial ecosystem (Frosch and Gallopoulos 1989) proposes an integrated model taking into account the recycling and re-use of waste in the production cycle, and in which issues of industrial ecology are considered. This idea was already present in previous studies on clusters, but the emphasis is strongly put on this dimension in the ecosystem approach.

The idea is to get closer to how natural ecosystems operate and to reverse the image of industrial activities as having negative impacts on the environment, by showing not only that industry can produce positive effects, provided important changes are realized, but also that synergies with the environmental dimensions can be built. This biological analogy between natural systems and industrial activities can be criticized for being reductionist, and should not be confused with an actual business operating model (Ehrenfeld 2003); however, this analogy is evocative, and industrial ecology – through its objectives and the local embeddedness of its activities – is strongly connected to the territorial dimension.

Thus, the benefits of geographical proximity among productive actors are often put forward and include opportunities in terms of transportation cost reductions and of local material and energy flows. Organized or institutional proximity is also seen as a prerequisite for, or as a result of, cooperation between actors. Thus, the industrial and territorial ecology approach proposes to develop project areas that present certain similarities with clusters and generate economic spin-offs besides purely individual benefits; spin-offs related to cost savings in terms of energy, resources, or waste treatment, or economies of scale generated by the pooling of services.

This dimension is particularly important in the case of eco-industrial parks, with the 'Kalundborg Symbiosis' ranking first among them (Jacobsen 2006). The latter has served as a model for many researchers and practitioners and constitutes evidence that it is possible to implement industrial ecology principles. This practical example of industrial ecology is founded on components such as trust and shared values among partners, the variety of interrelated technologies and geographical proximity, and is the basis for the creation of circular economy systems, which seek to reproduce the same characteristics as the Kalundborg eco-industrial park to optimize resource use and waste recovery. Although all components for a complete symbiosis are seldom obtained, a parallel can be drawn with the concept of clusters by highlighting the inter-dependencies between the production and recycling actors or the prevalence of the local dimension.

THE COORDINATION-ORIENTED APPROACH

While coordination is only one of the many dimensions of clusters and their variations, it has become central in approaches adopted by the 'School of Proximity' and in studies on the 'Geography of Innovation'. Indeed, these two approaches study the constraints of proximity in the relations between the different actors of innovation. How close to one another do they have to be to ensure their coordination in a joint innovation process, given that innovation activities are both spatially concentrated and scattered among different innovation zones? However, these approaches have both internal and external limitations. Their internal limitations lie in their difficulty in addressing the question of coordination discussed next, while their external limitations lie in a reductionist vision

of innovation, one that has little relevance to the contemporary reality of innovation, as discussed thereafter.

(a) The Economic Geography of Innovation: History and Limitations

The economic geography of innovation has expanded considerably in the last 30 years (Ferru and Rallet 2016), both conceptually and empirically, as well as in terms of its contribution to public innovation policies.

It initially focused on developing analytical frameworks to justify the concentration of activities, and naturally based its analysis on the concept of externalities, transposing Marshallian externalities into the context of an innovation economy based on knowledge exchange and co-production. The externalities driven by customer–supplier relationships in industrial systems, highlighted by the industrial complex approach (e.g. Perroux 1955; Hirschman 1958; Czamanski 1974) and further analyzed by Krugman (1991), have now been replaced by information externalities as a factor explaining the geographic concentration of knowledge-intensive activities such as research and development (R&D) (Ota and Fujita 1993; Gaspar and Glaeser 1998). More specifically, the authors in this school of thought have considered the characteristics of knowledge to be the key to understanding the geography of innovation. The distinction between tacit and codified knowledge served to explain the spatial concentration of innovative activities. Indeed, innovation processes are thought to be primarily based on the use of tacit knowledge, the sharing of which requires face-to-face interactions (Storper and Venables 2004).

This hypothesis has, however, not been directly tested in this literature, especially because the data used are not relational. It provides a framework for interpreting the observed concentration of innovation processes; concentration measured through the degree of co-location of innovation actors, itself deduced from bibliometric (co-authorships) or patent (patent citations) databases. Moreover, the geographical scale used to determine whether actors are located in the same geographic zone (a city or a more or less large region) varies according to the database used. From this point of view, the interpretive framework based on knowledge externalities and on the tacit knowledge argument is more or less convincing because it is more or less well suited to the geographical scale. Moreover, this interpretation is weakened by the mobility of researchers who temporarily travel to share tacit knowledge, and the increasingly widespread use of information and communication technologies for all types of knowledge, including tacit knowledge (Rallet and Torre 1995; 2009).

The main shortcoming of this externality-based approach is that it fails to explain or test the coordination mechanisms supposed to justify the geographical concentration of innovation activities and merely interprets co-location phenomena observed at specific stages of the innovation process (publications or patents).

The proximity-based approach has the advantage of explicitly focusing on the coordination mechanisms in the innovation processes and on their spatial dimension, through the initial question it raises: What forms of and how much geographical proximity do innovation actors need to coordinate their action and co-produce knowledge? The goal here is to understand the relative concentration of innovation activities in space, without presupposing the existence of a territory, which, through some specific normative qualities (qualities which an innovative milieu or technological district must present in

order to function as a localized innovation system) prompts innovation partners to co-locate their activities therein. The proximity-based approach does not deny the existence of innovation milieus or districts but does not consider them as representing a general model of local development. It, therefore, contests the appropriateness of defining public policies on the basis of this model only, as indeed has been the case all over the world since the 1990s (policies promoting clusters and poles of competitiveness).

