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03.12

Anja Dettmann, Sidonia von Proff and Thomas Brenner

Impressum:

Working Papers on Innovation and Space
Philipps-Universität Marburg

Herausgeber:

Prof. Dr. Dr. Thomas Brenner
Deutschhausstraße 10
35032 Marburg
E-Mail: thomas.brenner@staff.uni-marburg.de

Erschienen: 2012

Co-operation over Distance? The Spatial Dimension of Inter-organisational Innovation Collaboration

Anja Dettmann¹, Sidonia von Proff², Thomas Brenner

all from Section Economic Geography and Location Research, Institute of Geography, Philipps-University, Marburg.

Abstract:

In the literature there is a controversy about the relevance of the spatial dimension in innovation collaboration. We examine the link between the spatial composition of group members and group characteristics which are important for performing innovation projects. To this end, we introduce a social-psychological approach to the field of economic geography. The empirical part is a longitudinal study of 49 inter-organisational innovation groups in Germany. We find that the share of regional partners is rather stable after a funded formation stage. Hence, policy measures aiming at inter-regional collaboration have to be employed at an early stage of group development.

Keywords: innovation collaboration; collaboration over distance; network formation; Germany.

JEL Classifications: L14, R12, O38

¹ Corresponding Author: Anja Dettmann, E-Mail: a.dettmann@fz-juelich.de.

² Corresponding Author: Sidonia von Proff, Philipps-University Marburg, Deutschhausstraße 10, 35032 Marburg, Germany. E-Mail: vonproff@staff.uni-marburg.de.

1 Introduction

There exists a controversy about the importance of the regional environment and in particular regional partners for innovation collaboration. On the one hand, the region is a trigger and supporter of co-operation and innovation processes between actors due to the facilitating function of spatial proximity. This function is theorized in many ways: as supporter of knowledge flows (Arndt and Sternberg, 2000; Asheim and Gertler, 2007; Bell and Zaheer, 2007; Boufaden and Plunket, 2008) and thus as a facilitator for interaction and learning processes (Boschma, 2005a; Freel, 2003); as a minimiser of costs (Bayona et al., 2001), and finally as a pre-requisite for social relationships between co-operating partners (Broekel and Binder, 2006; Olson and Olson, 2000; Kraut et al., 1987; Dutton et al., 1996; Freeman, 1991). Due to these enabling factors of a regional environment it is argued that partners from the region are of high importance for innovation projects. On the other hand, the importance of spatial proximity is increasingly challenged (Rodríguez-Pose, 2011). Some researchers argue that rather (social) network structures (Breschi and Lissoni, 2009; Agrawal et al., 2006) or other types of proximity (Boschma, 2005b; Ponds et al., 2007; Ter Wal, 2009) are the underlying trigger of co-operation and innovation processes. However, the single reliance on proximate partners increases the risk of a lock-in. For a healthy economic development of a region some external knowledge has to be integrated (Grabher, 1993; Broekel and Meder, 2008).

The differentiated results regarding the role of the regional environment for innovation networks can be explained by the varying perspectives that economic geographers adopted during the last decades. Especially the integration of social determinants into geographical concepts turned out to be a challenging task. Social processes are strongly linked to individuals and their relationships. Thus, they are difficult to integrate into established geographical scales, like the region. To contribute to this evolving research area, the paper at hand adopts a social-psychological approach to analyse networks on the group level instead of the level of individuals. This approach offers the chance to combine spatial and group attributes on one level of analysis (see Levy et al., 2012, for a slightly similar approach on a project level).

Let us define 'regionality' as *the amount of regional members in a partner pool of an innovation group in relation to the amount of partners from beyond the region*. Then our study is focussed on regionality and how it is linked to distinct group characteristics as well as the question how regionality of networks develops over time. These issues are studied empirically by means of 49 German networks. For this purpose we develop an theory-based empirical approach that allows for measuring a number of crucial group characteristics.

The basis for our theoretical considerations as well as the empirical approach is a well-defined concept of the network we study. While many network studies investigate informal, hidden, or unaware structures between actors, we will focus on intended and officially established networks. In this case, individuals build their relationships consciously and voluntarily in order to form a group for a particular task (Powell, 1990). Innovation networks being formed on purpose have a strong group and project character. Forsyth (2006, p.159-160) states that these "...cross-functional teams include individuals with different backgrounds and areas of expertise who join together to develop innovative products and identify new solutions to existing problems... [They] are fundamentally groups, and they possess basic characteristics

of any group". Using the group level for an analysis is related to the idea that the whole is greater than the sum of the parts. Established innovation groups have very similar characteristics to professional teams: a distinct number of participants, face-to-face interaction over a longer period, differentiated roles, some kind of management, common norms, and group cohesion (Gebert and Rosenstiel, 1996, p. 127). However, established innovation groups are not perfectly comparable to work teams because their actors do not share a common institutional and organizational background. Hence, the main challenge beside the task to innovate and to coordinate the group effectively (Gebert and Rosenstiel, 1996) is to develop an organizational setting in terms of roles, norms and rules. Then, "individuals can identify with organizations [the network] and their interests as strongly as they may do with groups, with comparable psychological dynamics as a result" (Schruijer, 2008, p.430). Regarding the manifold theories about groups (for an overview see Forsyth, 2006, p. 53ff) our understanding of groups is a systemic one. In our context, a group is a self-organizing, evolving system that comes into existence when independent actors join together because they need each other (Miller, 1978) as it is the case in innovation projects. Note that the innovation process in our study is conscious, aspired and operationalized in an organisational environment.

