Social Processes in Network Formation and the Impact of Public Funding – A Spatial Case Study

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Abstract

Our study evaluates the public funded programme "Innovationsforen" supporting young innovation networks in the Neue Länder at their very beginning. We obtain insights in early network formation processes influenced by public funding and consulting and study the relationship between network characteristics before and after the funding. Through this the study provides insights in the short and long-term effects of early public funding in innovation networks with a focus on spatial and social aspects underlying the development of collaborative network structures.

Using interviews and document analysis techniques in combination with multivariate analysis, we got detailed insights in 15 networks. Our results show that supporting personal meeting and workshops has a very positive influence on later network success in terms of self-feeding structures and common project work because it creates an early common identity. But these processes are quite sensible to distance. Related to this we find that all networks became regionally focused over time.

1 Introduction

During the last ten years an increasing number of studies in economic geography dealt with questions about the influence of spatial proximity on business or business-research co-operations (AGRAWAL ET AL. 2006; CUMMINGS & KIESLER 2007; KRAUT ET AL. 2002; OLSON & OLSON 2000; PICCI 2008; PONDS ET AL. n.d.; SAXENIAN 1990; SCHUNN ET AL. 2002, TORRE 2008). Because those co-operations are deemed to trigger innovations (ASHEIM & GERTLER 2007; Boschma 2005; BOUFADEN & PLUNKET 2008; FELDMAN 1994; KIRAT & LUNG YANNICK 1999; OERLEMANS ET AL. 2001) they can make a valuable contribution to a firm's and region's economic performance. A deeper understanding about these processes would offer the chance to support and design co-operative structures in regions actively. Facing increasing globalized competition, today firms need a strong and supportive environment that helps them, at least, not to lose touch in their field and maybe to leapfrog their competitors by product or process innovations.

After the German Reunification in 1990 the Neue Länder faced the challenges of economic restructuring in a phase of increasing global competition. Therefore, the Neue Länder were supported by a number of government programmes (beginning in 1999) aiming at the development of sustainable network structures in regions and the support of innovative ideas in firms and research institutes to create jobs and economic development.

In our paper we evaluated one of these programmes namely "Innovationsforen". The programme aims to initiate co-operations for an innovation between local actors. Thus, it tries to develop sustainable and self-feeding network structures in regions to enable future innovations. Concerning its programmatic conceptualisation "Innovationsforen" considers the importance of spatial proximity in two ways. On the one hand it supports regional network initiatives and local co-operation structures. On the other hand it forces personal interaction between the network members at the beginning of a collaborative network development, which requires spatial closeness to observe and interact. Thus, the programme refers to the basic idea of temporal geographical proximity as a trigger for knowledge transmission and construction of trust (Torré 2008).

There are already a few studies about the influence of proximity or distance respectively on working groups aiming at innovations and they find the role of spatial proximity twofold: At the beginning high closeness is needed to interact face-to-face and to build up professional and personal relationships (see also DUTTON ET AL. 1996; HININGS & GREENWOOD 1996; HUNT ET AL. 1996; KRAUT ET AL. 1988; NARDI & WHITTAKER 2002) and to develop a common idea and strategy. In the performing phase of an invention, spatial proximity helps to meet regularly and to reduce organizational hurdles (see also CUMMINGS & KIESLER 2007; KIESLER & CUMMINGS 2002; KRAUT ET AL. 2002; OLSON ET AL. 2002).

We studied the development of 15 innovation networks spanning a time period of up to ten years. The fact that they had a guided and consulted start due to a public programme gave the unique chance to get systematic insights in the underlying processes at the beginning of a regional network formation for innovations. The definition and measurement of specific network characteristics, representing among others social processes between the network members, gave the opportunity to

analyse the importance and influence of personal relationships aside the professional level. Studies about research collaborations for innovations show especially that the social processes between partners are very influential on later success and failure in projects (Argyle &Henderson 1985; Hinings & Greenwood 1996; Dutton et al. 1996; Gersick et al. 2000; Guirdham 2002). Today, an established way to analyse co-operations for innovation is to use patent or bibliometric data and to define and compare attributes and artificial categories. With this method studies could show the importance of different types of proximity, especially social proximity (e.g. Ter Val 2009; Boschma 1999; Agrawal et al. 2006). However, only qualitative methods can give insights on how these social processes function, because databases do not include social information about the partners (degree of friendship, trust etc.). In our study we used document analysis, interviews and, after a codification process, multivariate analysis methods in order to get a better understanding of the importance of the social level between the collaborating partners and at this, the role of spatial proximity in different degrees.

Therefore, the paper starts with an introduction of the programme "Innovationsforen" and a description of the object of study: young network alliances for innovation. Then, a conceptual section introducing the existing literature on the role of spatial proximity in collaborative innovation networks follows. Here, we focus on the starting stage of a network development process, where underlying social processes and in the end the successful construction of personal relationships are very influential for later structures and success. Based on the literature, we deduce our hypotheses. The third section gives an overview about the database we created for that study and the methods we used to analyse the starting stage of the studied networks in terms of specific characteristics and their relationship to later structures and processes in the networks. As mentioned above, the question about the role of spatial proximity in these processes always guides the study. Finally we present and discuss our results.

2 The object of study: "Innovationsforen" and young network alliances

The following section gives basic information about the programme and the studied network alliances to explain the setting, motives and tools influencing the network development specifically. This is needed, because the development of the studied networks was influenced from the beginning by programmatic issues of a public funding initiative, by their specific regional contexts in the Neue Länder and first of all by their preliminary aim to generate innovations with local partners. Thus, the study reflects political network practice and gives insights in the short and long-term effects of early public funding in innovation networks with a focus on spatial and social aspects underlying the network development.

The public funding programme "Innovationsforen"

The programme “Innovationsforen” was originally a part of a bigger programme family named “InnoRegio” that supported network alliances in the Neue Länder (former GDR), who applied with a convincing idea for an innovation and a regional network concept to realize it. Despite a good basement of firms, a developed administrative and educative infrastructure and a tremendous amount of German and European funding, the Neue Länder had a huge backlog of innovations and thus a relatively weak economic performance. One reason were missing connections and linking units between the actors due to the radical economic change after the German Reunification. The programme “InnoRegio” aimed to trigger self-feeding and innovative network structures by consulting and funding young network alliances and to support the creation of unique economic profiles in the regions of the Neue Länder. It followed the idea that only co-operations and information exchange between the actors can lead to innovations. The mechanisms behind are new knowledge creation and improved access to resources for small and medium sized firms in the Neue Länder. “Innovationsforen”, the programme evaluated in this paper, was originally the first programmatic phase the chosen networks had to pass in their development. Later it became an independent programme of the BMBF (Federal ministry for education and research, Germany) and as such we evaluate it.