This approach to the spatial concentration of innovation activities is not centered on territory per se but rather on proximity: proximity seen as facilitating the coordination of the innovation process. This approach is very close to relational economic geography developed in parallel by Bathelt and Glücker (2003; 2011): both are based on a focus on the relationships between micro actors rather than on territories, the relative role of geographical proximity, and the need to address local and non-local dimensions as intrinsically interlinked. Let us briefly describe its analytical tools, as developed by the so-called French School of Proximity. Proximity is a multidimensional concept. There are several types of proximity, and therefore the question 'what needs in terms of proximity, does the coordination of innovation actors involve?' may have several answers depending on the nature of the knowledge exchanged. In particular, in earlier work we make a distinction between geographical proximity and a non-geographical proximity (Torre and Rallet 2005), which we refer to as 'organized proximity' to indicate that it is not geographical in nature. Economic actors can be close to one another and thus coordinate better without necessarily being geographically close, provided means supporting coordination exist. Support may include the rules of action imposed in organizations or institutions, common value systems, shared cognitive maps or cultures, and so on. The spatial distribution of innovation activities can be explained by needs for both geographical and non-geographical proximity. This results in various configurations, ranging from localized clusters to forms of non-territorial coordination (or, in other words, long-distance coordination) (Henn and Bathelt, Chapter 39, *this volume*).

Addressing this issue requires a more detailed explanation of the concept of 'organized proximity', which allows for an in-depth analysis of the localization of innovation partners, the spatial configuration of innovation systems being the result of a combination of various types of proximity. Researchers have defined categories of proximity which they consider important in explaining the geographical distribution of innovation partners by showing that the type of proximity needed by innovation actors depends on the characteristics of the sectors in which they operate. Boschma (2005) has played an important role from this perspective, by distinguishing five types of proximity. By thus operationalizing the concept of proximity, he gave rise to many quantitative empirical studies applied to a wide variety of sectors and territories and based on available databases (for a critical survey, see Ferru and Rallet 2016). Thus, a significant corpus of literature has been produced that provides a contrast to public innovation policies centered on the creation of or support to clusters.

These works have done more than just illustrate the central role played by various types of proximity in different sectors and territories. They also adopted a dynamic approach to spatial innovation patterns, by examining territorial resilience from an evolutionary perspective (Boschma and Frenken 2010; 2011): path-dependent regional technological development, risks of lock-in, bifurcations and so on. However, a dynamic analysis of proximity (Balland et al. 2014) becomes difficult to achieve because of the complex

combinations between multiple types of proximity. Distinguishing between five types of proximity, assumed to be independent of one another at time t, lends itself to static analysis but makes less sense in a dynamic approach where the various types become endogenous unless the temporal mechanism of this endogeneity is described in detail, which databases do not allow. This is why more recent studies seem to have abandoned this path and reverted to more traditional, more manageable concepts of industrial economy such as those of *relatedness* or *related competencies* (Boschma and Iammarino 2009; Boschma et al. 2014), which derive from concepts developed in the 1980s, such as technological proximity or knowledge proximity to analyze R&D-related spillovers (Griliches 1979; Jaffe 1986; 1989), product diversification (Pavitt et al. 1989), or the technological diversification of industries (Breschi et al. 2003).

The economic geography of innovation is now flourishing. However, it also has important limitations in accounting for new forms of innovation. It gives the impression of being a flagship approach, in the wake of a growing number of applied studies along a path that has been successful but is simultaneously locked in through a path-dependency effect, while innovation is now heading towards new shores.

(b) On the Necessity to Return to the Original Approach to Proximity

The economic geography of innovation is confined to a primarily industrial vision of innovation, in terms of concepts and data (Glückler, Chapter 17, *this volume*). And in the latest empirical research, it privileges the notion of technological proximity. This involves, for example, testing the effects of skill-relatedness – that is, the sectoral and scientific relatedness of skills – on the growth of a firm or on the implementation of mergers and acquisitions (Ellwanger and Boschma 2013). The initial extension of the approach to five types of proximities has given way to a strictly technological approach to innovation, in terms of proximity of technology classes. Thus, the other forms of proximity – and especially their social relations and inter-organizational dimensions – are being neglected. This marks a return to the traditional industrial economy approach, and the value added of this lies in combining this approach to proximity with the possible effects of 'geographical proximity'.

This regressive evolution can be explained by the fact that existing empirical studies have been largely data driven. Indeed, available databases center on science-based (bibliometrics) and technology-based (patents) innovation. The fact that those studies rest entirely on related databases has caused a decrease in interest in the questions of interaction between actors, and in a more general way about the notion of local and distant coordination mechanisms. No coordination support or mechanism is tested because the databases are not relational. Hypotheses of coordination are derived from indicators of technological similarity versus diversity or from co-location. Technological and geographical proximity indicators are supposed to reflect the existence of effective coordination between actors, whether located in the same areas or not. Thus, lack of complementarity or similarity between technological areas is used to explain the need for or ease of coordination, while the co-location of firms is interpreted as allowing for effective coordination.