Social-psychological literature offers concepts to analyze group characteristics to understand the shape and dynamics of a group. Since a functioning team is required for later performance, the analysis of a group's formation is a promising way to identify determinants of later success. Group success is difficult to measure, especially for young groups. Therefore, we take an indirect approach. We assume that certain group characteristics (developed from the literature) are precondition for success and we measure these characteristics. We take an evolutionary view on groups with a focus on their initial formation and on their further development while conducting innovative activities. Based on these explanations, we now introduce our definition of inter-organisational innovation groups being the object of this study:

Inter-organisational innovation groups are groups of independent actors that are consciously established with the purpose to conduct joint innovative activities in an organized manner.

They are systems that pass different stages of development and educe characteristics superior to the sum of the characteristics of their members. These systems consist of interdependent participants with different institutional backgrounds, show cooperative and coordinated interaction, have an own structure in terms of norms, rules and roles, are task-related and output driven, and appear as one unit to third parties.

The paper proceeds as follows. In the next section, we develop our theory regarding the role of regional and external partners in innovation groups. In addition, we define group characteristics which are later used for measuring the group performance. The characteristics that are used are derived from the literature on group level innovation and innovation networks. The third chapter contains our data and the analytical framework. In the first part of section four, we present how regionality develops over time. The second part of section four contains the presentation and discussion of the relationship between regionality and functionality. Section five concludes.

2 Innovation groups and space

2.1 Regional partners in innovation groups: the formation stage

Established groups have a distinct formation stage in the beginning. In this stage, actors aim to find partners, common goals, concrete projects, and an inner structure. In contrary to the stage where innovation projects are performed, the formation is dominated by finding, selecting, and integrating partners in the group. Studies found the regional context to be of great importance in partner searching processes (Broekel and Binder, 2006; Ter Wal, 2009; Blumberg, 2001). Economic and social aspects are the two main types of arguments explaining the importance of spatial proximity and in this sense the importance of regional partners for innovation processes. Due to our interdisciplinary approach, we present both strands in the following.

From an economic point of view, costs and resources of the co-operating partners have the strongest impact on size, geographical range, and success of innovation groups. There is certainly a firm somewhere in the world which is a technologically optimal partner. The internet is a tool to find out about potential partners, but an internet-based search will not suffice to decide whether a firm matches the requirements better than another one. Some direct contact is necessary to find that out. However, the costs for searching a potential innovation collaborator increase with the time spent on the search. Since there is too much information available on the internet, firms face information overkill. They need a strategy to reduce the information overkill and the costs for analysing the information systematically. Hence, they should search among their former collaborators or search for recommendations, i.e. firms which your own collaborators know (indirect links). Due to job mobility, customer and supplier relationships, and more, firms have some trustful connections to other firms, often locally situated (Cantner and Graf, 2006; Fleming and Frenken, 2007). Cooperation with a more or less well-known partner gives some security against hold-ups in the innovation competition because there is some trust. Trust and secrecy are highly important even during the partner search as original ideas could be stolen when you talk about the project. It is a trade-off relationship between innovative potential and trust (Cantner and Graf, 2010). Håkansson (1989) found that a spatially proximate network is of special relevance if there is no on-going commercial exchange between the partners to provide a basis for collaboration. If no prior partner comes into consideration, individuals will most likely either ask a person they know for an adequate partner or will search in his or her home region, where meeting an unknown person is easy. In short, a local search in a social or spatial sense is most likely. This is supported empirically by Singh (2005) as well as Breschi and Lissoni (2009), who find in empirical studies, that social proximity causes the bulk of knowledge flows. Since social networks are often of spatially limited expansion, the spatially limited knowledge flows result from both spatial and social proximity. Freel (2003) finds that smaller companies collaborate more often locally than larger ones, which can be explained by their lower resources. However, these economic consequences of the information overkill may often be unconscious and since they lead to the same result as the social arguments derived below they cannot be separated.

Beside the economic arguments, intangible factors between geographical proximate partners play a role. 'Embeddedness' (Uzzi, 1997), 'buzz' (Bathelt et al., 2004), or 'something in the air'

(Marshall 1927) try to name this phenomenon. This is supported empirically by findings on the strong tendency for repeated partnerships (Agrawal et al., 2006; Breschi and Lissoni, 2009; Goerzen, 2007) and the often stressed importance of social aspects in research partnerships (Dutton et al., 1996; Hinings and Greenwood, 1996; Kraut et al., 1987). The reason behind it is the fact that frequent interaction and unintended meetings are known to enhance sympathy and trust (Guirdham, 2002; Kiesler and Cummings, 2002; Lewicki and Bunker, 1996) and take place primarily in the close environment of persons. Since the close social environment is often also spatially close, personal relationships and groups are frequently built in a regional context. Tuckman (1965) identified stages of group development, wherein forming (the initial meeting of partners), storming, (the negotiation about norms, rules and goals) and norming (development of group cohesion) belong to the formation of a group. During these stages members predominantly face social processes which they describe as stressful and unpredictable. This explains the strong tendency to choose well-known partners.

A further mechanism is the need for at least temporal face-to-face contacts in the formation stage because social interaction requires non-verbal information (Aronson et al., 2009). Due to the low costs regional partners have for joining the constitutive group meetings, they have a lower barrier to take part in the group. We deduce our first hypothesis:

H1: Inter-organisational innovation groups choose regional partners primarily (> 50%) during the formation stage and thus they have a high degree of regionality.

Above, we already mentioned the importance of social ties for group formation. If actors of a group shared spatial proximity with distant actors in the past, they had the chance to build up strong social ties. Although the spatial proximity got lost between these actors, their strong social bonds can remain and enable the collaboration over distance (Breschi and Lissoni, 2003). Choosing distant partners requires the strong belief in a successful co-operation in advance. That indicates that groups integrating more distant partners have or reach soon a high social depth. In contrary, regional partners can be included although their social bonding may be weak knowing that relationships can be easier intensified over time in a joint environment than over distance. We state:

H2: Inter-organisational innovation groups with more distant partners show a stronger social bonding than those with few distant partners.

