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(Cris: please note that the author provided only the German title for the abstract; she preferred to have the translations done by us but she did provide the title for the German abstract)

Dimensions of proximity and knowledge bases

Innovation between spatial and non-spatial factors

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Abstract

Innovations face the challenge of integrating knowledge from heterogeneous sources by establishing an appropriate level of proximity. Proximity is thereby not a purely spatial phenomenon, but also includes organisational, institutional, social and cognitive dimensions. Geographical and social proximity are thereby auxiliary factors, whereas organisational, institutional and cognitive proximity act as critical enablers for learning. These dimensions can be connected to synthetic, analytical and symbolic knowledge bases. They thereby trigger a dynamic trade-off between various forms of proximity, whereby the proximity form varies depending on the underlying knowledge base. Innovation hence is a complex combination of spatial and non-spatial factors.

Dimensionen von Nähe und Wissensbasen. Innovation zwischen räumlichen und nicht-räumlichen Faktoren

Keywords

Proximity, knowledge base, learning, learning regions, geographic proximity.

JEL codes

O31 - Innovation and Invention: Processes and Incentives < O3 - Technological Change|Research and Development < O - Economic Development, Technological Change, and Growth,
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O33 - Technological Change: Choices and Consequences|Diffusion Processes < O3 - Technological Change|Research and Development < O - Economic Development, Technological Change, and Growth

1. Introduction

Learning and innovation are closely connected to heterogeneity. The mere definition of innovation as the combination of existing knowledge or the creation of something new (LINCOLN and GUBA, 1987; EDQUIST, 2001¹) shows that innovation goes beyond existing structures and is directly linked to the combination of heterogeneous knowledge (PAVITT, 2005). At the same time, learning is a difficult matter. The transfer of knowledge deeply relies upon proximity, as the assimilation of the exchanged knowledge is not possible at all without it.

Innovations involve the challenge of enabling renewal based on heterogeneity and facilitating the integration of knowledge through proximity.² Knowledge is, thereby, a complicated and not a homogeneous phenomenon. Many authors have pointed to the importance of geographical proximity in achieving an integration of diverse knowledge (cf. e.g. AMIN, 1999; AUDRETSCH, 2000; BATHELT et al., 2004; ENRIGHT, 1998), but its sources are often dispersed as innovation projects also involve heterogeneous internal and external actors from different places and backgrounds (BECHKY, 2003). The ability to innovate turns into an “ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments” (TEECE et al., 1997, p. 516), i.e. the ability to manage heterogeneous cooperation. Organisations hence have to find different ways to enable the involved heterogeneous actors to innovate.

The differentiation between various dimensions of proximity serves as an interesting starting point for understanding better how innovation can be organised. Proximity has frequently been treated as a purely geographical concept, although organisational, institutional, social and cognitive aspects play an equally important role (BOSCHMA, 2005). This article will demonstrate that geographical proximity may be important, but is simultaneously influenced by other dimensions of proximity which complement and substitute it. The first objective of this paper is hence to show how these forms of proximity fulfil different roles, in that cognitive, organisational and institutional proximity provide the foundation for collaboration, whereas geographical and social factors act as reinforcing dimensions. This shifts the problem from defining the appropriate level of proximity to arranging the dimensions of proximity. Without proclaiming the “death of geography” as such (MORGAN, 2004), a multifaceted perspective on proximity is indispensable in

1
2 order to abolish the geographical bias in the explication of innovativeness and instead fully grasp both the
3
4 spatial and non-spatial dynamics inherent in innovation.
5

6
7 Although these proximity aspects are useful for the analysis of learning and innovation, the debate
8
9 on proximity (BOSCHMA, 2005; BOSCHMA and FRENKEN, 2010; WETERINGS and BOSCHMA, 2009) has not
10
11 explicitly taken into account the complexity inherent in the use and transfer of knowledge in different
12
13 contexts. Instead, knowledge has been treated as a homogeneous concept. However, knowledge is a multi-
14
15 faceted concept which assumes a whole variety of shapes in different situations. In order to grasp the
16
17 complexity inherent in knowledge transfer, the second objective of this article is to connect the five forms
18
19 of proximity to synthetic, analytical and symbolic knowledge bases (ASHEIM and COENEN, 2005;
20
21 MOODYSSON et al., 2008). These knowledge bases mirror the availability and relevance of types of
22
23 knowledge in a certain geographical or sectoral setting.
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28 By connecting these two strands of literature, the article seeks to find proximity configurations in
29
30 knowledge bases, asks for the relationships between these and for spatial implications. Constellations of
31
32 proximity dimensions are neither universal nor fully industry-specific, but appear as a dynamic process of
33
34 adaptation, substituting each other in innovation processes. In this manner, organising innovation involves
35
36 a constant trade-off between various forms of proximity. This article thus contributes to the preciseness
37
38 and applicability of the concept. From a geographical perspective, a stricter differentiation between spatial
39
40 and non-spatial factors contributes to a better understanding of the dynamics occurring in innovation
41
42 projects.
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46
47 In order to further the understanding of the relationship between proximity and knowledge bases,
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49 this article will proceed as follows. Section 2 addresses how innovation draws upon both proximity and
50
51 heterogeneity and illustrates the importance of both. This will help to derive the necessity to dig deeper
52
53 into this subject and to sketch possible ways of establishing a balance. Possible solutions are not only
54
55 rooted in the degree of proximity, but also in the involved dimensions of proximity. Above all, proximity
56
57 cannot be looked at as a purely spatial problem. Section 3 differentiates between five dimensions of
58
59 proximity and classifies them as strategic, normative, cognitive and supporting categories. The importance
60

1
2 of the proximity types cannot be understood independently from the involved form of knowledge. By
3
4 transferring these dimensions of proximity to differing knowledge bases – synthetic, analytical and symbolic
5
6 ones – section 4 sketches expected patterns of proximity which inherently mirror sectoral differences. The
7
8 proposed trade-off between various types of proximity shows that establishing a balance between
9
10 proximity and heterogeneity involves a dynamic, constant adaptation even within a single project. The
11
12 paper finishes with a brief conclusion which outlines the need for further research in this field (section 5).
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14