Yet, in so doing, one forgets or denies the advantages of proximity- or geography-based approaches – that is to say, the importance of interactions and of institutions

in the coordination of innovation processes. Indicators of relatedness only point to a possibility of coordination; they merely serve to indicate potential collaboration. They do not demonstrate the existence of coordination, which is indeed a social and economic mechanism, often embedded in social relations (Granovetter 1985; Grossetti 2008; Ferru 2010, Bouba-Olga et al. 2014), in environmental contexts (Torre and Zuindeau 2009) or in organizational control (Lévy and Talbot 2015), a mechanism that requires that the potentials identified of such indicators be activated.

Analysis of the complexity of these mechanisms is abandoned in favor of technological reductionism. The economic geography of innovation is thus turning into a techno-geographical analysis matching technological and geographical distances. The focus therein is back on distances at the expense of proximity. The notion of proximity was privileged in our original work over that of distance for good reasons; otherwise we would have continued or developed an analysis in terms of distance. Distance is inactive in itself. It is a state: a person is far from or near to someone else; one technology is more or less similar to another. It only becomes active when related to a coordination mechanism external to it. In other words, it needs to be activated: defining the stages of a joint innovation project, rallying the necessary partners, finding funding, specifying the coordination methods used, dividing and allocating the tasks, distributing the value created by the project among its members, or agreeing on a common technological standard and a common market design.

Innovation necessitates that the coordination issues raised be addressed. The founding hypothesis of the Proximity School is that geography of innovation activities are explained by the impact of geographical proximity on the ability or inability to solve the coordination problems that emerge in geographic space. The mechanisms used to resolve the coordination issues associated with innovation, whether based on markets, social relations, formal institutions, professional communities, value systems or cognitive maps, are more or less affected by geographic distance. The spatial distribution of innovation activities appears to result from the varying ability of these mechanisms to deal with geographic distance. This is the core idea that lies at the intersection of geographical proximity and non-geographical proximity (organized proximity); it is non-geographical in that it can be defined as facilitating coordination in the absence of geographical proximity.

Reducing the analysis to an interrelation of 'distances', at the expense of an examination of the means of coordination used to solve the coordination problems associated with innovation, constitutes a regression compared to the proximity-based approach. This is why it is compatible with a return to the traditional industrial or spatial economy approach, which, for a long time, has framed the analysis of industrial organization phenomena in terms of distance.

We believe, on the contrary, that the proximity-based approach is superior in examining the varying ability of commercial, social, institutional or cognitive coordination mechanisms to manage geographical distance. A possible argument against this suggestion is related to the constraint of database availability. But the latter cannot dictate the appropriateness of an approach to a problem. Both quantitative and qualitative data are necessary but they must be coherent with the goals of a research program.

TOWARDS NEW DEFINITIONS OF INNOVATION AND ITS GEOGRAPHIES

Now that we have clarified the limitations of recent quantitative work on the geography of innovation, it is necessary to return to the very notion of innovation. Indeed, three elements prompt us to address this question and to suggest a new approach to innovation and its geography considering the pressing societal, digital and environmental changes of today. As discussed in consecutive sections below, the first element is the need to move beyond a purely technological innovation perspective. The second is the consideration of a new source of innovation, that is, the involvement, on a cooperative basis, of individuals, citizens or consumers in the production of innovations. The third is the ecosystemic context of innovation. These three characteristics are not in line with the prevalent conception of innovation and its relation to space.

(a) The Necessity of Extending the Notion of Innovation to Non-Technological Dimensions

As already pointed out, it seems today that innovation can no longer be restricted to its technological component. This can be justified as follows. The traditional way is to stress, in line with Schumpeter (1934), that not all innovations are technological, but commercial, financial, organizational and social innovations have become increasingly important in the contemporary economy that is dominated by services. As evidenced by innovation studies conducted in many countries, this has prompted efforts to identify and measure types of innovation other than scientific and technological innovation, as listed in the OECD *Oslo Manual* (OECD 2015). This enumerative approach to innovation does not, however, challenge the emphasis placed primarily on the technological dimension in much academic work. This is because the available data mostly pertains to the technological aspects of innovation. Other dimensions are recognized but in effect take a secondary place.

It is, we believe, necessary to look beyond the technological dimension to articulate the various dimensions of innovation and to place emphasis on the crucial role of the financial, commercial, social, organizational, environmental and institutional aspects in the development of innovation, whether it is technological or not. By neglecting this role, the geography of innovation obscures the central role of these dimensions in the innovative capacity of a firm or territory. This comes as a consequence of reducing a multidimensional phenomenon to a uni-dimensional one, with erroneous conclusions that may arise.

A good example of this is digital technology: technology is the driving force behind the dynamic development of this sector and its impact on the overall economy, but its effects are conditioned by the emergence of new forms of organization, new commercial circuits and new business models. The literature on the productivity paradox (Brynjolfsson and Hitt 2000) has shown that the impact of digital technology on business performance is conditioned by the existence of organizational changes. Similarly, many digital technologies result in economically unsustainable dynamics of production due to the lack of business models that could ensure their profitability. Here, technology is not what is lacking. A plethora of technological possibilities exists but their introduction

in the market implies innovations in areas other than technology. Non-technological innovations are essential in converting technological innovation into actual products or services, for example into economic value (Glückler, Chapter 17, *this volume*). Reducing this process – which is dramatically altering the world economy – to a patent-based measurement of innovation boils down to ignoring the fundamental problems associated today with the conversion of technology into economic value. Issues of data availability poorly justify the central emphasis placed on technological innovation.