Of course, new group members can be spatially proximate to one of the distant members and thus be distant members themselves. Nevertheless, on average, we believe Hypothesis H2 to be true.

2.2 Regional partners in innovation groups: the performance stage

During the performance stage, the group will further develop. The decision whether a company continues participating in the project or not depends to a large extent on the resulting costs and perceived benefits. At first, all actors have to invest resources (personnel; machinery; organisation effort) into the project. The effect is a reinforcement of the (up to then loosely) established structure (Håkansson, 1989). The involved actors gradually adapt to each other and transaction costs will decrease. Notwithstanding, the costs of collaboration stay higher for distant group members than for those within proximity. For example, spontaneous meetings – very important during product development – are much easier and travelling is cheaper.

For some actors, the focus of the group develops into a direction departing from their core competencies or aims. They will probably leave the group, while others maybe join it as soon as the group needs their competencies. Since the benefits are not yet real and will be uncertain for quite a while, the uncertainty can lead to some random fluctuation based on differences in the perception of benefits. The fewer resources a company has, the more likely uncertain future benefits will be a reason for leaving the group. Larger companies (i.e. with larger resources) can be expected to have greater stamina in this case and benefit from expensive but lucrative projects. This could explain the finding of Arndt and Sternberg (2000) that larger companies benefit more from inter-regional links and smaller firms more from intra-regional links.

However, economic arguments do not suffice to explain the commitment of members in innovation groups. Due to the voluntary character of innovation groups, social relationships play an outstanding role. Argyle and Henderson (1985, p.241) found out that “... under the right conditions, for example small and cohesive groups, work relationships are a very powerful source of satisfaction and support”. Hence, commitment is not only a question of economic benefits but can also be strongly linked to the motivating character of social patterns in group relationships. Additionally, the group performs the complex task of an innovation project requiring a lot of communication processes, coordination, and task-related learning. Here, sound relationships are of high importance, too (Gebert and Rosenstiel, 1996; Kraut et al., 1987). Argyle (1991) found out in a study of work teams showing different degrees of personal bonding (from social friends to disliked colleagues) that those teams with a high commitment were most successful. Lewicki and Bunker (1996) describe that the increase of trust in work relationships is linked to group cohesiveness and commitment. The increase of cohesiveness and commitment in turn is strongly linked to the amount of personal interaction requiring spatial proximity (Aronson et al., 2009; Kraut et al., 1988; Kiesler and Cummings, 2002). Hence, the supporting role of spatial proximity regarding the maintenance of sound work relationships is a key for successful innovation groups. The fact that spatial proximity is important in mutual learning and knowledge-exchange processes was already stated in earlier papers (Amin and Wilkinson, 1999; Bathelt et al., 2004; Bell and Zaheer, 2007; Kirat and Lung, 1999; Maskell and Malmberg, 1999; Morgan, 1997). However, continuous spatial proximity is a feature of regional partners only. A possibly low social bonding of regional partners can be compensated by the joint regional environment. Hence, the difference between regional and distant partners regarding the social depth is supposed to vanish soon as former are bonded from the beginning and latter can catch up over time. In contrary, loosely connected distant members have a high chance of being lost since strengthening the relationship is difficult. Hence, regional partners are lost less often and

integrated more likely while distant partners have a lower chance of being included and kept during the performance stage (if they are not tightly bonded to existing group members). To sum up, economic and social arguments lead to the same result: the group will rarely get spatially more widespread. We state:

H3: Inter-organisational innovation groups increase the degree of regionality they gained during the formation stage.

2.3 Regionality and the characteristics of innovation groups

In order to make the complex processes of groups theoretically and methodologically manageable, the psychological literature identified a set of qualities (in terms of characteristics) helping to characterize professional groups (Forsyth, 2006). If these characteristics are missing or are underdeveloped, teams might have a limited functionality. Regarding performance, a lot of findings exist for *single* characteristics like communication patterns of teams (Marvin et al., 1964; Bavelas, 1950; Fussell et al., 1998), structural characteristics like size (Ingham et al., 1974; Rikard, 1979) and the influence of management and leadership (Knorr-Cetina et al., 1979; Sydow, 2001b). But the study at hand aims to use a rather holistic approach like the UNESCO study on team performance once did (Andrews, 1979), and considers a wider portfolio of group characteristics. This is the key to understand where spatial attributes are influential on the character of a group and thus its ability to perform innovation projects: “A *multivariate design* approach is [...] required to examine the impact of the numerous group characteristics which may impinge upon innovation” (King and Anderson, 1996, p.87). The literature on group processes and professional groups offers many approaches to arrange and formulate characteristics of groups, reflecting the very different backgrounds of this field of research. Hence, we focus on one of the very few studies on group characteristics of innovating teams by King and Anderson (1996) and complement this by the existing literature on innovation group development and management (Conway and Steward, 2009; Endres, 2001; Forsyth, 2006; Human and Provan, 2000; Müller et al., 2002; Sydow, 2001a). The group characteristics cover social, coordination, and project related processes in innovation groups. They are: *communication and information* exchange within the group; *coordination* of the group representing the functionality and role of the group management; development of a common *identity*; *documentation and reflection* activities in the group; a goal-oriented *structure*; and *co-operation* between group partners (see table 1). For a deeper discussion about the distinct social-psychological processes that take place between members of a group, we would like to point to the original literature on group processes (see Forsyth, 2006; Luft, 1984; Argyle and Henderson, 1985; Guirdham, 2002; Guzzo and Shea, 1992).