15 16 17 18 **1. Heterogeneity and proximity – two sides of the same coin**

19
20 Heterogeneity, as can easily be derived from its close connection to innovativeness, carries important
21
22 advantages for innovation projects. In a way, heterogeneity in a project is always reliant upon some form of
23
24 cooperation. An isolated person cannot be heterogeneous, as diversity derives from a combination of
25
26 diverse actors along with their respective skills and competences. In this way, cooperation can be a source
27
28 of innovation (MUDAMBI et al., 2007) as it allows the combination of different knowledge sources and
29
30 helps to gain access to new knowledge. Furthermore, the interaction between heterogeneous actors
31
32 triggers creativity and thus allows for the development of new ideas which could not have emerged in
33
34 isolation. Hence, heterogeneity, or variety, is essential for any innovation project. In order to be innovative,
35
36 especially internationally oriented projects rely upon the input of extra-corporate cooperation partners and
37
38 the resulting learning chances (CANTWELL, 2005). The cooperation between heterogeneous partners allows
39
40 for the drawing upon additional expertise (BURT, 1992) and the accessing of additional knowledge (ZHANG
41
42 et al., 2007). This helps to combine different competences and to integrate explorative and exploitative
43
44 learning into the innovation project (MARCH, 1991; cf. also CALANTONE and STANKO, 2007; ROTHARMEL
45
46 and DEEDS, 2004). At the same time, cooperation breaks up established paths (WIESENTHAL, 1995;
47
48 GERYBADZE, 2004; RAMMERT, 1988) and thereby avoids getting trapped in lock-in situations (GRABHER,
49
50 1993). So, the inherent heterogeneity seems to be beneficial for innovation (POWELL and GRODAL, 2005).
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58 Nonetheless, this is only one side of the coin. Heterogeneity brings with it a high level of
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60 complexity, which can cause coordination problems (STRÜBING 2004). Communication is thus difficult
(ANCONA and CALDWELL, 1992), conflicts emerge (HOERING et al., 2001), and groups break up easily

1
2 (EGELHOFF, 2005). This does not only refer to scheduling, team work and related issues, but especially to
3
4 the difficulty in exchanging knowledge between various project participants. Knowledge is always context-
5
6 related and cannot simply be transferred seamlessly like a parcel to other actors (BOSCHMA, 2005; GLÄSER
7
8 et al., 2004). Thus, if learning among actors is to take place in a project, a certain degree of proximity is
9
10 necessary to establish a boundary object (STAR and GRIESEMER, 1989). This explains why proximity is just
11
12 as important as heterogeneity. Innovation is based on trust and solidarity (POWELL, 1990; WURCHE, 1994),
13
14 even if a contract acts as additional safeguard (ZELLER, 2002). Proximity, however, is based on similarities
15
16 and a shared understanding. Hence, it relies on homogeneity with regard to at least one characteristic and
17
18 is, in this way, opposed to heterogeneity.
19
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22
23 This illustrates that a balance between proximity and heterogeneity is a major challenge of
24
25 innovation. As can be seen, too much heterogeneity on the one hand and too much proximity on the other
26
27 can be harmful (BOSCHMA, 2005; BOSCHMA and FRENKEN, 2010). The decision about whom to involve in
28
29 an innovation project is consequently a delicate balancing act (POWELL and GRODAL, 2005). In dealing with
30
31 these two prerequisites, two important issues have to be considered. First of all, companies will seek to
32
33 find the adequate degree of proximity – and hence also of heterogeneity. Obviously, there is no perfect
34
35 solution as it is impossible to maximise both heterogeneity and proximity at the same time. Thus, secondly,
36
37 establishing the appropriate degree of proximity turns into a question of different dimensions of proximity
38
39 (BOSCHMA, 2005). The balancing act between proximity and distance is not a purely spatial one. Although
40
41 many contributions have pointed to the importance of the geographical dimension of learning, the spatial
42
43 focus does not provide a full picture. Proximity is a multifaceted phenomenon, and one can differentiate
44
45 between its cognitive, strategic and normative aspects as well as social and geographical proximity which
46
47 act as reinforcing dimensions. The following section will address this challenge in more detail.
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54 55 **2. Proximity – a multifaceted phenomenon**

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57 Proximity has often been analysed as a geographic phenomenon (cf. e.g. AMIN, 1999; AUDRETSCH, 2000;
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59 BATHELT et al., 2004; ENRIGHT, 1998). This can be justified in several ways, especially since geographic
60
proximity certainly plays a major role in the transmission of knowledge (FRITSCH and FRANKE, 2004).

1
2 Innovation is thus described as a highly localised phenomenon (KILDUFF, 2005) for which geographical
3
4 proximity matters (LOVERIDGE, 2007; GERTLER, 2008).
5
6

7
8 However, a closer look at geographic proximity shows that it has often been used as a catch-all
9
10 phrase. Of course, the geographical arrangement of activities is important, and short distances between
11
12 actors enable a smoother and less complicated interaction. For example, RODRÍGUEZ-POSE and ZADEMACH
13
14 (2006) show convincingly that geographic distance plays a major role in decisions about mergers and
15
16 acquisitions. Nonetheless, they do not separate spatial from other factors, such as the institutional setting.
17
18 In a strict sense, their results can only be interpreted as proof that proximity is still important. What they do
19
20 not enlighten is which *type* of proximity is crucial. In this sense, the mechanisms that make locations
21
22 important have not been explained satisfactorily (GIULIANI, 2007). Also, the definition of the terms
23
24 “spatial” or “geographical” often remains fuzzy.
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28
29 Also, studies with a geographical orientation tend to focus exclusively on external embeddedness,
30
31 i.e. on connections between a company and its regional surroundings. Thereby, they neglect firm-specific
32
33 and other important characteristics (GIULIANI, 2007, GIULIANI, 2008). For example, geographical proximity
34
35 cannot explain connections to partners in distant locations (GERTLER, 2008), and learning often takes place
36
37 in a combination of both geographically close and distant settings (BATHELT et al., 2004). Relational
38
39 networks thereby act in a complementary fashion towards purely geographical ones (MAGGIONI et al.,
40
41 2007). This is why the context of learning should be taken into account in a more structured way to
42
43 enhance our understanding of the involved spatial and non-spatial dynamics (STORPER, 2009³; cf. also
44
45 ZANFEI, 2000).⁴
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48

49
50 The picture gets even more complicated when companies are active in several countries.
51
52 Heterogeneity hereby derives from both internal and external cooperation. First, various subsidiaries are
53
54 situated in different contexts and bring together actors with a diverse educational and cultural background
55
56 (MORGAN, 2001; ZANFEI, 2000), which creates an internal heterogeneity of the knowledge base (BLACKLER
57
58 et al., 2000; GRANT, 1996; HISLOP, 2003). The relevant knowledge for innovation projects is thus not
59
60 concentrated in a single location, but increasingly spread out across the world (AMBOS, 2005; DOZ et al.,