Another example is that of environmental innovations. Such innovations undeniably have a technological dimension, but the lever that helps to foster them is not necessarily technological. The type of innovation proposed in the functional services economy (see the seminal work of Stahel and Giarini 1989), for example, is based on the idea of renting out the use of a good, rather than selling the good. Unlike a seller, who maximizes his/her profit by increasing product sales, a lessor increases his/her profit by reducing the resources necessary for providing a given amount of services. Thus a tire manufacturer no longer sells the tires to the customers but invoices them – that is, transportation firms – based on the kilometers driven. Under these conditions, the producer is encouraged to improve the durability of the tires through technological innovation, to increase the reliability and longevity of the product, minimize resource consumption, recycle end-of-life products and so on. Technological innovation here is the outcome of an economic innovation. This type of innovation has important implications for the sustainable development of territories, whether urban or rural.

(b) The Involvement of Individuals as Autonomous Sources of Innovation

The analysis of innovation from the angle of its technological dimension is based on a particular conception of knowledge, its production and implementation, as a linear process that starts with scientific invention and ends with its application in industrial processes. Emphasis is placed on how to improve the transfer of knowledge from the scientific domain upstream to the industrial field and downstream through appropriate legal instruments (i.e. intellectual property laws), suitable economic incentives (knowledge protection versus knowledge transfer), and organizational structures designed to facilitate the transfer process (technological inter-mediation agencies, clusters, etc.).

This linear pattern applies to both innovation within a firm and innovation within a territorial context (local or national innovation systems) (Lundvall, Chapter 29, *this volume*). This conception was first called into question at the firm level by introducing feedback loops from the market downstream to design upstream (Kline and Rosenberg 1986). The literature of the 1980s and the 1990s on innovation networks (Lundvall 1992) stressed the importance of cooperation between firms or between firms and research institutes. The concept of open innovation (Chesbrough 2003) goes even further in that it emphasizes the need to involve users and consumers in the design of products and services. However, these feedback loops remain internal to the idea of a knowledge process originating from science and going to the product or service. They improve the representation of the process without calling into question its direction (from upstream to downstream).

In this setting, innovation involves actors outside the firm and government, such as consumers, users and citizens. They are active participants in the innovation process in

that they cannot be reduced to mere sources of information fostering feedback loops in firms. They are also autonomous sources of knowledge and must be recognized as such. This phenomenon is observed both in the digital transformation and in the energy transition.

In the digital field, it materializes in the form of the central role played by users in the co-production of content, for instance facilitated by Web 2.0-based platforms (O'Reilly 2005) and the collaborative economy (Bostman and Rogers 2010; Gansky 2010). This results in a very different way of producing, distributing and consuming services (Benkler 2006). These are radical innovations that rest on the emergence of new actors of knowledge production. While these innovations are technology-based (intelligent terminals, connected devices, platforms, information processing capacity, etc.), their most striking characteristic is the fact that they involve the participation of new actors as producers of knowledge and no longer only as the endpoint of the above-mentioned linear process.

This emergence of new, non-industrial and non-academic actors constitutes a broader phenomenon. Many examples demonstrate that there is a capacity, among local actors, for innovation and creativity, including in the less technology-intensive, so-called peripheral territories. These innovations result from the creativity of local populations, without necessarily involving a high level of industrial input or productive specialization. They reveal the vitality of territories, which demonstrate their dynamism and capacity for invention through the utilization of local strengths.

One such example is that of the development of short distribution channels or of small-scale farming, in which the distance between producers (generally farmers) and consumers is shortened, the origin of products is identifiable, and the industrial intermediaries – deemed too expensive or hazardous to health – are bypassed. Citizens participate in various ways such as getting involved in the productive process, public debates, participatory democracy and decision-making processes. Regarding the productive system, consumers are involved in product design, in the development of shorter industrial production channels, as with AMAPs (French abbreviation for associations of consumers tied to a local producer), Fab Labs and Living Labs, in line with but going beyond von Hippel's (1988) theory of user-led production.

Another example is that of local collaboration projects, such as crowdfunding, inspired by practices in developing countries such as small-scale local fundraising, collective project support, loans between individuals, local solidarity savings – which have become so popular that some national banks have growing interest in the concept – or even the establishment of new local currencies. Crowdsourcing is another type of innovative practice in which the efforts of a large number of people are combined to develop and implement a common project, enabling local people to create products and develop concrete solutions, to come together as a think tank and innovate in service of their territory. All these initiatives are systemic and often cooperative in nature.

Shared or collaborative undertakings, activity and employment cooperatives, community transport organizations, healthcare pooling and parent-based child care all contribute to improving the resilience of territories in that they help to recreate proximity between local actors and maintain local solidarity, in complement to or substitution of technological innovation. Finally, the social and solidarity economy contributes to social or societal innovation (Moulaert et al. 2013). It consists of local cooperation networks able to provide help and support to individuals, particularly in times of crisis.

We would also emphasize the importance of citizen participation in decision-making concerning environmental issues. Thus, local decision-making processes are now being influenced by citizens' demands, as evidenced by the development of public participation forums, or conflicts involving citizens opposed to infrastructure construction, or extension projects supported by the public authorities or large corporations. These interventions modify the representation of environmental and development problems, and influence how they are addressed and solved. These new forms of innovation in the field of environmental protection and local planning must be seen as a result of the involvement of civic organizations combined with the traditional actions of firms or public institutions.