“Innovationsforen” started in 2000 (ongoing) and supported until 2010 more than 100 innovative network alliances. Like mentioned for “InnoRegion”, regional actors from the Neue Länder have to apply successfully with a network concept and an idea for an innovation project to get funded. “Innovationsforen” helps young alliances in their first six months to organize their own topic-related conference (“Forum”) where they get in touch with other firms, experts and consultants. Additionally, it finances market analyses, workshops and meetings for the network members to get in touch personally and find common goals. The funded networks have to write an application, organize the mentioned meetings, have to document their development and after six month they have to write a final report. “Innovationsforen” funds, consults and guides the networks in each of the phases and has got a maximum budget of 85,000 Euro for each network. Despite the limited budget and the short funding period of six month in relation to the long-term perspective of decades the networks are supposed to exist, “Innovationsforen” has got a very positive and long-lasting influence on the development of networks. With the help of geographical and social-psychological literature, we will give conceptual explanations for the strong impact of the programme, but before that it is worth to look at the characteristics of the study’s objects: the network alliances.

The characteristics of regional innovation networks

The funded networks are regional alliances from very different industries in the Neue Länder. Basically, all innovative ideas in combination with a regional network strategy can apply for the “Innovationsforen”-funding. For the study, the resulting problem of heterogeneity was reduced by defining six types of network developments concerning the point in time projects in the networks started. The reason is that not all networks were just funded by “Innovationsforen”. Some networks

got funding from different programmes before and/or after “Innovationsforen”; which influenced their development. Table 1 gives an overview of the categories.

TABLE 1: CATEGORIES OF NETWORK DEVELOPMENT

Type		Definition
Type of network development	InnoForen impulse	Networks, whose development was triggered by the funding of “Innovationsforen”.
	Mixed impulse	Networks, whose development was triggered by the funding of “Innovationsforen” and an additional funding.
	Pre-existing impulse	Networks, whose development started clearly before the „Innovationsforen“- funding.
	Post existing impulse	Networks, whose development started due to another events after the „Innovationsforen“- funding.
	Pre- and post existing impulse	Network, whose development was triggered or strengthened due to other events before and after the „Innovationsforen“-funding.
	No impulse	Networks without projects and thus without a development as defined above.

Another influencing factor on the network development is the long lasting and regional perspective they have. The reason is that “Innovationsforen” (among other public programmes) aims to create unique economic profiles in the regions of the Neue Länder to raise their competiveness. The funded networks are a starting point into the creation of these profiles. That often causes the young network alliances to apply with regional topics and a regional core of members (basic network). In some cases the networks are still influenced by the economic structures of the former GDR and in some cases the application stands for a completely new start. Hence, aside the innovation project, the funded networks are supposed to create long-lasting and self-feeding regional connections between firms, R&D units, political actors and other. The “Innovationsforen” networks are one step in a catch-up process of the Neue Länder concerning functional partner structures in regions.

But nevertheless, in a short term perspective the funded networks have the prior aim to innovate, what influences the formation process and partner choices a lot. The reason is that innovation projects are unpredictable concerning their result und therefore risky. They are expensive and they can take many years. A frequent face-to-face contact between the team members is needed over a long time period to trigger common learning processes whereby individual’s knowledge is combined to something new (Bathelt et al. 2004; Kirat and Lung 1999; Lazonick 2006; Nooteboom 2002). Myers and Marquis said, it is “…a complex activity which proceeds from conceptualisation of a new idea to a solution of the problem…” (Myers and Marquis 1969 as cited in West and Farr 1996). To enable frequent contacts face to face, lot of resources from each network member is required in terms of time, organizational and financial efforts. The higher the distance between members and the more complex the common activity is the higher are the required resources. Especially for small and medium sized enterprises (SME), being the biggest group of actors in the studied networks, this is an important point.

Aside the organizational and resource related aspects, innovation networks require trustful and intact relationships between the network members. Innovations help firms at least not to lose touch in their field and maybe to leapfrog their competitors. Thus, the members of innovation networks have to be sure that no opportunistic behaviour will occur between the partners, namely they have to trust each other. To analyse the competitiveness between the partners we defined different degrees of competition in the studied networks (see table 2). Network competitiveness is given, if firms are economic competitors, but share the same network.

TABLE 2: DEGREES OF COMPETITION BETWEEN NETWORK MEMBERS

Type of competition
Complementary Network
Competitive firms that contribute complementarily in the network
Network with competitive firms

The innovating networks in our study are, concerning their relationships, comparable with teams at work or precisely research teams with different contexts. Studies in social- psychology revealed that members of working teams need similar interests and skills (Hinings & Greenwood 1996) and agreement about goals, norms and values (Guirdham 2002) to be able to work and learn together. Kraut et al. (1987) summarize, that the "... establishment and maintenance of a personal relationship is the glue that holds together the pieces of a collaborative research effort. Often it is at least as important as the content itself." (Kraut et al. 1987, p. 53) Argyle & Henderson (1985) found that "… under the right conditions, for example small and cohesive groups, work relationships are a very powerful source of satisfaction and support." (Argyle & Henderson 1985, p. 241) On the one hand, this has to hold for the professional level, meaning that there has to be the conviction that the membership in the network leads to better results than one could receive on its own. On the other hand, it is important on the personal level, too. Due to the challenges that common innovation activities bring along it is quite important that a supportive effect occurs between the network members. It motivates and minimizes stress. Furthermore, team members sharing work relationship being close to a friendship leads to the best results (Argyle 1991). Because they are a mediate between market and hierarchy and base on a certain level of voluntariness, another aspect is important for networks. In contrary to work relationships in a firm or institute, work relationships in networks can be given up. If there is no match to other members of the network, it is likely that individuals leave the network because of missing satisfaction and support. Joining the studied networks is for most of the members an additional activity to the job they already have. Very often the members are heads of a SME or a R&D unit and that increases the importance that the membership in the network is personally and occupationally fruitful, satisfying and brings no additional stress. It is very important for the networks to have motivated members and this is strongly influenced by the constitution phase of a network as the next chapter will show.