1
2 2001; HEIKKINEN and TÄHTINEN, 2006). This results in an augmented need to find new ways of
3
4 coordination (BECKER-RITTERSPACH, 2006). At the same time, internationally active companies can enter
5
6 external cooperation in any of these locations, which again increases the level of complexity involved (cf.
7
8 e.g. INKPEN and TSANG, 2005; GHOSHAL and WESTNEY, 2005; CHILD and HEAVENS, 2007; MARSH and
9
10 STOCK, 2006). Taking this into account, geographical proximity cannot be the only way in which
11
12 heterogeneous actors are held together. Learning is a far more complex phenomenon which takes place as
13
14 a socio-spatial process (SAYER, 1985). In this broader view, space turns into a relational issue and ceases to
15
16 be a purely geographical concept. It is instead significantly constituted via social and contextual factors
17
18 (GEPPERT and CLARK, 2003; MORGAN, 2004; SAYER, 1982, 1992). The understanding of space as a social
19
20 rather than a physical phenomenon (SAYER, 2000) makes it necessary to open up the black box of
21
22 geographic proximity and distinguish more precisely between the different types of proximity involved (cf.
23
24 also HESS, 2004). With this aim in mind, BOSCHMA (2005) distinguishes between five dimensions of
25
26 proximity: geographical proximity, institutional proximity, organisational proximity, cognitive proximity and
27
28 social proximity. The following section will briefly address each of these five forms in order to show how
29
30 they differ from each other and also how they interrelate.
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37 Knowledge transfer can hence be the result of various types of proximity.⁵ BOSCHMA (2005, p. 71)
38
39 puts it the following way: “Organizational, social, institutional and geographical proximity may (...) provide
40
41 solutions to this fundamental problem of coordination. In theory, geographical proximity, combined with
42
43 some level of cognitive proximity, is sufficient for interactive learning to take place. Other forms of
44
45 proximity may, however, act as substitute for geographical proximity.” Geographical proximity is thus
46
47 neither a necessary nor a sufficient condition for enabling learning (BOSCHMA, 2005), i.e. its existence does
48
49 not at all guarantee that learning does in fact take place. Instead, learning can occur without geographical
50
51 proximity – and in turn, more factors are to be considered than merely spatial ones.
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56 Also, knowledge spillovers are not automatic (BOSCHMA and IAMMARINO, 2009; FRENKEN et al.,
57
58 2007), no matter how close geographic proximity may be. To have two people sitting in the same room
59
60 does not necessarily imply that learning will take place. The involved individuals need not look at each
other, let alone talk to one another. The transfer of knowledge, thus, always includes some intention to

1
2 interact, to learn, to share and absorb information. The first and most essential condition is that the actors
3
4 who are involved in learning are able to understand each other, i.e. use a “common interpretative scheme”
5
6 (MARKUSEN, 1996). The *cognitive dimension* of learning hence lies at the very core of the learning process.
7
8 It refers to the knowledge all the actors involved held before the learning process began. If the cognitive
9
10 distance is too large, the actors involved will not understand each other and will not be able to interpret
11
12 and assimilate the transferred knowledge (NOOTEBOOM, 1999). At the same time, if it is too small,
13
14 cooperation does not grant access to new knowledge. This is why the optimal level of cognitive distance is
15
16 often represented as an inverted U-shaped curve (NOOTEBOOM et al., 2007; BOSCHMA, 2005), and there is
17
18 a constant strive to achieve an appropriate level of cognitive distance (GRABHER, 2004). Evidently, without
19
20 a balanced level of cognitive distance, learning cannot occur at all. Hence, the cognitive dimension is more
21
22 important than the spatial one (MOODYSSON et al., 2008), and it can be regarded as a necessary condition
23
24 for learning.
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30 Once the cognitive dimension is set up, in a way which provides a suitable basis for learning, two
31
32 other dimensions of proximity enter the game. The first is strategic, i.e. a control-related dimension
33
34 (organisational proximity) and the second is a normative dimension (institutional proximity). BOSCHMA
35
36 (2005, p. 65) defines *organisational proximity* as “the extent to which relations are shared in an
37
38 organizational arrangement”. In a narrower understanding, this refers to the degree of internalisation, i.e. a
39
40 high organisational proximity means that the participants follow similar organisational logics or even belong
41
42 to the same company group.⁶ In this way, organisational proximity is closely related to a single control
43
44 instance which is in charge of all the relevant activities. With all the related tasks being carried out within a
45
46 single organisation, the company prevents external actors from accessing their knowledge and as a result
47
48 gaining insight into any of their innovative activities (BENDER, 2004). This implies that the organisation
49
50 maintains its ownership rights and maximises its level of control (ZELLER, 2002; BECKER and KNUDSEN,
51
52 2006). As competition can also arise between subsidiaries, organisational proximity is even higher within
53
54 one subsidiary than in the company group as a whole.⁷ Its effects are thereby ambiguous. While it
55
56 facilitates coordination, organisational proximity causes cuts in a firm’s flexibility and can thereby hinder
57
58 the emergence of innovation (BOSCHMA, 2005). Achieving an appropriate level of organisational proximity
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1
2 is thus a very difficult subject for internationally oriented companies (POWELL and GRODAL, 2005), as it
3
4 may be necessary to draw upon additional knowledge and incorporate external partners in order to be
5
6 innovative. At the same time, protecting the company's knowledge base is one of the most important keys
7
8 to competitiveness.
9

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11 The normative dimension of proximity refers to *institutional properties*. Hard institutional factors
12
13 like laws and rules are thereby equally important as soft ones, i.e. norms, values and routines. All together,
14
15 they form the socio-cultural, economic and political framework in which the actors are embedded
16
17 (BOSCHMA, 2005). In this manner, institutional proximity is a complex combination of macro-level factors
18
19 (XU and SHENKAR, 2002) which simultaneously enable and restrain learning.⁸ In many instances, the
20
21 importance of geographical co-location resides mainly in the context-specificity of knowledge (GERTLER,
22
23 2003), i.e. institutional proximity. ASHEIM and COENEN (2005) describe how regional agglomeration relies
24
25 on institutional factors. In this sense, as many institutions are defined or valid in a specific regional setting,
26
27 institutional proximity is often mistaken to be geographical.⁹ More precisely, geographical proximity implies
28
29 co-location, and institutional proximity refers to coherence in regard to laws and values. In fact, most
30
31 arguments involved in the debate on regional innovation systems (RIS) focus on how institutional settings
32
33 create learning opportunities (COOKE, 2001; HISLOP, 2003), which shows again how the term "spatial"
34
35 proximity can be misleading. A closer look at this debate shows that it is mainly a discussion about
36
37 institutions which accommodate local firms, i.e. about institutional proximity.
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44
45 Besides these three main dimensions of proximity, the cognitive, organisational and institutional
46
47 ones, social and geographical proximity act as auxiliary categories. These are not focussing so closely on
48
49 either control, framework or cognition, but act as intermediary variables fostering and reinforcing the
50
51 creation of other types of proximity whilst, simultaneously, providing a degree of proximity in themselves.
52
53 This does not mean that they are less important, but implies that they can only constitute innovation-
54
55 relevant bonding mechanisms if they accompany cognitive, organisational or institutional proximity forms.
56
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59
60 In this manner, social and geographical proximity act as accompanying variables to the three main
dimensions. *Social proximity* comes about as a result of shared personality characteristics, personal