These examples all suggest the need for a broader definition of innovation. A novelty that results in changes in existing operating procedures is an innovation. It may be technical or technological, but it may also be organizational (corporate governance structures, 'just-in-time', short circuits, etc.), social (e.g. micro-credit, social and solidarity economy movements) (Klein et al. 2014) and institutional (involving civil society, new laws and regulations, changes of power structures, etc.). Innovation no longer merely involves the utilization of researchers' or engineers' scientific knowledge but also involves the knowledge generated by civil society, local stakeholders, public or private organizations and associations.

(c) The New Innovation Context

The concept of ecosystem has been developed to account for the current characteristics of innovation, including its multidimensional nature and the emergence of new actors, who contribute to its development as well as dissemination.

Indeed, this concept places emphasis on the ability to manage the complexity of interactions between the different actors of the ecosystem involved in the innovation process. A wide variety of actors must be utilized and coordinated to bring technological innovations to the market: firms of all sizes, research institutes, intermediate agencies, institutions (local authorities, standardization committees, professional associations, etc.) and communities (i.e. users, consumers and citizens). The boundaries between sectors are dissolving as a result of lateral forces promoting interactions between actors from different sectors and disrupting their traditional roles. Many indirect network effects lead to 'chicken-and-egg'-type problems; the validity of economic models is called into question; regulations are no longer adequate; and new ones are not yet clearly emerging.

The above-mentioned concept of 'ecosystem' is suited to such situations where actors must define or redefine their economic environment (organization of relations with other actors, norms, standards, business models, actions to modify regulations, etc.) so as to be able to turn technological innovation into new products and new services. The concept refers to a situation characterized by the co-development of innovations and of their environment, whereas the concept used previously to describe the systemic nature of innovation, that of the network (OECD 2001), refers to a given environment – flexible and variable or not – that possesses traits conducive to innovation. A central question, therefore, is that of the capacity to construct and organize the ecosystem, bearing in mind that, depending on how an actor addresses and answers this crucial question, the ecosystem will have different perimeters, the models of value creation and distribution will vary, and the market designs and dynamics will be different.

Thus, in the field of new digital services, for example, different ways of constructing and organizing the ecosystem give rise to different innovation dynamics. As a matter of fact, in mobility services, the organization of the ecosystem's innovation matrix varies according to whether it is defined by the stars of the digital world (e.g. Google, Apple), the historical players (e.g. car manufacturers, transport operators) or by new entrants (e.g. telecom operators and start-ups such as Blablacar and Uber), even if the building blocks are the same.

This question is also central to environmental issues. Challenges related to climate change, energy transition, the reduction of pollution and emissions, de-carbonization, or greenhouse gas production are causing significant changes in industrial and innovation processes (Sinclair-Desgagné, Chapter 47, *this volume*) – changes that have an impact on patterns of production at the territorial level. Thus, the adoption of new 'clean' and 'green' technologies or innovations has given rise to a green business model that finds expression in 'green clusters' (Hamdouch and Depret 2010). This also finds echoes in the policies for sustainable development and renewable energy management implemented by public authorities (Cooke 2012), and leads to further questions concerning energy transition technologies, local waste recycling, methanization processes, or the virtues of industrial and territorial ecology.

The consideration of environmental issues, at the heart of the approach in terms of industrial ecosystems and eco-parks, and of the principles of circular economy, impose additional constraints which lead to the emergence of new stakeholders in the local system game (Sinclair-Desgagné, Chapter 47, *this volume*). It is necessary to involve the local populations, or to at least obtain their approval, in order to avoid serious deadlocks or conflicts. Thus civil society as a whole must be incorporated into the concept of local system, as the latter can only function if it complies with the projects and desires of local stakeholders. This adds another new and crucial dimension to the concepts of cluster, network or even ecosystem.

CONCLUSION

In this chapter we have discussed the current characteristics of innovation, and of its processes of creation and distribution, which require that we move beyond contemporary empirical studies of the geography of innovation or clusters that have become too limited.

Our discussion responds to these challenges by pointing our three necessities:

- The first necessity is to analyze how the various dimensions of innovation condition each other. The innovation process does not merely involve scientific and technological inventions gradually incorporated into the economy, but also social, organizational, economic and institutional innovations that open up new opportunities, including technological ones.
- The second necessity is the consideration of new sources of knowledge and innovation through the active involvement of consumers, users and citizens. The role of these actors has been dramatically underestimated, not only because they have been little called upon in reality, but also because the prevalent conception of innovation as being technologically inevitable has relegated them to a subordinate

role. Placing emphasis on the importance of the non-technological dimensions of innovation helps give them an active role as sources of knowledge to be utilized.

- Finally, the third necessity refers to the multidimensionality of innovation and the variety of actors involved, and raises the question of coordination and therefore that of the construction of an ecosystem able to support coordination between all the actors. In this context, innovation can be redefined as the ability to solve non-trivial problems of coordination. This ability emerges as the key resource, from which a broader vision of innovation can be built, whereas technology appears more of a disruptive than an organizing force.

What conclusions can we draw from this analysis with regard to public innovation policy and the role of local actors? The analysis shows, first of all, that local actors can serve as facilitators of interactions in innovation processes, between entrepreneurs and innovators in the traditional sense, but also with other stakeholders in civil society. We know that markets fail in the presence of externalities and that they cannot easily organize interactions between a large variety of actors, some of whom are not driven by a commercial rationale. Territories can serve as platforms for ecosystems, both in the technical sense (they have infrastructures) and in the organizational sense (they coordinate the different actors), thus facilitating the implementation of innovation (Attour and Rallet 2014). In this respect, they are the places from which the various actors accept or reject inventions and their conversion into innovations – that is to say, into solutions to coordination problems – without necessarily being guided by a commercial rationale, but rather by positioning themselves as part of the local governance process.