3 The role of spatial proximity in collaborative innovation networks

As mentioned above, one of the main characteristics of networks is the voluntariness the members engage with. Especially, when it comes to innovation, trust, valuable results and a supportive environment has to emerge between the team members. Very often in the literature of economic geography these aspects are traded like stable features that a network (or cluster) have got or not. But the development of trust and a collaborative and supportive environment enabling learning processes is quite a complex process and happens at the beginning of a network formation (constitution phase). Getting in touch face-to-face at least for a limited amount of time is an indispensable requirement in immature co-operation stages, because among professional issues the social/personal elements of collaborative relationships can be built up (Dettmann & Brenner 2010; Gersick et al. 2000; Kraut et al. 1987). The following section, that is a short excurse into the literature of social-psychology, gives important insights into these processes.

Referring to a concept by Tuckman (1965), every team passes four stages before they can work effectively. In the *forming stage*, the network members get in touch with each other and get information about the partners concerning their personality (communication patterns, sympathy, humour etc.) and their professional profile (skills, quality aspiration, motivations, firm or institution they present etc.) (Guirdham 2002; Tuckman 1965). In the forming phase of a collaborative relationship spatial proximity is important because it enables face-to-face meetings of persons. These meetings trigger the identifying process of each other's professional and personal profiles and define the starting point of a collaborative relationship. Even if people had information about the other one before (third persons talked about them, reading the other one's paper, etc.), only face-to-face contact and observation can transfer non-verbal information that is required to get a complete picture of the other one's profiles (Rüggenberg 2007). This leads to the requirement of being in the same place. The effects of getting to know each other are even stronger, if the members meet in different contexts, e.g. in professional events like fairs or workshops and social events like joint dinners etc. In the *storming stage* the team members first of all pursue they own interests. They negotiate about the methods, goals, roles and tasks of the project and want to make sure that their interests (or their firm's interests) are kept. In that stage individuals are willing to leave the network, if no solutions and compromises are possible (Guirdham 2002; Tuckman 1965). In the storming stage spatial proximity is in the same way important as in the forming stage. The reason is that people do not know each other very well, because neither the social information nor the professional information about the partner is complete. This increases the danger of misunderstandings and disappointments and occupationally the danger of misjudgement about the partner's professional skills or goals. Therefore, the opportunity of frequent interaction and the exchange of non-verbal communication must be given. This is only possible in high closeness enabling observation and face-to-face communication. Case studies about professional collaborative relationships gave strong advice that the storming stage usually takes place in the same context as the forming stage. Hence, we assume that the loss of spatial proximity before confidence about the partner's appropriateness

has developed leads to an exit of the network. In the *norming stage* a group feeling and cohesion develops. Usually, an open exchange of feelings and inner openness to other group members occurs (Guirdham 2002; Tuckman 1965). From now on, face-to-face communication can be replaced by other forms like calling or mailing. This is reasoned on the one hand by the development of norms and rules in the communication procedures between the partners. On the other hand, due to the forming and storming stage partners became more predictable what minimizes misunderstandings. But nevertheless, the opportunity of regular meetings should be kept, because the more often network members can change information the less details get lost and problems reveal in early projects stages (Kraut et al. 1988). Furthermore, the group cohesion is supported the more often members can meet. Especially, for networks of SME high organizational and financial efforts for meetings are hard to realize.

In the *performing stage* the issue of resources becomes even more important. The performing stage is supposed to be the longest stage of collaboration, when partners realise the project in their particular functions and roles (Guirdham 2002; Tuckman 1965). Thus, the cost factor of meetings becomes important. The longer it takes to meet the partner(s) the more organizational effort and resources are required to work on a joint project. This often lengthens projects and even if collaboration does not fail automatically because of missing high closeness, these collaborations are more difficult and resource consuming than collaborations done in close spatial proximity like being in the same office or building. But at least regular meetings between the team members should be possible, because innovation needs interaction.

In the literature of economic geography these processes were expressed in terms of different types of proximity (Boschma 2005). The fit of the professional relationships is linked to the term of cognitive proximity; the fit of the personal relationship is named social proximity being strongly linked to spatial proximity. The reason is explained by Tuckman's model. Spatial proximity is basically defined as the physical distance in units of length, or to get a more realistic picture of distance between people, it is measured in time units of how long it takes to reach somebody for a face-to-face contact (Frenken et al. 2009). Tuckman's model showed that in collaborative networks for innovation two main stages are passed: the constitution (forming, storming and norming) and the performance of an innovation network. These stages require different degrees of spatial proximity due to the different importance of personal relationships and issues in these stages. Hence, the constitution stage requires observing and interacting, which is only possible in a very close type of spatial proximity, like being in the same room or floor. Concerning the conceptual derivation, the performing stage allows lower degrees of proximity between the innovating network partners. The "Innovationsforen" programme, we studied in our paper, is funding workshops, meetings, a forum and social events for the network alliances in the constitution stage. Referring to the need of high closeness between the partners to interact and observe in that stage, the programme should have a positive influence on the network formation process. To analyse and explain the programme's impact we designed a research framework introduced in chapter 4.

Referring to the conceptual insights from economic geography and social psychology four hypotheses guide the study:

H1: The network characteristics develop positively in the funding stage due to the impact of the "Innovationsforen" programme.

H2: The "Innovationsforen" programme supports characteristics that refer to the social processes deeming to be important in the constitution stage of a network.

H3: Because of the limited financial and personnel resources in SME-dominated networks, they do not extend the regional level concerning their partner structure.

H4: The development of the network characteristics during the funding has a positive impact on later network characteristics.