1
2 interaction and a sense of familiarity between individual actors. In its mode of creating mutuality among
3
4 actors, it is closely related to institutional proximity, but takes place at the micro-level and occurs in the
5
6 form of friendship or kinship or also based on past interactions. More than any of the other dimensions of
7
8 proximity, social proximity relies on trust and in this manner encourages actors to engage in
9
10 communication (BOSCHMA, 2005). The simple sharing of characteristics like gender or race can intensify
11
12 the bonds between actors in a network (IBARRA et al., 2005). This is particularly evident in communities of
13
14 practice or epistemic communities.¹⁰ Even stronger, friendships and other informal relationships are
15
16 important door-openers to new jobs (and thus towards re-connecting actors who may learn from each
17
18 other) (GRABHER and IBERT, 2006), and socially well-connected individuals act as gatekeepers linking
19
20 different research groups (BRESCHI and CATALINI, 2007). These examples show how powerful social
21
22 proximity can be.¹¹

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28 This inherent characteristic for encouraging communication and facilitating interaction is also
29
30 exactly what *geographical proximity* provides. In a strict sense of the term, physical geographical proximity
31
32 is defined as co-location of the involved actors. In such a local context, it is easy to establish contacts with
33
34 potential cooperation partners and to exchange knowledge without major effort (cf. also MORGAN, 2004).
35
36 Casual and unintended meetings, overhearing conversations and constant exposure to a vivid 'industrial
37
38 atmosphere' (MARSHALL, 1919; ASHEIM, 2000) result in 'buzz'¹², continuous knowledge spillovers
39
40 (MARSHALL, 1979 [1890]; BATHELT et al., 2004; STORPER and VENABLES, 2004) and 'unintended
41
42 interdependencies' (STORPER, 1997).¹³ This shows that "soft" factors, i.e. untouchable, tacit elements,
43
44 seem to be more crucial in connection to geographic proximity, whereas most of the other factors can be
45
46 traced back to one of the other types of proximity. Hereby, geographical proximity is also regarded as a
47
48 means of creating trust (MASKELL and MALMBERG, 1999; MORGAN, 2004), i.e. as a mechanism fostering
49
50 social proximity. In its purest sense, geographical proximity is a mechanism that *helps* to establish
51
52 additional proximity which might also have been created without the spatial component, but not as easily
53
54 (cf. also GERTLER, 2008¹⁴). In this sense, geographical proximity carries strong relational elements
55
56 (MORGAN, 2004; SAYER, 2000). Its auxiliary character can hence be traced back to the relational nature of
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1
2 space (cf. also YEUNG, 2005; BATHELT and GLÜCKLER, 2003). As space is not purely geographical, the
3
4 bonding elements are likewise more varied.¹⁵
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6

7 Above all, as we can see, geographic proximity facilitates face-to-face interaction and may in turn
8
9 favour innovation (ASHEIM et al., 2007). However, the need to interact does not necessarily result in
10
11 agglomerations, but can also take place as a temporary co-location. Travelling (and being in the same place
12
13 on a temporary basis) acts as a substitute to traditional clustering in many cases. Similarly as the
14
15 continuous allocation of all actors in the same place, temporary co-location can foster the emergence of
16
17 common frames of thought, of personal bonds and of mutual understanding, and in this way opens up
18
19 novel learning opportunities (MASKELL et al., 2006; TORRE, 2008).
20
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23
24 The differentiation between the five types of proximity, in this manner, leads back to the initial
25
26 question on the role of spatial proximity. It can be stated that proximity is a phenomenon that goes far
27
28 beyond the geographical dimension. Important proximity elements can also be traced back to cognitive,
29
30 institutional, organisational and social factors. In order to fully understand spatial implications of
31
32 innovation, it is indispensable to take these non-spatial factors into account.
33
34
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36
37
38 It has to be noted that the different types of proximity are closely interrelated (cf. also KNOBEN and
39
40 OERLEMANS, 2006). Although geographical proximity may not be decisive in itself, it carries with it a
41
42 reinforcing power which triggers the other types of proximity (BOSCHMA, 2005). In essence, it acts as a
43
44 facilitator for the creation of further proximities, and it is generally an enabler for closer interaction and
45
46 interconnections. A particularly close interrelation can be observed between institutional and geographical
47
48 proximity (BOSCHMA, 2005; GERTLER, 2003). In a similar way, social proximity is closely interconnected
49
50 with all the other types of proximity. More than paving the path for the other forms, it is encouraged by
51
52 them, occurring as a side-effect and as a result of proximities in the other dimensions. The social effects in
53
54 turn reinforce the initial proximity forms, too, which can lead to a spiral of reinforcing dynamics. Above all,
55
56 social proximity often represents the macro-level institutional proximity on the micro level.
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1
2 When considering these interrelations, it is crucial to note that the terminology is often used in a
3
4 fuzzy and confusing way. For example, IBARRA (2005) describes social preferences towards relatives as a
5
6 cognitive phenomenon – with the definition introduced above, this is clearly social proximity. Nevertheless,
7
8 the tension inherent in all these types of proximity is, surprisingly, very similar. Too much proximity results
9
10 in lock-in effects and reduces learning potentials. Too little proximity leads to difficulties in assimilating the
11
12 exchanged knowledge and entails a lack of learning capacity.
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19 In conclusion, the introduction of these five proximity forms and their classification in various
20
21 categories displays that the discussion on proximity has so far treated knowledge as a homogeneous
22
23 concept and has failed to ask questions about the factors which may influence the relationship between
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25 and the importance of various forms of proximity. In this sense the five identified forms of proximity are
26
27 only the first step. The second step is to dig deeper into their interdependence with knowledge. The
28
29 presented debate treats knowledge as a coherent whole, and it neglects the vast amount of shades and
30
31 differentiations which occur between various types of knowledge and between contexts in which
32
33 knowledge is being used. The ways of dealing with the dichotomy between proximity and heterogeneity
34
35 differ between these suggested types of proximity, which makes an array of proximity combinations
36
37 available to innovation projects. The next section differentiates between different knowledge bases
38
39 (MOODYSSON et al., 2008; ASHEIM et al., 2007). This helps to explain which types of proximity are
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41 important for which types of knowledge and, hence, for which sectors as it disentangles the spatial and
42
43 non-spatial characteristics of the various constellations.
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51 **3. Knowledge bases and proximity**

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53 The differentiation between different dimensions of proximity has so far been a conceptual one. The
54
55 understanding of proximities can, thus, be enhanced by linking it to different types of knowledge. In such a
56
57 view, knowledge cannot be regarded as a homogeneous entity, but has to be taken into account as a
58
59 manifold, complicated and multi-faceted construct. Instead of treating it as a catch-all term, explicating the
60
link between the identified proximity types and the different types of knowledge can foster a deeper and