A second conclusion is that the complexity of innovation, which consists in producing new services and in building the framework necessary for services production, requires the implementation of local experiments. Of course, one can conceive of globally developed innovations as being applicable to all local contexts. But in the field of local services (such as environmental services, smart cities, smart areas or new infrastructure), global innovations are not easily applicable locally, as it is necessary to interact with local actors to produce innovations and to convert the initial inventions into innovations. Transaction costs are, consequently, high for global firms, giving non-global actors much leeway. Furthermore, the complexity of the innovation process in an ecosystemic framework requires the implementation of locally based experiments. Experimentation does not just consist in testing a technology, but also, and above all, in building an ecosystem that can effectively foster innovations, and reject or modify them. That is why many local experiments of this type are being implemented today, as illustrated by the development of Living Labs. Indeed, this very extensive concept incorporates the idea of bringing together, in an open and non-conventional setting, a variety of different partners, for the purpose of experimenting with new ways of generating innovations. This leads to many local experiments. The aim of innovation policies must be to support their development, but also to facilitate their application on a wider scale, and to other local contexts. In terms of public innovation policies, these new elements outline an alternative approach of building local experiments to ensure development, instead of large-scale project policies.

REFERENCES

Asheim, B. and Gertler, M. (2006) *The Geography of Innovation: Regional Innovation Systems*, Oxford: Oxford University Press.

Attour, A. and Rallet, A. (2014) 'Le rôle des territoires dans le développement des systèmes trans-sectoriels d'innovation locaux: le cas des *smart cities*', *Innovations*, 43, 253–279.

Aydalot, P. (1986) *Milieux Innovateurs en Europe*, Paris: GREMI.

Balland, P.A., Boschma, R. and Frenken, K. (2014) 'Proximity and innovation: From statics to dynamics', *Regional Studies*, 49, 907–920.

Bathelt, H. and Glückler, J. (2003) 'Toward a relational economic geography', *Journal of Economic Geography*, 3, 117–144.

Bathelt, H. and Glückler J. (2011) *The Relational Economy: Geographies of Knowing and Learning*, Oxford: Oxford University Press.

Bathelt, H., Malmberg, A. and Maskell, P. (2004) 'Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation', *Progress in Human Geography*, 28, 31–56.

Bathelt, H. and Schuldt, N. (2008) 'Between luminaires and meat grinders: International trade fairs as temporary clusters', *Regional Studies*, 42, 853–868.

Becattini, G. (1979) 'Dal settore industriale al distretto industriale. Alcune considerazioni sull'unità di indagine dell'economia industriale', *Rivista di Economia e Politica Industriale*, no. 1; in English: *Industrial Districts: A New Approach to Industrial Change*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 2004, 7–17.

Becattini, G. (1987) *Mercato e forze locali: il distretto industriale*, Bologna: Il Mulino.

Becattini, G., Bellandi, M. and De Propris, L. (eds) (2009) *A Handbook of Industrial Districts*, Cheltenham and Northampton, MA: Edward Elgar Publishing.

Becattini, G. and Rullani, E. (1995) 'Système local et marché global. Le district industriel', in A. Rallet and A. Torre (eds), *Économie industrielle et économie spatiale*, Paris: Economica, 171–192.

Benkler, Y. (2006) *The Wealth of Networks: How Social Production Transforms Markets and Freedom*, New Haven, CT: Yale University Press.

Boschma, R. (2005) 'Proximity and innovation: A critical assessment', *Regional Studies*, 39, 61–74.

Boschma, R. and Frenken, K. (2010) 'The spatial evolution of innovation networks: A proximity perspective', in R. Boschma and R. Martin (eds), *The Handbook of Evolutionary Economic Geography*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 120–125.

Boschma, R. and Frenken, K. (2011) 'The emerging empirics of evolutionary economic geography', *Journal of Economic Geography*, 11, 295–307.

Boschma, R., Heimeriks, G. and Balland, P. (2014) 'Scientific knowledge dynamics and relatedness in biotech cities', *Research Policy*, 43, 107–114.

Boschma, R. and Iammarino, S. (2009) 'Related variety, trade linkages, and regional growth in Italy', *Economic Geography*, 85, 289–311.

Boschma, R.A. and Martin, R. (eds) (2010) *The Handbook of Evolutionary Economic Geography*, Cheltenham and Northampton, MA: Edward Elgar Publishing.

Botsman, R. and Rogers, R. (2010) *What's Mine Is Yours: The Rise of Collaborative Consumption*, New York: Harper Collins.

Bouba-Olga, O., Grossetti, M. and Ferru, M. (2014) 'How I met my partner: Reconsidering proximities', in A. Torre and F. Wallet (eds), *Regional Development and Proximity Relation*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 223–239.

Brandenburger, A.M. and Nalebuff, B.J. (1996) *Co-opetition*, New York: Doubleday.

Breschi, S., Lissoni, F. and Malerba, F. (2003) 'Knowledge-relatedness in firm technological diversification', *Research Policy*, 32, 69–87.