Table 1. Group characteristics and their indicators

Derived analytical framework			Theoretical Basis	
<i>Innovation group characteristic (our definition)</i>	<i>Description of characteristic</i>	<i>Derived indicators to measure characteristics of inter-organisational innovation groups (our approach)</i>	<i>Characteristics by King and Anderson (1996)¹</i>	<i>Characteristics in studies on innovation networks/groups¹</i>
[IaC] Information and Communication	[IaC] reflects information and communication processes reflecting the agreement on important structural group aspects. Effective communication structures and agreement are necessary to avoid conflicts and misunderstandings (Aronson <i>et al.</i> 2009; Arrow <i>et al.</i> 2000; Endres 2001; Guirdham 2002; Gebert and Von Rosenstiel 1996).	(1) general goals of the group are defined (2) roles within the group are defined (3) a development strategy for the group exists (4) communication infrastructure exists	Group structure and longevity Has a positive impact if: <ul style="list-style-type: none"> • Roles and norms are defined (2) • Communication structure is developed (4) • A groups perspective is clear (3) 	Common goals and visions as central determinant for successful professional groups (1), (3)
[Coor] Coordination	[Coor] refers to the group management that is supposed to be one of the most important units in the group (Endres 2001; Sydow 2001b). Communication and interaction in a group with many members is complicated and thus needs to be co-ordinated to avoid misunderstanding and negative sub-group development (Gebert and Von Rosenstiel 1996; Müller <i>et al.</i> 2002).	(1) group management is implemented (2) group management has a long-term perspective (<i>is also related to group longevity</i>) (3) the management is well connected with the group members (4) the management calls for contributions of group members (5) the management coordinates information (6) group meetings are organised regularly	Leadership Management and coordination of intra-group processes (1). Positive impact on innovations if: <ul style="list-style-type: none"> • Has moderate control over group (2) • Unit is connected to the group (3) • Helps to organise work processes (4) 	Unit supports communication process regarding goals and network development (Endres 2001) (6) and keeps overview and openness for ideas (Müller <i>et al.</i> 2002) (5), (6) Unit has to support evaluation processes (Sydow 2001b). (6)
[Ident] Identity	[Ident] refers to the group member's cohesiveness. It reflects a positive social group dynamic (Forsyth 2006; Human and Provan 2000; Huxham and Vangen 2006; Runkel and Speit 2005).	(1) group success is important for the members (2) a group logo is designed (3) a formal group manifestation (an association, company, etc.) exists (4) group membership is communicated towards third parties (5) the group is content wise connected to the region	Cohesiveness Positive impact on innovations if: <ul style="list-style-type: none"> • Feeling of belonging to a group is strong (2), (3), (4), (5) • Satisfaction from group action (1) 	All members of innovation networks should profit: monetary, emotional, resource wise etc. (Endres 2001) (1)
[Str] Structure	[Str] refers to the functionality - regarding the innovation project - of the group. Hence, the aim is not to draw the whole group structures in the sense of the	(1) members judge the group to be complete (2) group consists of best partner options for the innovation	Group composition Composition of members has a positive impact on innovations if <ul style="list-style-type: none"> • All required competences are 	

	<p>structuralist network tradition (Wellman and Berkowitz 1991), but rather to make the group's structural characteristics visible (van Waarden 1992).</p>	<p>process</p>	<p>available (1)</p> <ul style="list-style-type: none"> The team is composed by competences (2)
<p>[DocRefl] Documentation and reflection</p>	<p>[DocRefl] Documentation and reflection activities describe how often and regular the group partners reflect their own development. That implicates the group is managed reflexively and has the ability to react on events in and beyond the group (Sydow 2001b).</p>	<p>(1) the group development is documented (Homepage, protocols at meetings etc.) (2) reflection of the group development is done in meetings</p>	<p>Workshops and meetings in the context of projects require a systematic documentation (Endres 2001) (1)</p> <p>Evaluation of the status quo, results and structures in the sense of a reflexive network development (Sydow 2001b) (2)</p>
<p>[Coop] Cooperation</p>	<p>[Coop] reflects trust and cooperative activity and thus represents interaction and positive social relationships between the group members (Argyle 1991; Håkansson and Johanson 1993; Tyler and Blader 2000; Yeung 1994;)</p>	<p>(1) group partners have started joint projects (2) trust between partners is present (3) members make the contributions they agreed on (4) members are judged to be personally predictable to each other</p>	<p>Innovation needs task-orientated activity (Forsyth 2006) (1)</p> <p>Successful cooperation between team members requires trust (Endres 2001) (2)</p> <p>Reliability and predictability of partners is indispensable for common projects (Endres 2001) (3) (4)</p>

¹Numbers in brackets refer to the indicators in the third column.

Of course, the defined characteristics in their function as indicator for group functionality can only be a first proposal to measure innovation groups in a holistic and longitudinal way. The lack of interdisciplinary (Schruijer, 2008) as well as evolutionary network studies (Powell et al., 2005) in economic geography indicate that many years of research are still required in order to understand the complex relationships between innovation activities and spatial proximity.

Using this approach for the first time, it is difficult to develop hypotheses a priori about the way a regional partner pool influences distinct group processes. What we derive from literature is that the more developed the group characteristics are, the more a group is qualified to perform innovation projects and to develop self-sustaining structures. We can only assume that the regionality of an inter-organisational innovation group has first of all an impact on the social group characteristics like co-operation patterns or the group identity because of the cultural proximity within a region. Furthermore, the group structure could be affected by a close regional partner pool. For very complex innovation projects, a regional partner pool is maybe too small to contain all needed experts. But as mentioned above, it is hardly possible to develop theoretically grounded hypotheses about the relations we study here for the first time. Hence, we analyse very openly how regionality is linked to group characteristics and whether a regional partner pool rather triggers or hampers their development.