1
2 more differentiated understanding of both. This challenge is at the core of this article and will now be
3
4 addressed.
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6
7 Traditionally, the different degrees to which proximity matters in knowledge transfers has been
8
9 linked to the nature of the involved knowledge, i.e. the classical distinction between tacit and explicit
10
11 knowledge (POLANYI, 1978; cf. also ASHEIM et al., 2007; MOODYSSON et al., 2008). The argument is that
12
13 tacit knowledge can only be transferred in intense face-to-face interaction and thus relies upon personal
14
15 interaction in close geographical proximity (ASHEIM and GERTLER, 2005). Know-how, i.e. practical abilities,
16
17 and know-who, i.e. the capability to effectively use social networks to access additional expertise, are
18
19 largely dependent on these tacit elements (LUNDVALL and JOHNSON, 1994). Explicit knowledge, on the
20
21 other hand, can easily be codified and then transferred with the use of written documents, which allows it
22
23 to transcend greater distances (CASTELLANI and ZANFEI, 2006). This codified knowledge includes know-
24
25 what, i.e. mere factual knowledge, and know-why, i.e. knowledge about methods and scientific principles
26
27 (JENSEN et al., 2007). Clustering and face-to-face interaction are thus directly linked to tacit knowledge and
28
29 learning-by-doing and learning-by-interacting (BATHELT et al., 2004).
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36 Whilst this dualism certainly highlights important aspects, recent publications (ASHEIM and
37
38 GERTLER, 2005; ASHEIM et al., 2007; MOODYSSON et al., 2008) have pointed out that the matter of
39
40 knowledge transfer is more complex, especially when it is not only considered as a geographical issue, but
41
42 as the result of various types of proximity. They therefore suggest distinguishing between different
43
44 knowledge bases, synthetic, analytical and symbolic ones. Although this classification is connected to the
45
46 differentiation between tacit and explicit knowledge, it is more refined and includes further dimensions.
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49
50 In the first place, *synthetic knowledge bases* are characterised by mainly incremental innovation,
51
52 whereby hands-on solutions emerge from current work and informal coordination with clients and
53
54 suppliers are crucial. The main perspective is functional. The most important goal is to apply what has been
55
56 found, and knowledge is considered as a means to achieve new solutions (MOODYSSON et al., 2008). In
57
58 turn, the dominant forms of learning, i.e. learning by doing, using and interacting, show that tacit
59
60 knowledge is essential in these knowledge bases (DUNNING et al., 2002). Learning is a recursive trial and

1
2 error process, involving constant feedback-loops and moving experimentally backwards and forwards
3
4 (MOODYSSON et al., 2008). Activities mainly focus on technological knowledge, which explains why know-
5
6 how is the most important form of knowledge in these knowledge bases (MOODYSSON et al., 2008). Face-
7
8 to-face interaction fosters knowledge exchanges. These are typical characteristics of engineering branches
9
10 (ASHEIM et al., 2007), i.e. manufacturing and the automobile industry belong to this group. The
11
12 development of a new engine in the sector of transportation serves as an illustrative example.¹⁶
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15
16 The outstanding characteristic of learning in synthetic knowledge bases is personal interaction. It
17
18 can partly take place through “buzz”, i.e. learning happens by just being there, coincidentally and without a
19
20 purpose or a fixed aim in mind (BATHELT et al., 2004). If such learning is to take place, which types of
21
22 proximity are crucial? First of all, learning occurs in close interaction, based on mutual understanding
23
24 (cognitive proximity) and the willingness of the involved actors to communicate with each other and to
25
26 learn from each other (social proximity). This is the case when several engineers as well as the project
27
28 leader work together at the engine itself. Evidently, both requisites – cognitive and social proximity – are
29
30 more easily achieved if the actors share norms and values and act in a comparable frame of reference. This
31
32 refers to the facilitating power of institutional proximity, and as geographical co-locations are usually
33
34 characterised by common institutional frameworks, geographical proximity is likely to trigger the formerly
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36 mentioned three types of proximity – particularly in hands-on learning processes which are physically
37
38 connected to implementing the engine in the vehicle. In contrast, control-related organisational proximity
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40 is not a dominant mechanism of integration as coordination in personal interaction tends to rely on trust
41
42 and interaction rather than on contracts and control. This is obvious in the initial stage of the project which
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44 is driven significantly by individual dedication rather than via pre-established corporate channels. As a
45
46 result of this, the most important types of proximity in synthetic knowledge bases are cognitive and
47
48 institutional, whereby both social and geographical proximity prove to be very helpful to enable the
49
50 inherent vivid and informal communication.
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58 In contrast, *analytical knowledge bases* proceed in a more planned and intentional fashion. They
59
60 aim mainly at understanding principles and mechanisms. The most important form of knowledge involved
is scientific and thus based on know-why (MOODYSSON et al., 2008). Innovation is radical and results from