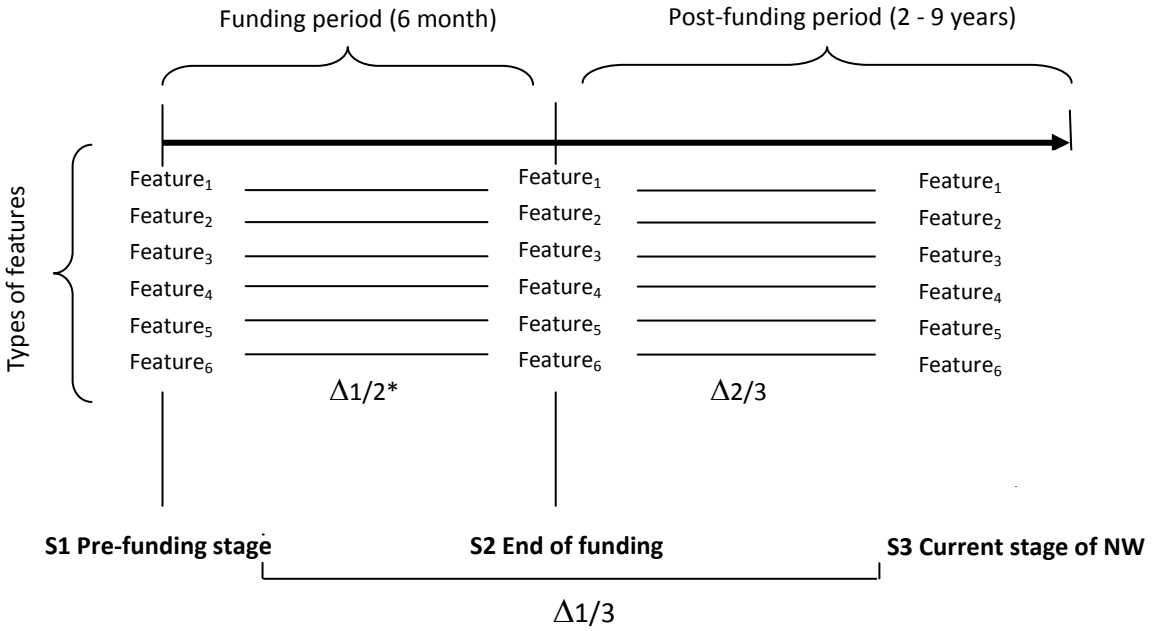
4 Methods and Database

The heterogeneity of the studied groups courses three main challenges for the research concept. The first is that a lot of time is passing by between the funding in an early network stage and later success after a long innovation process. Thus, the concept has to ensure that a distinction between the funding effects and later events in the network is possible. The second challenge is the heterogeneity between the innovation projects because of the different industry they stem from or serve. The projects are different in the requirements concerning resources, know-how, customer needs, the different size of the markets they aim at etc. Hence, different motivations and development strategies mould the network development. The concept has to find criteria to compare these networks in basic characteristics without losing too much of their uniqueness. The third challenge is the different age of the studied networks. Some networks were quite young and they were funded recently by "Innovationsforen", others were more than nine years old when we evaluated them. Hence, the networks are studied in different development stages and the funding effects are present to different degrees.
To face these challenges conceptually, a combination of qualitative and quantitative research methods was used for the research concept.

Research concept
The main idea of the research concept is, to identify network features underlying all funded innovation networks in our study and to compare them in different points in time – no matter how different the networks are in kind, aim and development. With the help of existing studies and literature on network development and management (ENDRES 2001; KING 1996; MÜLLER ET AL. 2002; SYDOW 2001) we defined six network features assuming that the more developed these features are,

the more successful a network is. Successful in our sense means, that the networks are able to generate and perform projects to realize their innovative idea and, in a long-term perspective, to create self-feeding partner structures in and beyond their region. Measuring these features before and after the funding and today gives insights in the strength and timing of the network's development and additionally into the impact of the funding programme. Figure 1 gives an overview about the research concept.

FIGURE 1: THE RESEARCH CONCEPT



** Describes the change of the features due to the public network funding.*

The six features measured in our study are: *co-operation* between network partners, *communication and information* exchange in the network, *coordination* of the network, the development of a common *identity*, *documentation and reflection* activities in the network and a goal-fitting *structure*.

- [Coop] Co-operation means, that projects between the network partners started, trust occurs and that members make the contributions they agreed on.
- [IaC] Communication and information includes that general goals and roles are defined. Furthermore, it includes the existence of a development strategy for the network.
- [Coor] Coordination refers to the network management. It is supposed to be one of the most important units in the network and has to be implemented, has to have a long-term perspective, has to organize network meetings and has to call for the contributions.
- [Doc] Documentation and reflection describes how often and regular the network partners reflect their own development. That implicates the network is managed and has the ability to react on events in and beyond the network.
- [Ident] Identity refers to the network member's cohesiveness between each other and concerning the network. This includes a common regional background (culture), the

importance of the network success for the members, a common logo and formal network manifestation in an association or company.

- [Str] The last features is the structure reflecting the share of regional members in the network, the amount of network members, whether it is judged complete and whether it could acquire best partner options.

Two of these features, co-operation and identity, refer directly to the social processes underlying a network development. Measuring the development of the different features and their impact on the other features will provide insights into their importance in a network forming process.

Aside this basic structure of measuring six features for each network in three points in time, we decided to create a research framework that gains results on three levels of analysis. The *first level* is the network level, where data about each network is qualitatively collected and evaluated. These results show the unique development of each network case and will give deep insights in the development process considering the specific kind, goals and situation of each network. The *second level* is descriptive analysis, where we look for relationships between the studied networks. These results hold for the evaluated networks, but cannot be generalized. Therefore, a *third level* of analysis is designed. With the help of multivariate analysis methods we will look for general results about the development of public founded networks.

To serve the described three levels of analysis with data, we used different types of data sources and different methods to prepare the data for qualitative, descriptive and multivariate analysis. The following section describes the sources and methods.

Database

For each of the three levels of analysis we had to measure the six network features for every network case and had to codify them into numbers. Unfortunately, it is not possible to measure features like co-operation, identity etc. directly with database or interviews. Thus, the first step was to create *measurable variables* that in combination result in each of the features. The definition of the features given above also includes the different variables we developed. On the basis of these variables we created a catalogue that explicitly defines for each feature which variable it consists of and under which circumstances the variable gets a certain degree. Figure A.2 in the appendix shows an excerpt of the catalogue for the feature ‘information and communication’. With the help of a number of observable variables we can project each feature on an interpolated scale from zero to one for each studied network case.

The data for the study is gained from three different sources for the three points in time in which the development of the network features studied:

- Stage 1 (pre-funding): Document analysis (applications of the networks for the funding)
- Stage 2 (end of funding): Document analysis (final reports of the networks after the funding)
- Stage 3 (current state): Telephone interviews with network managers

For the pre-founding stage (S1, see Figure 1) the network's applications for the public funding were analyzed. These documents contain information about the network manager, partner options, the innovative project including schedule, strategy and resources, a regional network strategy and many more. This information is required for applying for funding and ensures that an analysis of these documents provides a quite complete picture of all studied networks in the pre-funding stage. Hence, with the help of the catalogue the variables for the first stage could be measured with the information given in the application documents. For the stage *after the funding* (S2) we analyzed the final reports of the networks about their development during the funding, expected perspectives and long-term goals. Again, these documents had to include specific information defined by the public funding programme, thus the document analysis provided similar information about each network after the funding (like a concrete strategy to realize the innovation project, the acquired network partners and their roles, identified markets and a long-term strategy for the regional network development). The third data source is telephone interviews with the network manager of every studied case. These interviews were done semi-guided and delivered data about the *current degree of the variables* (S3), categorical information, network output and the chronology of network development in terms of milestones and upheavals. Additionally, the interviews completed information that the document analysis could not deliver, first of all statements about the social processes in the network development.