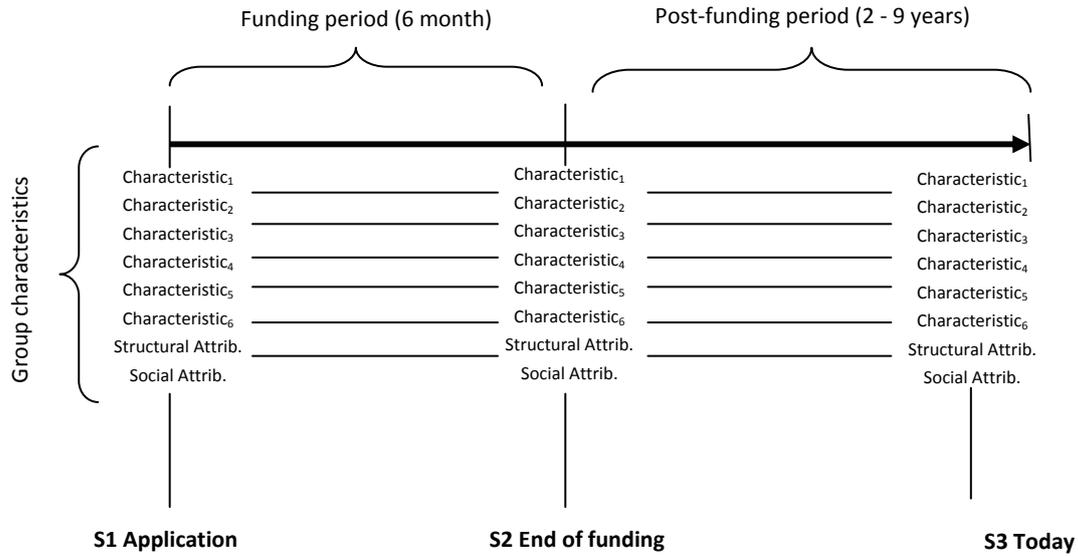
3 Data and Method

3.1 Empirical Approach

The objects of study are innovation groups in the eastern part of Germany which received public funding during their formation. The funding programme named *Innovationsforen* is conducted by the German Ministry of Education and Research (BMBF) and aims for fostering network structures between regional actors in order to raise the innovation performance of these regions. Until 2010, the programme supported more than 120 inter-organisational innovation groups and it is still ongoing. *Innovationsforen* funds primarily very young initiatives and tries to create opportunities for face-to-face communication and the establishment of relationships through financing topic-related conferences, workshops, and meetings for six months. To receive funding, the groups have to apply with a convincing innovation project and a network concept to conduct the project. Hence, the groups pass two formation stages: before they apply (basic group) and during the funding period that focuses on partner search processes and the development of inner structures. We have measured the groups for the first time at application (stage 1), a second time after the funding (stage 2), and a third time today (stage 3). Hence, we know how regional the inter-organisational innovation groups are after an unsupported formation (measurement S1), after a funded constitution stage (measurement S2), and at one point of the ongoing performance stage (measurement S3).

The basic idea of our research concept (see figure 1) is to measure the group characteristics as well as the regionality and to compare them in the named three points in time. Additionally, the relationships of the variables between the three stages are analyzed.

Figure 1. Temporal structure of our research approach



To measure the characteristics, we used different types of data sources. For S1 (pre-funding) we analysed the application documents of the groups, for S2 (end of funding) the final reports, and for today (S3) we interviewed the group managers by phone for approximately one and a half hour. The analyzed documents had distinct standards set by the funding programme regarding the group information they have to disclose. This ensured that detailed information is available for most of the groups. Missing information regarding stages S1 or S2 was gained in the interviews. For the study at hand 49 inter-organisational innovation groups were chosen out of a sample of more than 120 funded groups. Firstly, the criteria were to choose groups for which all documents and an interview were available and secondly to gain a broad heterogeneity in the sample regarding successful and failed group developments.

Since *Innovationsforen* is open for all industries and innovation ideas, the groups are very heterogeneous in size, structure, and strategy. Additionally, the funding took place in different years (between 2001 and 2010) giving the performance stage a variable duration but also enabling an analysis over a long time period. Having a heterogeneous sample like this, using three different sources of data, and aiming at underlying relationships between group characteristics and regionality, the research concept requires a high level of standardization. In this case, the key tool is a catalogue of indicators measuring the group characteristics (see column 3 in table 1). In order to get quantitative and categorical information respectively from the group managers, a strictly standardized catalogue was designed covering all indicators and additional variables. Because of the data sources consisting primarily of text (written and spoken), we had to assign numbers to the content or answer categories. Three possible values for each indicator were defined: 0 = the indicator is not given, 0.5 = the state of the indicator is partly developed or planned, 1 = the indicator is completely developed. The lower and upper limit can be determined exactly what is expressed in the extremes of 0 and 1. Since we build upon textual data, we are not able to measure the exact degree of completion. Consequently, everything in between gets assigned the value 0.5 which is the most correct way to express contentual betweenness. The values of the group characteristics consist of the equally-weighted

indicators and they are normalized so that each characteristic takes a value between zero (characteristic is not existing) and one (characteristic is completely developed).

3.2 Method

In order to test for structural and social factors beyond the group characteristics, we defined additional variables (see table 2). Furthermore, the performance stage is of a varying duration in the sample (1 to 10 years). For this reason, we had to create control variables measuring important events like additional funding from other sources. Note that not all group members participate in all group projects: a project is a concrete problem solution (innovation) and there may be several projects conducted in one inter-organisational innovation group. The variable *proj* is related to this fact: it measures the share of group members actively involved in one or more innovation projects. The data for the additional variables were collected as quantitative or categorized data, thus in a numeric way. Table 2 presents these variables and describes them; table 3 adds descriptive statistics of the group characteristics.