1
2 the creation of new knowledge, whereby learning by searching provides the starting point. Innovation is
3
4 hereby regarded as something which can be planned, and intentional action is taken to move towards
5
6 innovation step by step. Although this may not result in a linear sequence of activities, the resulting
7
8 innovation process is very much a formalised one (MOODYSSON et al., 2008). Communication can follow
9
10 more standardised modes and run along pre-defined channels. Research collaborations focus on the
11
12 exchange with scientific partners and the emergence of new knowledge is an aim per se and not a means to
13
14 an end (ASHEIM et al., 2007). A good example for a sector with an analytical knowledge base is drug
15
16 development in the pharmaceutical industry. At the same time, traditional synthetic sectors incorporate
17
18 more and more analytical elements. This is, for example, the case in the automobile industry, where the
19
20 increasingly prominent role of software and IT in automobiles, particularly in connection with new energy
21
22 and drive technology projects, opens up a whole spectrum of cognitive backgrounds that need to be
23
24 combined in a single innovation project. In order to draw upon these backgrounds, traditional analytical
25
26 knowledge bases such as IT and chemistry have to be interlinked with the classical, synthetic knowledge
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28 base.
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35 Generally, the deliberate mode of procedure makes it possible to draw upon codified knowledge,
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37 to intentionally create accessible and durable knowledge “stores” and to use them independently of
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39 geographical, social or institutional proximity. In a pharmaceutical drug development project, for example,
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41 chemical formula and study protocols as means of knowledge storage are closely followed by all the
42
43 participants. Besides, a certain degree of cognitive proximity is indispensable to achieve a correct
44
45 interpretation of the stored knowledge (NOOTEBOOM, 1999). The participants subdivide tasks according to
46
47 their professional background and use these professional codes in their communication. Additionally,
48
49 organisational proximity is necessary to gain access to the stored information, as organisations tend to be
50
51 careful not to disclose innovative ideas to potential competitors light-heartedly. In the investigated case,
52
53 communication with outsiders does not take place at all. Whilst cognitive and organisational proximity are
54
55 hence crucial, social and geographical proximity facilitate the transfer of knowledge and shape the inclusion
56
57 of members especially in early stages of the project. However, the latter forms turn negligible as soon as
58
59 the initial, explorative stages have been concluded.¹⁷
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1
2 In turn, *symbolic knowledge bases* are related to aesthetic characteristics of products and mostly
3
4 result in an unexpected recombination of existing knowledge. The involved knowledge is thus explicit. It is
5
6 inherent in tokens, artefacts and symbols, but at the same time, the art of combining these elements is
7
8 highly tacit and relies upon subjective and ambiguous factors such as taste and trends. Learning is an
9
10 interactive process that is based upon an exchange with creative partners, but also occurs through
11
12 observation and interaction with the rest of the world as part of everyday life. In this context, knowledge
13
14 does not emerge by applying scientific principles, but through know-who and socialisation in this particular
15
16 business. Innovation processes are highly emergent and communication is not essentially linked to
17
18 explanations, understanding and showing, but often resides mainly in a “buzz” of seemingly irrelevant
19
20 interaction which triggers the process of thinking and may result in new ideas. Face-to-face communication
21
22 hence represents a critical element. Symbolic knowledge is most obvious in cultural and creative industries
23
24 (cf. ASHEIM et al., 2007). Nonetheless, just as the other knowledge forms, it is also a cross-sectoral
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26 phenomenon, as e.g. in the globalising automobile sector, design has turned into the key competitive
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28 factor, and with it, symbolic knowledge assumes a more prominent role in automotive innovation projects.
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35 In this case, at least temporary geographical proximity is absolutely essential. Simultaneously, the
36
37 subjectivity and ambiguousness involved in this knowledge base underline the importance of trust and, in
38
39 turn, of social proximity. In many aspects, this trust has to be unconditional, notwithstanding the fact that
40
41 there is no objective means of controlling whether or not the proposed solution is adequate. In a design
42
43 project, there is no clearly right or wrong solution; instead, judgement depends more on the feeling for the
44
45 situation. Institutional proximity can also play a role, as it is necessary to know the values and preferences
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47 of the customers as well as the applicable laws. Socio-cultural and legal factors influence taste and routines
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49 of the target group. As soon as the product aims at a global market, however, this factor becomes
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51 negligible. Products then have to fit into various different institutional frameworks at once. In contrast,
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53 organisational proximity is not the focus of attention. Knowledge is deeply rooted within individuals and
54
55 their past experiences. This makes close control redundant while they exclusively work for one organisation
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57 and impossible as soon as they change companies. Brands and reputation are not easy to imitate.
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59 Moreover, although a certain degree of cognitive proximity is absolutely essential, its level can remain
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1 comparably low. There is no clear training involved, and experience and practical issues are far more
2 important than knowing a certain set of rules or procedures. As symbols speak a different language,
3 “talking shop”, scientific knowledge and formal training modules are negligible in the learning process.
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9 Social proximity hence acts as the main integrating power in symbolic knowledge bases, reinforcing
10 especially the institutional dimension and also as a substitute to cognitive proximity.
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14 Drawing the traits of all three knowledge bases together, synthetic knowledge bases are also
15 referred to as “industrial knowledge bases” (ASHEIM and GERTLER, 2005, p. 294). Here, hands-on activities
16 are dominant, innovation processes focus on applied research and development, and learning emerges
17 from problem-solving in close face-to-face interaction. In analytical knowledge bases, basic research is an
18 end in itself, and many findings are only later translated into applications. Learning here takes place based
19 on the intentional search for new knowledge, concepts and methods, and much of it relies on abstract
20 know-why (MOODYSSON et al., 2008). Symbolic knowledge bases centre on or around informal and
21 emergent learning processes in face-to-face interaction, which avoids any formalisation and is thus not easy
22 to control and protect (ASHEIM et al., 2007).
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35 It could also be shown that each knowledge base has its particular patterns of proximity types.
36 Different forms of knowledge are often complementary (ZANFEI, 2000), but can also act as substitutes.
37 Whilst cognitive proximity is always crucial, a trade-off between institutional and organisational proximity
38 takes place. Social proximity combined with at least temporary geographical co-location also acts as a
39 simplifying mechanism for the overall project. If the project is complex, social proximity creates a greater
40 identification with the project and hence more coherence among the participants. Nonetheless, it is not the
41 crucial means of coordination upon which the projects draw. Besides, the importance of the proximity
42 types varies among the knowledge bases. Dominant in synthetic knowledge bases, institutional proximity
43 encourages a bottom-up process of learning, whereby actors voluntarily and effortlessly get in touch with
44 each other. Social and geographical proximity are thus also important in these learning processes. In
45 analytical knowledge bases, on the other hand, institutional proximity is not as high. This time, the control
46 dimension is more important, which is why common framework conditions are traded for organisational
47 proximity. Belonging to one organisation encourages the sharing of knowledge as a top-down process.
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2 Learning is here based on official permission or even obligation rather than on macro-level commonalities.
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4 This shows that in symbolic knowledge bases, geographical proximity and co-location are decisive, and
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6 learning relies highly upon applicability and creative processes. Organisational proximity is not particularly
7
8 important as much of the involved knowledge evades any attempt to control it. Instead, institutional
9
10 proximity and especially social proximity based on past interactions can grant a certain level of
11
12 predictability in the innovation process (cf. also table 1).
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16 Despite its usefulness for obtaining a general idea of the nature of the three knowledge bases, a
17
18 stiff classification does not grant deeper insights into any particular sector (ASHEIM et al., 2007). For
19
20 example, the empirical study conducted by MOODYSSON et al. (2008) shows that both synthetic and
21
22 analytical knowledge bases play a major role in the pharmaceutical sector. The strict divisions between the
23
24 different knowledge bases, in this manner, blur in real innovation projects. Then, various knowledge bases
25
26 can overlap and interact in one and the same project. The various types of proximity thereby mirror the
27
28 involved knowledge bases and help to identify in which aspects a certain knowledge base is crucial. An
29
30 example is the development of a new drive technology in the automobile sector. Whenever hands-on
31
32 activities take place and the synthetic knowledge base dominates, these are organised in close geographic
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34 proximity and usually carried out by co-workers who know each other (social proximity) and preferably
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36 have the same background (institutional proximity). Those parts of the process that are more academic and
37
38 reflect the analytical knowledge base take place with a close eye on the protection of property rights
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40 (control dimension, organisational proximity). Third, the actors involved in symbolic knowledge questions –
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42 such as design – are granted a high degree of individual freedom, which is meant to trigger creativity.
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44 Simultaneously, they have to be familiar with the legal frameworks all over the world to ensure their
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46 concepts fit to the prevailing laws (institutional proximity), a process which is facilitated through personal
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48 contacts to representatives in the respective countries (social proximity). This brief insight displays that
49
50 there is a parallelism between various knowledge bases and a dynamic trade-off between multiple forms of
51
52 proximity. At the same time, it shows how interrelated the various forms of proximity are. Single innovative
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54 functions take place in overlapping knowledge bases drawing upon combined sets of proximities. At the
55
56 same time, process dynamics induce a continuous change of the resulting constellation. The empirical
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2 identification of knowledge bases hence has to look carefully inside the involved activities as a combination
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4 of various facets and factors, not as a homogeneous construction.
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8 Returning to the initially outlined balance between heterogeneity and proximity, we can conclude
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10 that the three knowledge bases find different ways towards it. Coping with this challenge is thereby not
11
12 merely a decision about the degree of proximity, but also involves a trade-off between various types of
13
14 proximity. Depending on the characteristics of the underlying knowledge base, specific dimensions of
15
16 proximity vary in regard to their importance. This allows for institutionalising simultaneously proximity and
17
18 heterogeneity. Whilst one or several types of proximity occur, the distance dominating the remaining
19
20 dimensions represents heterogeneity and thus provides variety and newness for the project. In this
21
22 manner, both proximity and heterogeneity can be achieved through partial solutions in that the various
23
24 dimensions of proximity upon which projects draw are complementary and compensatory to each other.
25
26 Although a solution is not possible within any of these proximity forms their coexistence enables
27
28 establishing a solution across several types of proximity in that a lower level of proximity in one dimension
29
30 can be complemented with a higher level in another type (cf. also BOSCHMA and FRENKEN, 2010). This
31
32 leads to the conclusion that a purely spatial view on innovation is not adequate and can easily be
33
34 misleading. In order to understand the dynamics which occur in innovation projects, it is indispensable to
35
36 look at all five forms of proximity as well as their complementarities and substitution effects. The involved
37
38 dynamics make it impossible to derive clear spatial patterns for any type of innovation in a theoretical or in
39
40 an empirical view. Instead, the spatial arrangements of different knowledge bases undergo continuous
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42 adaptation processes based on complex shifts and balancing acts.
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51 **4. Conclusions and outlook**