Methods

Qualitative analysis

The qualitative analysis is supposed to display the unique development of each network for the three points in time. It considers the specific kind, goals and situations of each network to get deep insights in the required circumstances under which the different network features developed over time. Furthermore, it delivers specific information about the network output, importance of consulting by the programme promoters and a personal chronology by the network manager aside the development we modelled on the basis of the feature's development. On the basis of the variable catalogue, we categorized information from the three databases described above and finally codified them into the numbers zero, one and two (representing the degree each variable can have). For each feature the belonging variables were summed up and interpolated on a zero to one scale in a spider network graph. For each network an own chronology, spider network graph and specific graph description was compiled to analyse the development of the six network features considering the specifics of each network case.

Descriptive analysis

The descriptive analysis delivers information about the group of studied networks in terms of categories. Different aspects, like the importance of consulting during the funding, degree of competition between the network partners, size of the network core, receive of additional funding, network type and type of development, were measured with specific questions in the interview and partly with the codified information gained in the qualitative analysis. The descriptive analysis gives

important side information about commonalities in the network's characteristics and the importance of the funding programme.

Multivariate research methods

With the help of multivariate research methods (here: regressions and t-tests), we tried to generate results that are generally valid. These insights could give indices for the importance of specific network characteristics and processes in the network development in general. In our study we analysed the following relationships:

- Calculation of the network feature's change over different periods of time (t-test)
- Calculation of the current network features due to different variables (regression)
- Calculation of the relationship between network features in the pre-funding stage and development in the funding period (regression)
- Calculation between the relationship between the development of the network features and the post- funding period (regression)

All regression models include a dummy for the network age and a dummy for additional funding.

For our study we evaluated 15 network initiatives and table 3 gives an overview about the diversification concerning the year of funding in the studied group:

TABLE 3: YEARS OF FUNDING IN THE STUDIED GROUP

Year of funding	Total
2001	4
2002	0
2003	0
2004	1
2005	0
2006	1
2007	3
2008	4
2009	2

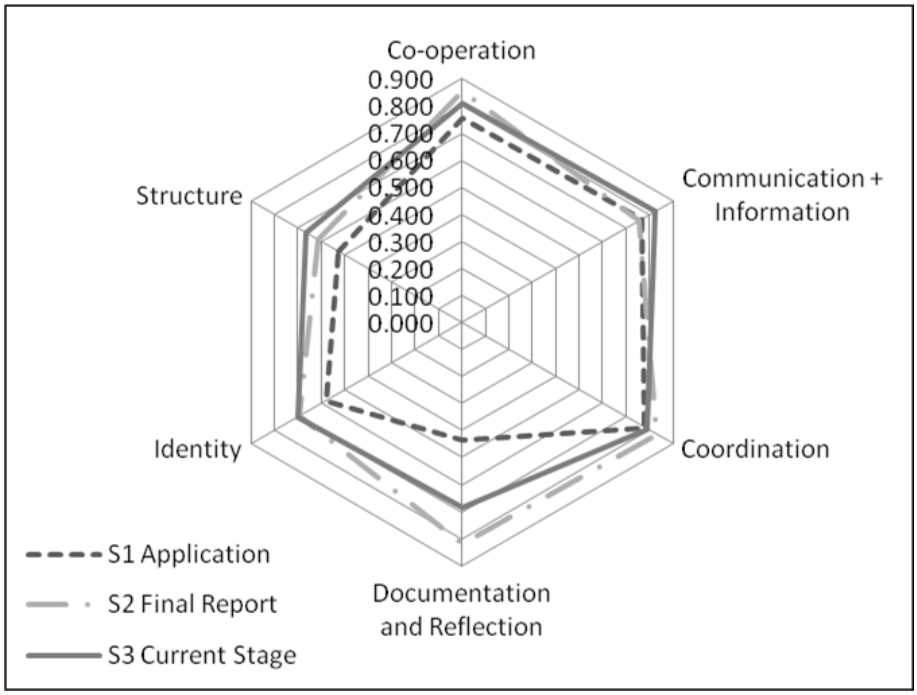
5 Development of innovative networks and impact of public funding

The following chapter presents the results we got on the three level of analysis and answers the hypotheses. Due to the limited space of a paper, the qualitative results of the network developments are not separately discussed. An overall spider network graph (see figure 3) representing the average of all unique network developments (graphs) was generated and allows discussing the most important developments, features and the impact of public funding in a summarized way. Of course, that summarized presentation is completed by information of single network cases when needed. The qualitative data is completed by descriptive statistics and the results of the multivariate analyses.

Network development and the impact of public funding

In chapter two we deduced the hypothesis that "t*he network characteristics develop positively in the funding stage due to the impact of the "Innovationsforen" programme."* A spider network diagram representing the average of the six features from all network cases in three points in time shows a positive development in five of six features during the funding period (period from S1 to S2). The funding seems to have no impact only on 'Communication and Information'.

FIGURE 3: AVERAGE DEVELOPMENT OF THE FEATURES OF ALL NETWORKS



The descriptive statistics show (table 4) that in nine of 15 network cases the network development started with the "Innovationsforen" funding and in two cases the funding worked in combination with an additional funding as a trigger (mixed impulse).

TABLE 4: NUMBER OF NETWORK CASES BY TYPE OF NETWORK DEVELOPMENT

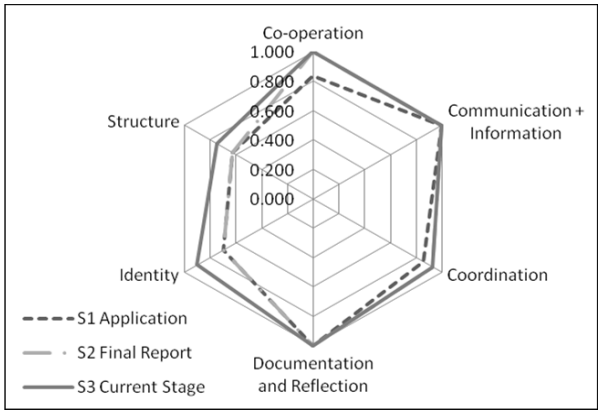
Type of network development	Number
InnoForen impulse	9
Mixed impulse	2
Pre-existing impulse	1
Post existing impulse	1
Pre- and post existing impulse	1
No impulse	1
Total	*15*