Brynjolfsson, E. and Hitt, L.M. (2000) 'Beyond computation: Information technology, organizational transformation and business performance', *Journal of Economic Perspectives Perspectives*, 14, 23–48.

Camagni, C. (ed.) (1991) *Innovation Networks: Spatial Perspectives*, GREMI, Belhaven Press, 1–9.

Cassiolato, J.E., Lastres, H.M.M. and Maciel, M.L. (2003) *Systems of Innovation and Development: Evidence from Brazil.* Cheltenham and Northampton, MA: Edward Elgar Publishing.

Chesbrough, H. (2003) *Open Innovation: The New Imperative for Creating and Profiting from Technology*, Boston, MA: Harvard Business School Press.

Cooke, P. (2012) 'Transversality and transition: Green innovation and new regional path creation', *European Planning Studies*, 20, 817–834.

Courlet, C. and Pecqueur, B. (1992) 'Les systèmes industriels localisés en France: un nouveau mode de développement', in G. Benko and A. Lipietz (eds), *Les Régions qui gagnent. Districts et réseaux: les nouveaux paradigmes de la géographie économique*, Paris: PUF, 81–102.

Czamanski, S. (1974) *Study of Clustering of Industries*, Halifax: Institute of Public Affairs, Dalhousie University.

Ehrenfeld, J.R. (2003) Putting a spotlight on metaphors and analogies in industrial ecology', *Journal of Industrial Ecology*, 7, 1–4.
Ellwanger, N. and Boschma, R. (2013) 'Who acquires whom? The role of geographical proximity and industrial relatedness in Dutch domestic M&As between 2002 and 2008', *Papers in Evolutionary Economic Geography (PEEG)*, no. 1319.
Feldman, M.P. (1994) *The Geography of Innovation*, Dordrecht: Kluwer Academic.
Feldman, M.P. and Massard, N. (2002) *Institutions and Systems in the Geography of Innovation*, Dordrecht: Kluwer Academic.
Ferru, M. (2010) 'Formation process and geography of science–industry partnerships: The case of the University of Poitiers', *Industry and Innovation*, 17, 531–549.
Ferru, M. and Rallet, A. (2016) 'Proximity dynamics and the geography of innovation: Diminishing returns or renewal?', in R. Shearmur, C. Carrincazeaux and D. Doloreux (eds), *Handbook on the Geographies of Innovation*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 100–122.
Frosch, R.A. and Gallopoulos, N.E. (1989) 'Strategies for manufacturing', *Scientific American*, Special Issue 'Managing Planet Earth', 261, 144–152.
Gansky, L. (2010) *The Mesh: Why the Future of Business Is Sharing*, New York: Portfolio Penguin.
Gaspar, J. and Glaeser, E.L. (1998) 'Information technology and the future of cities', *Journal of Urban Economics*, 43, 136–156.
Giuliani, E. (2017) 'Industrial clusters in global networks', in H. Bathelt, P. Cohendet, S. Henn and L. Simon (eds), *The Elgar Companion to Innovation and Knowledge Creation*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 000–000.
Giuliani, E. and Bell, M. (2005) 'The micro-determinants of meso-level learning and innovation: Evidence from a Chilean wine cluster', *Research Policy*, 34, 47–68.
Glückler, J. (2017) 'Services and innovation', in H. Bathelt, P. Cohendet, S. Henn and L. Simon (eds), *The Elgar Companion to Innovation and Knowledge Creation*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 000–000.
Gordon, I. and McCann, P. (2000) 'Industrial clusters: Complexes, agglomeration and/or social networks?', *Urban Studies*, 37, 513–532.
Granovetter, M. (1985) 'Economic action and social structures: The problem of embeddedness', *American Journal of Sociology*, 91, 481–510.
Griliches, Z. (1979) 'Issues in assessing the contribution of research and development to productivity growth', *Bell Journal of Economics*, 10, 92–116.
Grossetti, M. (2008) 'Proximity and embedding effects', *European Planning Studies*, 16, 629–642.
Hamdouch, A. and Depret, M.-H.)2010('Policy integration strategy and the development of the "green economy": Foundations and implementation patterns', *Journal of Environmental Planning and Management*, 53, 473–490.
Henn, S. and Bathelt, H. (2017) 'Transnational entrepreneurs and global knowledge transfer', in H. Bathelt, P. Cohendet, S. Henn and L. Simon (eds), *The Elgar Companion to Innovation and Knowledge Creation*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 000–000.
Hirschman, A.O. (1958) *The Strategy of Economic Development*, New Haven, CT: Yale University Press.
Jacobsen, N.B. (2006) 'Industrial symbiosis in Kalundborg, Denmark: A quantitative assessment of economic and environmental aspects', *Journal of Industrial Ecology*, 10, 239–255.
Jaffe, A. (1986) 'Technological opportunity and spillovers of R&D: Evidence from firms' patents, profits and market value', *American Economic Review*, 76, 984–1001.
Jaffe, A.B. (1989) 'Real effects of academic research', *American Economic Review*, 79, 957–970.
Klein, J.L., Laville, J.L. and Moulaert, F. (eds) (2014) *L'innovation sociale*, Toulouse: Eires Editions.
Kline, S. and Rosenberg, N. (1986) 'An overview of innovation', in R. Landau and N. Rosenberg (eds), *The Positive Sum Strategy*, Washington, DC: National Academic Press.
Krugman, P. (1991) 'Increasing returns and economic geography', *Journal of Political Economy*, 99, 483–499.
Lagendijk, A. (2017) 'Innovation, regional development and relationality', in H. Bathelt, P. Cohendet, S. Henn and L. Simon (eds), *The Elgar Companion to Innovation and Knowledge Creation*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 000–000.
Lévy, R. and Talbot, D. (2015) 'Control by proximity: Evidence from the "Aerospace Valley" competitiveness cluster', *Regional Studies*, 49, 955–972.
Lundvall, B.-A. (ed.) (1992) *National Systems of Innovation: Toward a Theory of Innovation and Interactive Learning*, London: Pinter Publishers.
Lundvall, B.-Å. (2017) 'National innovation systems and globalization', in H. Bathelt, P. Cohendet, S. Henn and L. Simon (eds), *The Elgar Companion to Innovation and Knowledge Creation*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 000–000.
Maillat, D. (1995) 'Milieux innovateurs et dynamique territoriale', in A. Rallet and A. Torre (eds), *Economie industrielle et économie spatiale*, Paris: Economica, 211–231.