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53 This article has outlined that it is crucial to differentiate between different types of proximity in order to
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55 understand learning processes correctly and to disentangle spatial and non-spatial logics of innovation.
56
57 Following BOSCHMA (2005), it has introduced five types of proximity, namely cognitive, organisational,
58
59 institutional, social and geographical. The first three of them can be classified as knowledge, control and
60
framework oriented. On the other hand, social and geographical proximity act as auxiliary, reinforcing

1
2 mechanisms. Connected to the different modes of knowledge, the concept helps to explain how learning
3
4 takes place involving both geographical concentration and supra-regional connections (BATHELT et al.,
5
6 2004). The simultaneity of various geographical settings reflects a trade-off between multiple types of
7
8 proximity and triggers a dynamic way of coping with the dichotomy between heterogeneity and proximity.
9
10 Neither absolute proximity nor complete heterogeneity thereby provides a solution. Proximity in all the
11
12 proposed categories would be superfluous, whereas no proximity at all would impede collaboration. Based
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14 on the trade-off between various forms of proximity, it is possible to find a way of establishing a balance
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16 without opting clearly for one of the extremes.
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21 It has been shown that the nature of the underlying knowledge base plays a significant role for the
22
23 types of proximity necessary to exchange knowledge. First of all, a certain degree of cognitive proximity is
24
25 crucial in any type of knowledge exchange. Secondly, a trade-off takes place between institutional and
26
27 organisational proximity. Whereas the former relies upon shared values and laws and encourages learning
28
29 through informal mechanisms, the latter is based upon formal control and permits the sharing of
30
31 knowledge. This explains why knowledge exchange based on institutional proximity is dependent upon a
32
33 higher degree of proximity also in the auxiliary variables, i.e. in social and geographical proximity, as the
34
35 overall intensity of interaction has to be very high. This is exactly what occurs in synthetic knowledge bases.
36
37 On the other hand, the transfer of largely codified knowledge as in analytical knowledge bases can take
38
39 place in an environment involving a generally lower level of proximity, and as a consequence, social and
40
41 geographical binding mechanisms are not as important. Hence, the difference between the three types of
42
43 knowledge bases resides in the types of proximity which have to be present as well as the degree of
44
45 proximity necessary to trigger learning processes.
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51 We can conclude that the three forms of knowledge bases rely on different modes of proximity for
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53 learning and innovation, whereby the forms of proximity complement and substitute each other. A closer
54
55 look at geographical proximity shows that is not at all the crucial mechanism. Rather, many of the
56
57 arguments in the debate on regional learning in fact refer to the institutional framework. Geographical
58
59 proximity in a narrower sense acts mainly to facilitate the creation of other forms of proximity, social,
60
organisational and institutional proximity. Only in symbolic knowledge bases does it have an isolated effect.

1
2 At the same time, this does not at all imply the death of geography. On the contrary, it is exactly the
3
4 facilitating character of spatial proximity which turns geography into a crucial enabler of innovation and
5
6 learning, whereby the resulting ties are not strictly geographical, but can more precisely be described by
7
8 recurring upon a wider array of proximity types. Table 1 summarises the relationship between proximity
9
10 types and knowledge bases.
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17 → Table 1: Dimensions of proximity in different knowledge bases
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23 The specific characteristics of analytical, synthetic and symbolic knowledge bases are, as can be
24
25 seen, closely linked to sector-specific characteristics. Engineering provides a typical case of applied
26
27 learning-by-doing in synthetic knowledge bases, whereas the pharmaceutical industry is an example of a
28
29 scientific synthetic knowledge base and the creative industries as well as design projects are based on
30
31 symbolic knowledge bases. However, no industry is strictly limited to a single type of knowledge base.
32
33 Instead, different types of proximity are combined in a dynamic way, which is why “it can be suggested that
34
35 the degree to which (elements of) one mode of knowledge creation dominates is related to the actual stage
36
37 and activity in the innovation process.” (MOODYSSON et al., 2008, p. 1047). This leads to the assumption
38
39 that companies from any sector cope with the dichotomy between incorporating heterogeneous
40
41 knowledge and maintaining control through proximity in a dynamic way, which was illustrated in the
42
43 example of the new drive technology project.
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48
49 This article has presented a conceptual framework for connecting knowledge bases and
50
51 proximities. It does not give a full insight into the issue, but opens the door for further research. First, it
52
53 provides starting points for *empirical investigations*. A broad study of innovation could help to derive
54
55 operationalisation mechanisms and to break down the – so far rather abstract – dimensions of proximity
56
57 into measurable characteristics. Some initial steps have been undertaken to do this, but satisfactory
58
59 indicators for disentangling the various forms of proximity have not yet been developed (WETERINGS and
60
BOSCHMA, 2009; cf. also BOSCHMA and IAMMARINO, 2009; FRENKEN et al., 2007). Additionally, focussed

1
2 in-depth case studies of innovation projects in particular industries could allow deeper insights, whilst
3
4 cross-sector comparisons should be conducted to obtain a better understanding of general, inter-sectoral
5
6 patterns. In order to disentangle spatial and non-spatial dynamics, we also need process-oriented in-depth
7
8 case studies of whole innovation projects, following them through from their emergence to the market
9
10 launch. At the same time, important *theoretical questions* remain open, in particular regarding the
11
12 underlying processes of communication within and also across knowledge bases. All these topics clearly
13
14 remain highly relevant. They shed light onto complex intra-organisational and inter-organisational learning
15
16 and thereby help managers, politicians and scholars not only to understand the underlying spatial and non-
17
18 spatial processes in a more coherent way, but also to design, organise and frame them accordingly.
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24 ¹ EDQUIST (2001, p. 219) defines innovations as “new creations of economic significance of either a material or an
25
26 intangible kind. They may be brand new but are more often new combinations of existing elements.”
27