Looking at the question, whether the "Innovationsforen" funding aiming to support young network alliances has also an impact on developed networks, we got the following insights. Some of the network alliances we evaluated had a development trigger before they got the "Innovationsforen" funding (pre-existing impulse). The spider network graphs show for two cases that the impact of the

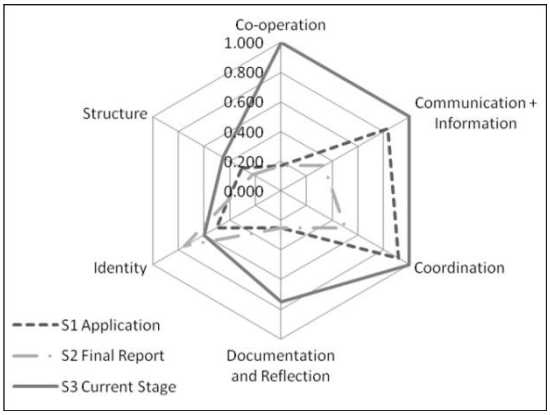
funding on more mature networks is lower than on young network alliances. Either there is no increase between stage 1 and stage 2 (Figure 4a) or even a decrease (Figure 4b).

FIGURE 4: SPIDER NETWORK GRAPH FOR A) AN PRE-EXISTING IMPULSE AND B) A PRE- AND POST EXISTING IMPULSE

a)



b)



The results we got from the multivariate analyses strengthen the qualitative data. Table 5 shows that in the funding period three of six features increase significantly. Especially, the features representing the underlying social processes in a network formation are affected by the "Innovationsforen" funding. This is reasoned by the programmatic concept forcing frequent face-to-face interactions of the network members because of workshops, meetings, the forum etc. As mentioned in the conceptual part of the paper, the network members can identify their personal and professional profiles and can pass the forming and storming stage due to that high closeness. How important these processes are for the later network development is analysed in the next section. Forming and Storming are processes in small groups that happen at the beginning of a network forming process, which explains the strong positive influence of the funding programme on younger network alliances relatively to more mature ones.

TABLE 5: T-TEST FOR A CHANGE OF THE NETWORK FEATURES IN THE FUNDING PERIOD (S1 TO S2)

Feature	Coop	IaC	Coor	Doc	Ident	Str
P-value	0.029 *	0.848	0.239	0.000 ***	0.009 **	0.134

0 *** 0.001 ** 0.01 * 0.05 . 0.1 1

Hence, hypothesis 1 stating that the network characteristics develop positively in the funding stage, can be confirmed.

The next step is to study whether this development during the founding phase depends on the state that a network had already reached before funding (see table 6). Conducting regressions we find significant results only for two the developments of two features: documentation and reflection and structure. The development of the documentation and reflection activities in the funding period is negatively related the documentation and reflection activities before the funding. This means, the more they are developed before the funding, the less they develop during the funding. The development of the network structure during the funding is positively influenced by developed co-

operation and coordination activities in the pre-funding stage. This means, concerning the structure development a functional network management and some experience between the network members before the funding have a positive effect. Hence, the funding should meet potentials to have effects; a funding of networks on point zero is less effective.

TABLE 6: DEVELOPMENT OF FEATURES DURING THE FUNDING DUE THE FEATURES IN THE PRE-FUNDING STAGE (Regression with individually significant features)

Development of 'documentation and reflection'						
Feature (S1)	Coop (S1)	IaC (S1)	Coor (S1)	Doc (S1)	Ident (S1)	Str (S1)
Estimate				-0.5494		
P-value				0.0645 .		
Development of 'structure'						
Estimate	0.22959		0.33499			
P-value	0.0219 *		0.0718 .			

0 *** 0.001 ** 0.01 * 0.05 . 0.1 1

Long-term effects of public funding in networks

In Hypothesis 4 we stated that "*the development of the network characteristics during the funding has got a positive influence on later network characteristics".* Thus, the early network funding should have long-lasting effects in the network. Our analyses support this only partly.

Beginning again with the qualitative data (see Figure 3) a very mixed picture occurs. The positive development of the networks during the funding period does hardly continue in the post-funding period. Only 'communication and information', 'structure' and 'identity' increase, 'co-operation', 'coordination' and 'documentation' decrease. Checking the significance of the changes (Table 7) leads to the finding that the increase in 'identity' is slightly (10%-significance level) significant and the decrease in 'documentation' is significant. This might be positively interpreted by arguing that the developments triggered by the funding are sustainable, because they do not disappear afterwards. One might also argue that the initial development in the funding phase does not seem to trigger further developments later on.

TABLE 7: T-TEST FOR CHANGE OF THE NETWORK FEATURES IN THE POST-FUNDING PERIOD (S2 TO S3)

Feature	Coop	IaC	Coor	Doc	Ident	Str
P-value	0.217	0.487	0.928	0.017 *	0.058 .	0.099

0 *** 0.001 ** 0.01 * 0.05 . 0.1 1

However, the in-depth interviews show that the above finding needs some qualification. A first hint that the above picture does not represent the complete story is found in the number of network members (see table 8). Further evidence comes from statements from the interviews about the positive network output.

TABLE 8: THE AVERAGE CHANGE OF THE NUMBER OF NETWORK MEMBERS

Period	Average Change of Network Members
Stage 1 to 2	5

Stage 2 to 3	8
Stage 1 to 3	16

Therefore, we take a more detailed look at the developments in the post-funding period. Due to the different ages of the evaluated networks in our study, the post-funding period covers a period between two and nine years. We use the developments in this post-funding period as dependent variable in regressions using the developments in the funding phase as independent variables. The significant results are presented in table 9.

Table 9 shows that the development of the identity in the funding period has got a positive influence on 'information and communication' activities and the network 'structure' (see discussion next section). A negative influence on the development of 'information and communication', 'coordination', 'identity' and 'structure' in the post-funding period has got the length of the network development (T). This means that the more mature a network becomes the worse its network features develop. The negative impact of the length of the network development occurs in later regressions, too. An explanation is given at the end of this section.

TABLE 9: CHANGE OF NETWORK FEATURES IN THE POST-FUNDING PERIOD DUE TO THE CHANGE OF FEATURES IN THE FUNDING PERIOD (Regression with individually significant features and T) [1]

Independent variables	D12_Coop	D12_IaC	D12_Coor	D12_Doc	D12_Ident	D12_Str	T
Change of Information and Communication							
Estimate					0.79410		-0.06285
P-value					0.091 .		0.048 *
Change of Coordination							
Estimate			0.15773		0.64868		-0.06405
P-value			0.793		0.205		0.063 .
Change of Identity							
Estimate	-0.04111	0.19637			0.11274	0.78787	-0.03594
P-value	0.8341	0.3611			0.7032	0.1518	0.0528 .
Change of Structure							
Estimate					0.52700		-0.03962
P-value					0.0950 .		0.0613 .