Table 2. Structural, social, and control variables.

Variable (abbreviation)	Description of the variable
Number of members (size)	Structural variable for measuring the group size in terms of number of firms or other organisations; n = 145 ^a , mean = 22, sd = 32.1
Regionality (regio)	Structural variable for measuring the share of regional members (number of regional members relatively to size); n = 131, mean = 0.75, sd = 0.24
Share of project members (proj)	Structural variable for measuring the share of project members (number of project members relatively to size), n = 105, mean = 0.56, sd = 0.42
Group relationship (bonding)	Social variable for measuring the social depth of personal bonding regarding the majority of group members (categorical: 0= do not know each other, 0.5 = sharing a professional relationship, 1 = sharing a professional and personal relationship); n = 85, mean = 0.78, sd = 0.21
Degree of sub-group development (subgr)	Structural variable for measuring in how far the group is divided into sub-groups. Subgr was measured only in S3; max = 1, min = 0, n = 48, mean = 0.32, sd = 0.33
Age of the group (t)	Structural variable for measuring the duration of the post-funding period in years; n = 49 (all groups), mean = 5, sd = 2.3
d_pre	Dummy, indicating a pre-funding impulse for the group development, d_pre was measured only once; n = 45; #(dummy = 1) = 15
d_post	Dummy, indicating a post-funding event, e.g. additional funding from another source. d_post was measured only once; n = 47; #(dummy = 1) = 29

^a There are 49 groups with 3 measurement points, i.e. n_{max} = 147
A number behind the variable indicates its measurement at one of the three points in time.

Table 3. Descriptive statistics of the innovation group characteristics.

Variable	IaC	Coor	Ident	Str	DocRefl	Coop
Mean ^a	0.728	0.827	0.509	0.551	0.578	0.733
Stand. dev.	0.257	0.225	0.239	0.298	0.324	0.277

^a There are 49 groups with 3 measurement points, i.e. n = 147

As the objects of study are so different regarding their location, industry, and innovation ideas, we did not use a standard definition for region. We asked the interviewees to refer to

partners who are regional to them. In doing so, we guaranteed that the interviewees always had a group in mind whose members are of eased accessibility and who share a regional context.

The study at hand based on two methods of analysis. In order to test for the change of variables between different points in time ($\Delta 12$ or $\Delta 23$) the paired Wilcoxon test is used. To test how different variables are related to each other within or between different stages, we estimated linear regression models. The residuals are normally distributed according to a KS test. We tested the models using a test of variance inflation for multicollinearity. The test result was always negative showing that the group characteristics and variables measure different aspects of a network. We use a 5%-significance level unless stated otherwise.

4 Results and Discussion

The first part of this section shows the empirical findings related to the theory in section 2.1 and 2.2. In particular, it contains findings on how the regional partner pool develops over time, that social bonding is important to overcome distances and whether public funding can reduce the strong tendency to choose regional partners. The second part presents our findings on the relationship between regionality and innovation group characteristics.

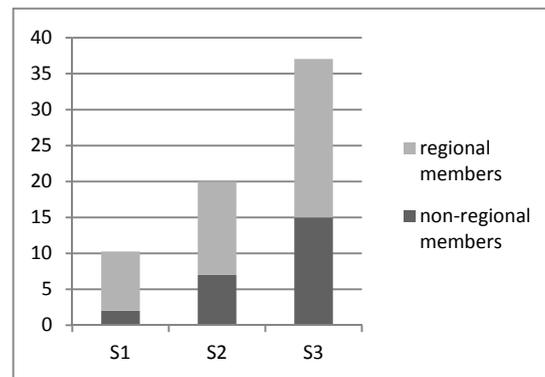
4.1 The Change of Regionality in Innovation groups

As explained above, the group formation consists of two parts: the 'natural' formation before application for funding and the 'established' formation during the six months of funding. Figure 2 shows the highest degree of regionality after the first formation (S1). Without the support in sense of funding or consulting, innovation groups are built primarily of regional actors. Hence, Hypothesis H1 is confirmed for a 'natural' formation stage of groups. The amount of non-regional partners rises significantly during the funding stage (from S1 to S2) from 20 to 35 percent (Wilcoxon test: p-value= 0.006).

The result indicates that groups following their natural search have a strong tendency to choose regional partners whereas public funding can reduce this strong tendency for regional partners significantly. It increases the group resources and guides the members through the risky and stressful stages of early group development processes. These supportive economic but first of all psychological effects were pointed out in nearly all of our interviews. Although, the inter-organisational innovation groups integrate a lot of distant partners, the regional environment remains to be the most important pool for partners: over all stages approximately 68 % of the group members are regional actors. We assume that this value would be a lot higher in unfunded groups as the 'natural' search leads to a higher degree of regionality. The change after funding ($\Delta 23$) is not significant in contrast to our Hypothesis H3 stating that regionality increases over time. A possible reason for this is the choice of interview partners and our definition of regionality: the question of regional group members was answered by the group managers. Thus, every member at distance from the spatial core of the group is viewed as a distant member, even though they can be spatially close to other distant group members. We cannot investigate this further with the available data.

Figure 2 shows a strong growth of the groups during funding by doubling the number of members in six months. The growth in the post-funding stage from an average size of 20 members (S2) to 37 members today is also large, but this stage can endure up to nine years in our sample.

