Knowledge Transfer and Innovation in Subsidized Regional Networks – Empirical Evidence of a German Promotion Scheme

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Abstract

The paper presents some empirical evidence on knowledge transfer and innovation activities in regional networks in eastern Germany, which are funded by the German Federal Ministry of Education and Research (BMBF) and are still in the process of building up. The aim of the promotion scheme known as the "InnoRegio" is to stimulate formal and informal cooperation between the various regional protagonists in order to strengthen regional innovation and economic growth.

The results are based on a survey carried out in autumn 2002. As a first main result, knowledge transfer measured by information got from network partners is quite intense and positively correlated to information flows from inside the own institution. On the other hand, information from outside is rather independent from intra-network information flow. There is evidence that information influx varies with internal conditions of the networks and the complexity of the innovation. Further research will focus on the dynamics of knowledge transfer, the relevance of other sources of knowledge and the economic impact of innovation based on local networks.

Keywords: knowledge, innovation, regional innovation systems, innovation policies

JEL-Classification: 031, D62

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1. Introduction

According to theoretical assumptions innovations, as a major precondition for market success, are based on production and exchange of knowledge. Exchange of knowledge, esp. tacit knowledge, relies almost on direct personal contacts. Therefore spatial proximity of persons involved in the innovation process is suitable to the transfer of knowledge. It is hypothesized that regional networks defined as a system of potential partners such as companies, universities, research facilities or intermediate institutions are a vehicle to speed up innovations or make them easier and are thus essential for successful co-operations.

This paper contributes some empirical evidence on knowledge transfer and innovation activities in regional networks as a specific issue of that general theoretical framework. It is based on the complementary research financed by the German Ministry of Education and Research to the InnoRegio program, a big support program to initiate or foster regional innovation networks.

In section 2 the InnoRegio program is described addressing the aim and the implementation of the promotion scheme as well as illustrating the networks. Section 3 shortly reviews the literature on knowledge transfer and innovation, stressing the importance of proximity. Section 4 discusses aim and approach of the paper, section 5 the database. In section 6 some empirical evidence is presented. First, ways and intensity of knowledge transfer are described. Then the factors, which are relevant for knowledge transfer, are investigated. Section 7 draws some conclusions in order to explore the limits and possibilities for further research.

2. The InnoRegio program

More than ten years after German reunification the economic situation in eastern Germany is still unsatisfactory. New approaches were being sought in promotional policy so that the weaknesses that are known or suspected can be better targeted and removed. One of these weaknesses is insufficient research activities, and the consequent shortage of innovation by companies. Another is inadequate regional cohesion between companies and related facilities. Formal and informal co-operation between the various regional protagonists is regarded as essential to strengthen innovation and exploit the regional economic potential, and that means networking companies, research facilities, universities, the administration and politicians.

In 2000 the German Federal Ministry of Education and Research (BMBF) therefore launched a promotion scheme known as the InnoRegio[1]. Out of 444 applicants 23 networks were selected in a multi-stage-competition for taking part. Each of the InnoRegio-network has its own budget and is responsible for development and realization of individual projects of the network partners. During the period from 1999 to 2006 the BMBF is providing a total of € 255 million for this program. Thus, the InnoRegio Initiative is the most important pillar of the ministry's innovation policy for eastern Germany.

[1] For further information see http://www.innoregio.de

The implementation and performance of the InnoRegio program is monitored by complementary research, which is conducted by the DIW Berlin (Eickelpasch et al. 2002). This research undertakes the tasks of analyzing the elaboration and implementation of the InnoRegio networks and identifying success factors, fostering the dialogue between the networks on their individual experiences, working out proposals to transfer successful approaches to other networks and regions, advising the BMBF on the implementation of the main areas of promotion, assessing the promotional approach, and making recommendations for future promotional programs.