0 *** 0.001 ** 0.01 * 0.05 . 0.1 1

The last analysis about the long-term effects of public-funding in innovation networks is to check the relationship between the feature's development in the current stage and former processes and development of the features. Table 11 presents three main results. Firstly, the development of 'identity' in the pre-founding stage has a positive impact on the development of every network feature today. That means that an early cohesiveness between the network member and concerning

[1] Abbreviations for multivariate analysis tables:

T: Length of network development (S1 to S3, two to nine years)

dFu: Dummy for additional funding

D12: funding period (S1 to S2)

D23: post-funding period (S2 to S3)

the network occurs as the most influential characteristic for later network development (see discussion next section).

Additional funding has got a slight positive impact on four of six network features. There could be two reasons for that result: either the additional funding itself is a positive trigger for network features today or first of all networks with a lot of potential were chosen for another funding and that tendency was proofed to be true. Table 10 gives an overview about the numbers of networks that got additional funding; most of them were networks with an "Innoforen" impulse.

TABLE 10: NUMBER OF NETWORKS WITH ADDITIONAL FUNDING

Point in time of additional funding concerning the „Innovationsforen" funding	Number	... share of networks with „InnoForen" impulse
Pre-funding	1	0
Post funding	10	7
Pre- and post funding	0	0
No additional funding	4	2
Total	*15*	*9*

The development of 'cooperation' during the funding period has a slightly negative impact on the features today. Additionally, we again found a negative impact of the length of the network development (T).

TABLE 11: CURRENT STAGE OF THE FEATURES DUE TO FORMER STAGES AND DEVELOPMENTS (Regression with individually significant features, T and dFu)

Independent variables	Coop (S1)	IaC (S1)	Coor (S1)	Doc (S1)	Ident (S1)	Str (S1)	D12_Coop	dFu	T
Co-operation									
Estimate		0.35082	-0.59534		1.21087		-0.55702		-0.09161
P-value		0.08170 .	0.14639		0.00239 **		0.18191	0.12540	0.00108 **
Information and Communication									
Estimate	0.31466		-0.27071		1.36155		-0.57531	0.09203	-0.07810
P-value	0.13707		0.42971		0.00241 **		0.05936 .	0.35144	0.00248 **
Coordination									
Estimate	0.37812		-0.63196		1.27497		-0.60210	0.18827	-0.08414
P-value	0.39596		0.33345		0.00986 **		0.41027	0.09645 .	0.00500 **
Documentation									
Estimate	-0.07911			0.20148	1.16038		0.15664	0.25075	-0.07579
P-value	0.77564			0.60742	0.01363 *		0.55619	0.06777 .	0.00221 **
Identity									
Estimate	0.04171		-0.21440		1.28972	0.25660	0.35569	0.20547	-0.08356
P-value	0.8938		0.7617		0.0902 .	0.7900	0.5029	0.0867 .	0.0120 *
Structure									
Estimate	0.06126	0.35642	-0.19035		1.20950		-0.20564	-0.07848	0.19885
P-value	0.8297	0.1780	0.7724		0.0426 *		0.7883	0.0272 *	0.0669 .

0 *** 0.001 ** 0.01 * 0.05 . 0.1 1

The phenomenon that the more time between funding and current stage is the worse the features become occurred in former regressions, as well. As mentioned above, the qualitative data show a similar picture, but referring to the interview statements about network development, growth and output that negative impact of time is quite irritating. After a careful analysis of additional interview statements about the network development and research on network literature, we found an explanation for the phenomenon. During the development process of the networks a restructuring process starts triggered by the increase in network members, the raise of different projects ('co-operation') and probably by additional funding programmes. The process is the development of different sub-networks or clusters representing the different project and research groups of an innovation network (this process is reflected by the positive development of 'co-operation'). In stage one and two, when the networks were small, it was possible to measure the features on the whole network level by interviewing the network manager. But the more a network splits into different sub-networks the less adequately the features can be measured on the general level. The more projects, the more members and the more re-structuring processes due to additional funding occurred in the network the more common activity shifted into the sub-networks beyond our level of measurement. The only chance to capture the features in their current stage completely is to make interviews with all project managers in the sub-networks and to sum them up. Not to capture all network processes in the current stage appears in our study as a decrease of the network activity and thus as a decline of the network features. The development of 'co-operation' representing an increase of projects appears with a negative impact on some features, because it strengthens the re-structuring process. The length of the network development seems to have a negative impact too, because the longer a network develops the more the re-structuring process continues and the less we can measure the features.

Social processes in the network development – Just a side effect?

The importance of underlying social processes between the members of a developing network was discussed conceptually in chapter two. The data presented in the this section will proof the impact of intact social processes on a positive network development and answers hypotheses two stating that *"the 'Innovationsforen' programme supports characteristics that refer to the social processes deeming to be important in the constitution stage of a network."*

Table 5 showed that from three significantly affected features by the funding programme two represent the underlying social processes: 'co-operation' and 'identity'. These features include among others aspects like a common regional culture, elements of trust, the performance of common projects and thus co-operative behaviour in general. The funding programme first of all affects these features because its programmatic concept forces the network members to interact face-to-face frequently due to the required workshops, meetings and the forum. As mentioned in chapter two, that strong spatial proximity during the meetings allows the network members to observe and interact with each other. Finally, they can judge, whether a membership in the network could be satisfying due to the personal profiles of the other members. Additionally, the meetings

required by the “Innovationsforen” programme offer the chance to meet in different professional contexts. That helps members to judge about the complementarities with other members concerning goals, norms, rules, methods and skills. Hence, the six month of funding supports the development of a group that is supposed to have fewer conflicts personally and contextually. This is first of all represented in the increase of ‘co-operation’ and ‘identity’.
Table 12 shows that this is an important aspect to avoid conflicts in the networks. Most of the networks have got members that are complementary actors in the economy.

TABLE 12: COMPETITORS IN THE NETWORKS

Type of network competitiveness	Number
No competitors in the network	8
Competitors, but complementary in field of the network	3
Network with competitors	2
Network does not exist anymore	2
Total	*15*

The hypothesis, that “Innovationsforen” supports first of all the social features can be confirmed and that an early development of these social features has got a positive impact on the later development was proofed in the last section (table 11). ‘Identity’ in the pre-funding stage has got a positive impact on almost all network features today and its development in the funding stage affects the network structure and information and communication activities in the post-funding stage. The development of ‘co-operation’ in the funding period triggers the re-structuring process of the network into sub-networks, where the performing of projects in terms of co-operation and communication processes can be much more effective.