Figure 2. The share of regional partners in the groups before (S1), after funding (S2), and today (S3)



The interviews revealed that overcoming spatial distance is a problem for innovation projects. Although only 32 % are distant partners over all stages, this group is responsible for 40 % of group membership resigns. We assumed from the theory that distant actors, who are chosen as group members, are socially stronger bonded to the other members than regional partners or are likely to be lost. To answer this question, we asked the group managers how they would describe the relationship of the majority of the group members concerning the three points in time and additionally to assign their answer to the following categories: 0 = do not know each other, 0.5 = have a professional relationship, and 1 = have a professional and personal relationship. If groups with more distant members showed a higher social depth at the end of constitution there should be a negative correlation between regionality and group relationship (Hypothesis H2).

Table 4. Relation between regionality and group relationship before (S1) and after (S2) funding, today (S3), and over all stages

	Before funding (n=24)	After funding (n=27)	Today (n=30)	Over all stages (n=81)
Spearman correlation	-0.240	-0.432*	-0.105	-0.354*

*: significant at alpha <0.05

Analysing the data independently from particular stages, the correlation is significantly negative. On average, the more distant partners a group has, the higher the social bonding is between the partners. Running the test for particular stages, we only found this relationship to be significant for S2. There is no indication that the funding programme has got a different impact on distant and regional partners regarding social processes. Thus, the high social depth regarding distant partners is brought into the groups from past contexts. Hence, Hypothesis H2 is confirmed. Looking at the data for stage 1, we found out that in 21 of 24 cases all members were regional actors. This lack of groups with distant partners can explain the missing

significance in stage 1. Overall, we conclude that there is a tendency to integrate distant partners only in case of social bonding.

We assumed from the theory that the spatial proximity facilitates regional partners to maintain and intensify relationships when performing projects. This indicates that over time the difference between rather regional groups and the ones with more distant partners vanishes regarding social depth. We found an evidence for this, since the relationship between regionality and group relationship becomes insignificant in S3. Hence, groups with many distant members reach social depth sooner, but those with regional partners catch up over time due to the advantages of spatial proximity.

Our results shed new light on the relationship between spatial proximity and social processes in groups. The longitudinal perspective of our study reveals that the choice of partners is primarily led by social and economic determinants and less by spatial proximity per se. It has rather an indirect effect, as on the one hand social-psychological processes make it very likely that well known partners are also regional partners. On the other hand spatial proximity saves resources and thus facilitates to integrate also less known partners. Both aspects lead to a strong preference for regional partners. Only if the resources of a group are increased, e.g. in the case of funding, this regional bias can be weakened. It seems as if during formation social processes and ties are the most important determinants in group development.

4.2 The Relationship Between Regionality and Characteristics of Innovation Groups

In the following, the relationship between regionality and group variables is investigated. We built linear regression models with regionality in stage 2 and stage 3 respectively as dependent variable. The independent variables were the six group characteristics, the group size [size], regionality [regio], the group relationship [bonding] and the share of project partners [proj] in the group of the stage before.

Model 1:

$\text{Regio2} = f(\text{IaC1}, \text{Coor1}, \text{Ident1}, \text{Str1}, \text{DocRefl1}, \text{Coop1}, \text{Size2}, \text{Regio1}, \text{Bonding1}, \text{Proj1}, \text{d_pre})$

Model 2:

$\text{Regio3} = f(\text{IaC2}, \text{Coor2}, \text{Ident2}, \text{Str2}, \text{DocRefl2}, \text{Coop2}, \text{Size3}, \text{Regio2}, \text{Bonding2}, \text{Proj2}, \text{d_post}, \text{Subgr})$

Because of the different length of the post-funding stage, we tested for the influence of time by integrating a time variable (t) in the regression models, but it never had a significant impact on any variable. Hence we excluded it in the final models in order to increase the degrees of freedom. Model 1 is found to have no explanatory power and no variable is significant in this model, not even the level of regionality at S1 has a significant impact on regionality at S2. Model 2 has a good explanatory power (see table 5). The highly significant regionality variable indicates a high stability of the level of regionality during the performance stage. The group characteristics do not influence regionality. Even the growth of the groups (see figure 2) does not change the degree of regionality in the post-funding stage (cf. section 4.1). Independent from the duration of the performance stage, regional groups keep the tendency to choose regional partners whereas groups with many partners beyond the region keep including distant (but apparently socially bonded) actors.

Table 5. Relation between regionality (S3) and other group variables (S2) – Model 2

	IaC2	Coor2	Ident2	Str2	DocRefl2	Coop2	Size3	Regio2	Bonding2	Proj2	D_post	Subgr
coefficient	0.063	0.030	-0.334	-0.202	0.000	0.037	-0.001	0.533*	0.011	0.296	-0.020	0.09

*Linear regression; *: significant at alpha < 0.01; R² = 0.67.*

Hence, a predominantly regional partner pool at an early development stage makes it very difficult for innovation groups to overcome a regional limitation. For politicians, this result indicates that the restructuring of groups is very difficult the more regionally limited they are already. In short, there is a strong path dependency. No other significant impacts on the regionality of the groups are found. Thus, we turn to the impact of regionality on the performance.

The longitudinal research concept allows for measuring the influence of regionality on group characteristics between different stages. We tested, on the one hand, the influence of regionality in S1 on characteristics in S2 and, on the other hand, the influence of regionality in S2 on characteristics in S3 (see tables 6 and 7).