The InnoRegio program does not specify objectives, topics, or composition of the networks in concrete terms. The 23 InnoRegio networks that received support thus cover a broad spectrum of activities and differ significantly among themselves in terms of the individual participants involved. The networks are active in the areas of medical technology, renewable resources, biotechnology, micro-system technology, mechanical engineering, manufacturing technology, circular-flow economics, environmental technology, and automotive technology. Various branches of the service industry may also be included here, such as those offering travel and tourism for disabled people, or establishing consultation and treatment services for people with diabetes. Restriction to one strictly limited technological field is the exception rather than the rule: usually, each network includes more than one field. The differences in the choice of topic are reflected in the structure of participation. The share of manufacturing industry, service enterprises universities and scientific facilities differs widely among the actors in the individual networks.

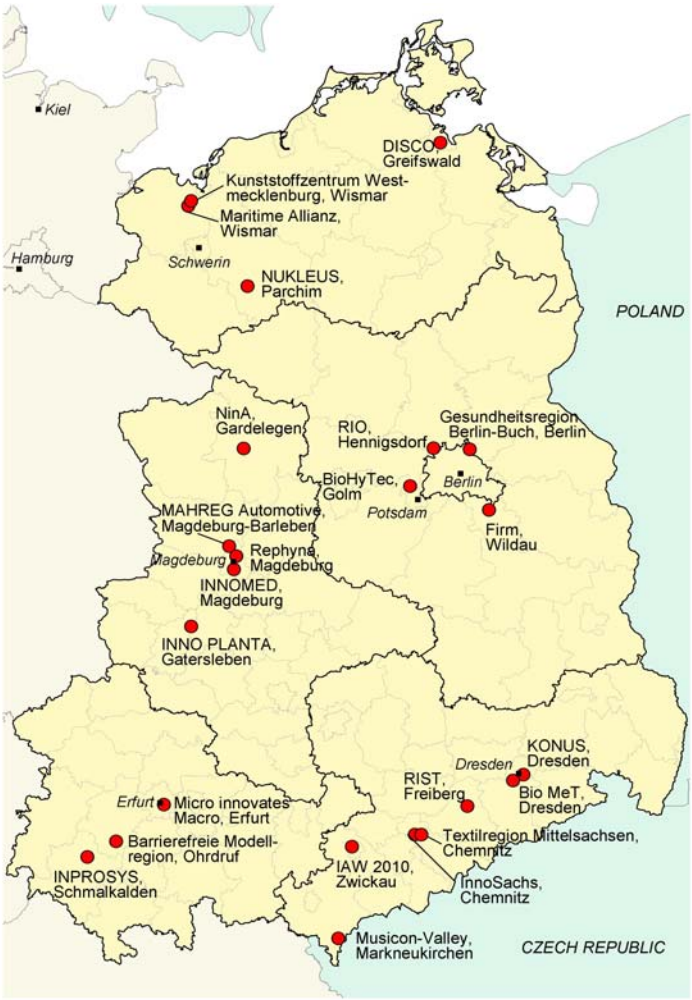
The size of the networks is very different as well. Taking as a yardstick the support volume given by the ministry we can classify twelve as small networks (less than € 10 Mill.), six networks as medium-sized (€ 10 mill. up to € 15 mill.) and five networks as large (more than € 15 mill.).

According to the InnoRegio approach to mobilize regional economic potential wherever in eastern Germany, there were also no restrictions concerning the location of the participants' network. Thus, the networks involved are spread all over eastern Germany, Berlin, Brandenburg, Saxony, Saxony-Anhalt, Mecklenburg-Western Pomeranian and Thuringia (map). Measured by density we can identify seven networks in agglomerations (mainly Berlin, Dresden), nine networks in medium dense regions and seven networks in rural areas (like the northern parts).