Limited spatial range of innovation networks

As mentioned in chapter two, the “Innovationsforen” programme first of all supports young network alliances applying with a regional network strategy. But the programme aims to support the development of external network partners, too. With reference to the importance of high closeness in the constitution phase of a network and the fact that most of the actors in the networks are SME having limited resources to care for external contacts, we assumed that most of networks remain regional ones (hypothesis 3).

Descriptive data and the conceptual deduction strengthen this hypothesis (see table 13). We defined three categories of regional ranges. The first is defined by the share of regional partners exceeding two third of the whole number of partners. The second is defined by a share of regional partners between one third to two thirds and the third category is defined by regional partners amounting for less than one third of the network partners. A switch from one category to another is interpreted as process of increasing or decreasing regionalisation.

TABLE 13: THE REGIONAL RANGE OF THE NETWORKS

Change of share of the regional partners in the network	Number

Increase of regionalisation	2		
No Change	11	...state before funding	Number
		> 2/3 are regional Partners	9
		1/3 to 2/3 are regional Partners	2
		< 1/3 are regional partners	0
Decrease of regionalisation	0		
Network does not exist anymore	2		
Total	15		

Table 13 shows that no network became less regional concerning the partner structure. In contrary, two networks became even more regional than they were before the funding. But of course, these descriptive results have to be complemented by a deeper analysis.

Limitations of the study and outlook

The first limitation in our study is of course the small number of 15 network cases. "Innovationsforen" funded more than 100 network alliances during the last nine years. Thus, the descriptive data is not representative. For the multivariate analysis we use 14 cases what leads to two problems:

- Maybe some important relationships in the data concerning the development of the network features could not be detected.
- Relationships based on slight significance have to be interpreted carefully, because they could get lost when data of more cases is used.

The second problem occurring in our study is that the results we got on the different levels of analysis sometimes do not reflect the real development of the networks. One example is the negative influence of the length of the network development and the raise of co-operation activities in the funding period on the current network characteristics. It is quite likely that the networks develop sub-networks over time representing project groups. Hence, we cannot measure the network activities on the whole network level anymore because they shifted into the sub-networks. That process appears as negative impact in our multivariate analysis.

The last problem is that for some aspects we only have descriptive data to answer them, like the spatial range of the networks.

To deal with these limitations an additional study with 50 interviews in the "Innovationsforen" funded networks is planned. That raises the number of network cases and will increase the reliability of the multivariate and qualitative results. Furthermore, it is planned to deepen the study about the spatial range of the networks with specific questions in the interviews.

Conclusions

In our study we evaluated the impact of a German funding programme named "Innovationsforen" on a positive network development. The funded networks in our study aim to generate innovations and to create sustainable partner structures between different actors in regions, mainly SMEs. Using a

research design combining qualitative and quantitative methods, we could proof the positive impact of early network funding for a later successful development:

- The qualitative data show, that 11 of 15 networks started their development due to the funding. Almost every network improved their network features representing a positive network development in that period. Except two, all networks survived until today and perform common projects.
- The quantitative analyses prove the positive development during the funding period. Especially, co-operation activities, documentation and reflection and the identity improved significantly.

The funding programme has got the strongest impact on young network alliances that have to pass early stages of a network development. Theories and findings from social-psychology proved that working together successfully, especially when it comes to complex activity like innovating and common learning processes – requires two elements: to be able to judge about partners personally (trust is strongly linked to the predictability of a person) and to know the professional skills, backgrounds and needs of partners (BAIN ET AL. 2001; PAYNE 1996; KRAUT ET AL. 1988; KRAUT ET AL. 1987; DETTMANN & BRENNER 2010). Due to its programmatic design that forces the network partners to interact face-to-face in different contexts and events, "Innovationsforen" supports the early stages of a network development. The high spatial proximity that the partners have in the workshops, meetings and on the forum enables them to observe and interact with each other. After six month they got insights in the personal and professional profiles of their partners and can start to work effectively on their innovation projects. Additionally, that intensive period of interacting secures that first of all the motivated and fitting partners remain in the network.

It is important to stress, that the funding should not start at point zero of a development. Especially, a certain degree of co-operative experience and some common identity between the network members is very helpful for the later network development.

In our paper we could prove the importance of personal interacting at the beginning of a network development to pass the constitution stage of a network development where first of all common goals, norms and trust have to be developed. Due to the limited resources that SME can provide the required frequency of interacting at the beginning but also in the performing stage limits the spatial range of networks. An eased access to network partners, unintended meetings and the chance to observe each other are always important in small innovative networks like the funded ones in our study.

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Figure A.2 provides an example of how various variables are coded into the network features that we us in our study. The first row names the feature and gives a short definition. The first column names the measurable variables that in combination present the feature. The second column describes the variables. The third defines the condition required that a variable attains a certain degree. Every variable gets a degree between two, what means that the variable is fully developed, and zero meaning a variable is not developed.

FIGURE A.2: EXCERPT OF THE FEATURE CATALOGUE ('INFORMATION AND COMMUNICATION')

Communication + Information	That feature represents the communication and information processes between the network partners.	
	Definition of variable	**Definition of scale**
Roles/contributions of network members are clearly stated	Measures the distinct allocation and statement of tasks and roles between the network members.	(2) very clearly stated: Tasks are allocated and clearly stated for the network members. (1) partly clearly stated: Tasks are allocated and stated just for a few network members or are stated very generally. (0) not clearly stated: Tasks are not allocated and clearly stated for the network members.
Long-term goal of network is clearly stated	Measures the clear statement and determination of a long-term goal in the network.	(2) very clearly stated: A long-term perspective and measures of network modulation are stated. (1) partly clearly stated: Only unspecific network goals are stated.

		(0) not clearly stated: No long-term perspective are stated.
Development strategy is clearly stated	Measures how concrete and clear a development strategy for the network is determined and stated..	(2) very clearly stated: Development strategy includes dates and concrete measures. (1) partly clearly stated: Dates OR concrete measures are missing in the development strategy. (0) not clearly stated: A development strategy for the network is missing.

The first row names the feature and gives a short definition. The first column names the measurable variables that in combination present the feature. The second column describes the variables. The third defines the condition required that a variable attains a certain degree. Every variable gets a degree between two, what means that the variable is fully developed, and zero meaning a variable is not developed.