Models 3a-f:

$IaC2/Coor2/Ident2/Str2/DocRefl2/Coop2 = f(IaC1, Coor1, Ident1, Str1, DocRefl1, Coop1, Size1, Regio1, d_pre)$

Models 4a-f:

$IaC3/Coor3/Ident3/Str3/DocRefl3/Coop3 = f(IaC2, Coor2, Ident2, Str2, DocRefl2, Coop2, Size2, Regio2, d_post, Subgr)$

Neither before funding nor after funding regionality is found to have a significant influence on the later degree of the group characteristics. The development degree of all group characteristics in stage 2 depends mainly on their degree in stage 1, indicating strong path dependency. The missing relevance of regionality regarding the development of the group characteristics is also confirmed in stage 3. For the development degree of the characteristics today we do not find any significant relationships with regionality in stage 2. We find four variables in S2 to have a positive impact on other variables at S3: a high identity feeling, a low established structure, additional funding, and low sub-group development (see Table 7). However, these variables are not in the focus of this paper.

Table 6. Relation between regionality (S1) and group characteristics (S2) (Models 3a-f; n=38)

Group characteristic in S2 as dependent variable	IaC1	Coor1	Ident1	Str1	DocRefl1	Coop1	Size1	Regio1	d_pre	Adj. R ²
IaC2										0.09
Coor2		+								0.47
Ident2			+							0.36
Str2				+		-			-	0.46
DocRefl2					+	-				0.25
Coop2						+				0.26

A positive (+) or negative (-) sign indicates a significant relationship, an empty cell refers to an insignificant relationship.

Table 7. Relation between regionality (S2) and group characteristics (S3) (Models 4a-f; n=39)

Group characteristic in S3 as dependent variable	IaC2	Coor2	Ident2	Str2	DocRefl2	Coop2	Size2	Regio2	d_post	subgr	Adj. R ²
IaC3			+	-					+	-	0.40
Coor3		+	+	-					+	-	0.51
Ident3			+	-					+		0.30
Str3											0.01
DocRefl3			+							-	0.27
Coop3				-					+		0.19

A positive (+) or negative (-) sign indicates a significant relationship, an empty cell refers to an insignificant relationship. The variable "proj2" was not included due to insufficient cases.

In sum, we found out that the degree of regionality has no significant relationship to the successful development of group characteristics which are required to perform innovation projects successfully and for the group to be self-sustainable. We assume that the success or failure of inter-organisational innovation groups strongly depends on the topics, strategies, and aims that have to fit to the regional partner pool and thus it becomes a question of the *quality* of regional partners. Hence, the earlier findings of other empirical studies presented in section 2 are consistent in so far, that there is no *direct* influence of regionality on group characteristics and vice versa. In a further model, we pooled the variables of S2 and S3 in order to find out whether there is a general relationship between regionality and other group characteristics without a time lag, i.e. without assuming any causality. Table 8 shows the results.

Model 5: Regio = f(IaC, Coor, Ident, Str, DocRefl, Coop, Proj, Size, Bonding, d_post)

Regarding the focus of our paper the most important result is that regionality is linked to a less good developed structure as well as a lower level of bonding (the latter relationship we already found in table 4). In contrast to many findings in previous studies, which found out that regional partners have the closest bonding due to spatial proximity, we find that groups with many spatially distant partners show more personal bonding.

Table 8. General relation between regionality and other group variables

	IaC	Coor	Ident	Str	DocRefl	Coop	proj	Size	d_postfund	Bonding
Estimate	0.217	-0.141	0.226	-0.314*	0.179	-0.029	0.014	-0.002	-0.022	-0.143*

*: significant at alpha < 0.05. Subgr was excluded since it was measured only for S3. Adj. R² = 0.28.

This result helps to specify the function of a regional environment for innovation groups in more detail. It seems to be a pre-requisite to build up personal relationships which later help to overcome long distances in joint projects. Regional groups are rather incomplete and not optimally staffed (low level of *Str*). That shows how important distant partners are – the more specific or complex projects are the more important distant partners are. Interestingly, regional groups do not display the strongest social relationships. Thus, spatial proximity can be a protector for social overembeddedness. The regional environment is of high importance in order to add a critical number of actors who can become either very good partners because of an eased social catching up or who keep their rather distant position bringing in fresh ideas as well as a professional way of interacting.

5 Conclusion

The study at hand analyzes the development of inter-organisational innovation groups during their earliest stages. The focus lies on the regionality, i.e. the amount of regional group members, its development over time, and its relation to several group characteristics. In the theory part, these characteristics are developed from economic-geographic, social-psychological, and management literature. They are relevant for performing innovation projects successfully. The empirical part consists of a longitudinal analysis of 49 inter-organisational innovation groups in Germany.

In the theory part we present arguments for a spatially rather limited partner search and discuss the ambivalence of spatial proximity for group success characteristics. We then empirically analyse the development of the regional partner pool and how its size is linked to other group characteristics - within distinct development stages and between them. We found out that regionality per se is neither a facilitator nor a barrier for the successful development of characteristics that the groups need to perform projects and become self-sustaining. Groups with a larger share of distant partners show a high social bonding from the beginning on, whereas groups which are more regionally limited catch up. The way a group will develop is decided in a surprisingly early stage. Once it is constituted, the regionality does not change a lot anymore – despite the inclusion of new partners. This means that groups show strong path dependency in their regionality. Therefore, policy measures aiming at inter-regional collaboration have to be employed at an early stage of group formation. Very regional groups are often less optimal staffed and incomplete, i.e. the structure is less developed. Probably, the region as core pool for partners is often too small. Overall, the partner search in the innovation groups under investigation was strongly led by social processes and personal ties.

In our study, we took an innovative approach and analyzed innovation groups as an own unit of analysis in terms of being a group with distinct characteristics and dynamics. With this holistic and longitudinal perspective we could show how important social processes are for the constitution of groups, how important personal ties are to overcome distances, and how path dependent the spatial dimension of innovation groups is. Further studies in this line are necessary to improve our understanding of the development of innovation groups.

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