Markusen, A. (1996) 'Sticky places in slippery space: A typology of industrial districts', *Economic Geography*, 72, 293–313.
Marshall, A. (1890) *Principles of Economics*, London: Macmillan.
Martin, R. and Sunley, P. (2003) 'Deconstructing clusters: Chaotic concept or politic panacea?', *Journal of Economic Geography*, 3, 5–35.
Maskell, P. (2001) 'Towards a knowledge-based theory of the geographical cluster', *Industrial and Corporate Change*, 10, 921–943.
Moore, J.F. (1993) 'Predators and prey: A new ecology of competition', *Harvard Business Review*, 71, 75–86.
Moulaert, F., MacCallum, D., Mehmood, D. and Hamdouch, A. (eds) (2013) *International Handbook of Social Innovation: Collective Action, Social Learning and Transdisciplinary Research*, Cheltenham and Northampton, MA: Edward Elgar Publishing.
OECD (2001) *Innovative Networks: Co-operation in National Innovation Systems*, Paris: OECD.
OECD (2015) *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, 3rd edn, Paris: OECD.
O'Reilly, T. (2005) *What is Web 2.0?*, http://oreilly.com/web2/archive/what-is-web-20.html (accessed 30 May 2017).
Ota, M. and Fujita, M. (1993) 'Communications technologies and spatial organisation of multi-unit firms in metropolitan areas', *Regional Science and Urban Economics*, 23, 695–729.
Pavitt, K., Robson, M. and Townsend, J. (1989) 'Technological accumulation, diversification and organisation in U.K. companies, 1945–1983', *Management Science*, 35, 81–99.
Perroux, F. (1955) 'Note sur la notion de pôle de croissance', *Économie appliquée*, 8, 307–320.
Porter, M.E. (1998) 'Clusters and competition: New agendas for companies, governments and institutions', in M. Porter (ed.), *On Competition*, Boston, MA: Harvard Business School Press.
Porter, M.E. (2003) 'The economic performance of regions', *Regional Studies*, 37, 549–579.
Rallet, A. and Torre, A. (1995) *Economie industrielle et économie spatiale*, Paris: Economica.
Rallet, A. and Torre, A. (2009) 'Temporary geographical proximity for business and work coordination: When, how and where?', *Spaces Online*, 7(2009-02), 1–25, www.spaces-online.com.
RERU (Revue d'Economie Régionale et Urbaine) (1993) *Economie de Proximités*, Special issue, no. 3.
Schumpeter, J. (1934) *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, New Brunswick, NJ: Transaction Publishers.
Shearmur, R., Carrincazeaux, C. and Doloreux, D. (eds) (2016) *Handbook on the Geography of Innovation*, Cheltenham and Northampton, MA: Edward Elgar Publishing.
Sinclair-Desgagné, B. (2017) 'Innovation and the global eco-industry', in H. Bathelt, P. Cohendet, S. Henn and L. Simon (eds), *The Elgar Companion to Innovation and Knowledge Creation*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 000–000.
Stahel, W. and Giarini, O. (1989) *The Limits to Certainty: Facing Risks in the New Service Economy*, Dordrecht: Kluwer Academic Press.
Storper, M. and Venables, A.J. (2004) 'Buzz: Face-to-face contact and the urban economy', *Journal of Economic Geography*, 4, 351–370.
Teece, D.J. (2007) 'Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance', *Strategic Management Journal*, 28, 1319–1350.
Thorelli, H. (1985) 'Networks, between markets and hierarchy', *Strategic Management Journal*, 7, 37–51.
Torre, A. (2008) 'First steps towards a critical appraisal of clusters', in U. Blien and G. Maïer (eds), *The Economics of Regional Clusters, Networks, Technology and Policy*, Cheltenham and Northampton, MA: Edward Elgar Publishing, 29–40.
Torre, A. and Rallet, A. (2005) 'Proximity and localization', *Regional Studies*, 39, 47–59.
Torre, A. and Wallet, F. (eds) (2014) *Regional Development and Proximity Relations*, Cheltenham and Northampton, MA: Edward Elgar Publishing.
Torre, A. and Zuindeau, B. (2009) 'Proximity economics and environment: Assessment and prospects', *Journal of Environmental Planning and Management*, 52, 1–24.
von Hippel, E. (1988) The *Sources of Innovation*, Cambridge, MA: MIT Press.