28
29 ² Even though the strictly correct opposites would be to use the terms “homogeneity” and “heterogeneity” or
30
31 “proximity” and “remoteness”, this article uses the terms “heterogeneity” and “proximity” as counterparts. The
32
33 underlying reasons are as follows. The term proximity acts as a link to the debate opened up by BOSCHMA and others
34
35 (BOSCHMA, 2005) upon which this article explicitly draws. Additionally, proximity implies commonalities which go
36
37 beyond similarity, but does not suggest sameness or homogeneity. It hence reflects the argumentation line more
38
39 appropriately than any of the other available terms. Likewise, the term heterogeneity mirrors the requirements in
40
41 innovation projects better than distance or remoteness would. Variety is here the central idea, not detachedness. In
42
43 this sense, I hope the reader can forgive pairing these two faintly related concepts – the entailed lack of precision in
44
45 the pair of opposites is, in my eyes, made up by a more precise transmission of the meaning in the terms.
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48
49 ³ STORPER (2009) describes context as a “dark matter”, as there are presently only few and rather simplistic attempts
50
51 to explain this phenomenon.
52

53
54 ⁴ Similarly, GRABHER (2004, 2006) stresses the importance of context in reference to projects.
55

56
57 ⁵ Besides the five-fold break-down of proximity in this article, other authors have suggested approaches with differing
58
59 foci. Examples include the differentiation between professional, organisational, contextual, technical and further types
60
of distance named by ZELLER (2002) and that between geographical, societal and network embeddedness as proposed
by HESS (2004).

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3 ⁶ BOSCHMA (2005) uses the term “organisational” not only for those actors who work in the same company, but also
4
5 if they work in similar organisations and are therefore familiar with the types of rules and modes of coordination that
6
7 apply. As companies increasingly adopt an international focus and consist of a multitude of intra-organisational
8
9 linkages (BARTLETT and GHOSHAL, 1990), but also cooperate externally, organisational proximity is even stronger
10
11 within organisations. It does then not refer to hierarchical or heterarchical forms of organisation, but is, by definition,
12
13 a means of coordination that embraces all the actors within a single company group. In this article, strong
14
15 organisational proximity does thus not refer to a common organisational culture etc., but to formally belonging to the
16
17 same judicial entity.
18

19
20 ⁷ Although organisational proximity within a single subsidiary is always higher than it can be between several
21
22 subsidiaries of the same company group, the formal control and property structures within a MNC in both cases
23
24 guarantee a significantly higher level of organisational proximity in comparison to situations involving external
25
26 partners.
27

28
29 ⁸ The importance of institutional frameworks and their impact on organisations have also been discussed in the
30
31 debates on national innovation systems (NELSON, 1993; TAKAHASHI, 2007; LUNDVALL et al., 2002; EDQUIST 1997) and
32
33 varieties of capitalism (JOHNSTON, 2005; WHITLEY, 2000). In this manner, institutional proximity also influences the
34
35 internal manner of coordination and organisation, i.e. organisational proximity.
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39 ⁹ In the same manner, “institutional thickness” (AMIN and THRIFT, 1995) is not a geographic, but clearly an
40
41 institutional phenomenon.
42

43
44 ¹⁰ Communities of practice and epistemic communities are examples for the power of social proximity. Both rely
45
46 deeply upon social, tacit and personal forms of interaction. At the same time, social proximity remains a means to an
47
48 end and does not stand alone. GERTLER (2001, p. 18) describes communities of practice as “informally bound together
49
50 by shared expertise and a common problem”. This definition reflects the importance of cognitive elements (expertise,
51
52 professional background) in this form of cooperation (cf. also KNOBEN and OERLEMANS, 2006). Furthermore,
53
54 organisational proximity acts as a pre-selection mechanism which applies before social criteria influence the choice of
55
56 the actual participants within such a community. Similarly, epistemic communities are deeply knowledge-based,
57
58 whereby the involved experts share at least cognitive and normative beliefs and values (HAAS, 1992). In short, neither
59
60 of these forms of community emerges based exclusively on social criteria.

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¹¹ It must not be forgotten that, just as all the other types of proximity, too much social coherence can be harmful. It results in “strategic friendships”, irrational preferences and lock-in into group thinking (GRABHER and IBERT, 2006).

¹² ASHEIM et al. (2007) claim that buzz is not restricted to face-to-face interaction, although it has widely been interpreted as a spatial concept. The underlying claim is hence not that buzz has to take place in geographic proximity, but, in agreement to ASHEIM et al. (2007), that it does most easily and frequently occur in spatially concentrated settings.

¹³ For a discussion of buzz, spillovers and the resulting “learning regions” cf. also MALMBERG et al., 1996; MASKELL and MALMBERG, 1999; MASKELL and KEBIR, 2006.

¹⁴ “In short, ‘being there’ underpins the joint production, circulation and sharing of knowledge.” (GERTLER, 2008).

¹⁵ MORGAN (2004) and others have stressed the continuing importance of geographical aspects of learning. The line of argumentation focuses on relational aspects, i.e. on how geographical proximity fosters the creation of trust and entails commonalities in cultural and legal aspects. These factors are here regarded as social and institutional proximities. At the same time, they are evidently more common and more easily created in geographical proximity, a fact which again underlines the facilitating character of geographical aspects for the other forms of proximity.

¹⁶ The empirical evidence used in this article to illustrate the theoretical argument stems from research the author conducted in the project “Regional Learning in Multinational Companies”. Each cited case involves approx. 20 narrative expert interviews in subsidiary, headquarters and the region in question. I would like to thank the Volkswagen Foundation for the financial support of this project and, above all, the interview partners for their time, effort and their disposition for allowing me an in-depth insight into their fascinating innovation projects.

¹⁷ In more complex projects, geographical proximity may turn into a more important auxiliary factor. This can result in temporary co-location, taking the form of meetings or conferences (MASKELL et al., 2006; TORRE, 2008).

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	Synthetic knowledge	Analytical knowledge	Symbolic knowledge
Core idea of innovation	Emergent application or recombination of existing knowledge	Planable creation of new knowledge	Interactive recombination of existing knowledge
Cognitive proximity	Fundamental	Fundamental	Fundamental (low level)
Organisational proximity	Subordinate to institutional proximity	Dominant form of integration (learning as top-down process)	Secondary
Institutional proximity	Dominant form of integration (learning as bottom-up process)	Subordinate to organisational proximity	Important if market is local
Geographical proximity	Helpful (auxiliary)	Negligible	Critical

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Social proximity	Helpful (auxiliary)	Negligible	Critical (social networks as a substitute to formal training and cognitive proximity)
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Table 1: Dimensions of proximity in different knowledge bases (own representation)

For Peer Review Only