3. Some theoretical references of the InnoRegio program

In order to ensure competitiveness in the long run, enterprises have to generate innovations. In reason of increasing specialization of the firms (concentration on core-competencies) and the complexity of new technologies, the knowledge needed in innovation processes is widespread. Thus innovation and the process of knowledge creation and diffusion within the economy almost are based on division of labor. Regarding to the coordination of

Map: Geographical allocation of the InnoRegio-networks in eastern Germany
- Site of the coordinators' office –



those interactions, market-coordination as well as coordination on hierarchies pose some difficulties. Due to this, networks are viewed as superior mechanism of coordination according to divided innovative activity (Fritsch 2001).

The concept of innovation systems is based, just like the network-approach, on the idea of division of labor according to the innovation process. Research activities on this refer to national, supra-national, sectoral and regional innovation systems. All of those approaches assume that innovation processes take place in a systemic context, which includes a lot of actors and their interactions (e.g. feed-back) and interrelations (Edquist 1997). Therefore the approach focuses on the functions and the contributions of different types of organizations (such as enterprises, universities, public research facilities, labor administration) to innovation processes.

Especially evolutionary approaches of innovation theory are regarding, that innovation mostly depends on re-combination of already existing ideas and experiences. Thus creation of knowledge always includes aspects of learning. Deepening these theories of learning differentiate between "learning by doing" (Arrow 1962), "learning by using" and "learning by interacting" (Lundvall 1992).

The distinction between codified knowledge, that is easily transmittable in a formal and systematic language and tacit knowledge (Polanyi 1966) that has an implicit or personal related character, has an implication for innovative activities. Exchange of tacit knowledge that furthermore is increasing over time because of accelerated tempo of knowledge production and decreasing possibilities for structuring and codification entirely relies almost on direct personal contacts. Therefore spatial proximity of the persons involved in the innovation process is suitable to transfer this type of knowledge. This is considered as an important advantage for regions in generating innovations.

The networking of regional protagonists in the innovation process should in principle evolve spontaneously from the interests and needs of those involved, and by self-organizing. But in view of many obstacles, such as high start-up costs, lack of confidence and the free-rider problem, promotion can be helpful in the initial phase. It is then also reconcilable with policy on the general order.

4. Aim and approach

In this paper we focus on a specific issue as a part of the general framework outlined above. We investigate first the ways and intensity of knowledge transfer inside and outside the networks. As a second step we focus on one way of knowledge transfer, the influx from partners of the network and its pre-conditions.

Following this approach we first have to define the notion of "knowledge transfer" further. In general, knowledge can be transferred in different ways; it can be transferred by sales or purchases of goods (i.e. investment goods), by hiring or dismissal of qualified personnel or by cooperation among persons (Breschi, Lissoni 2001). In this paper we concentrate on the cooperation among persons. In general, this means the exchange of information, in terms of encouragements, experiences or professional support. Knowledge transfer has different dimensions: It can be intense or not, knowledge can flow among many or few partners, can flow among different partners like companies, universities and research institutions and can flow in only one direction or on both directions.

Second, we have to define "regional networks". By definition, all networks investigated here are regional networks. Nevertheless, the regional dispersion varies from one network to another. In agglomerations the partners involved are mostly located nearby and can quite easily be reached. On the other hand, in some, but not all rural areas the location pattern of the partners is rather disperse and as a consequence, accessibility less easy.

Third, we have to put into concrete terms the idea of "innovation activities". In this paper, "innovation activities" means the activities related to the realization of the projects, which are subsidized by InnoRegio and carried out by companies, universities or research institutions.

5. Database

The results are based on two sources. The database of the ministry contains information on each funded project, its title, subsidy recipient and the total and the subsidy volume of the project. Here database dated from mid of July 2002 is used.

As the official database does not provide all information needed, a survey was realized. In summer 2002 a questionnaire was sent out to about 400 companies and institutions with funded projects. The questionnaire comprises a lot of questions, such as questions on the obstacles while realizing the project, on kind and intensity of co-operations inside and outside the network, the characteristics of the network, the evaluation of the network management, the manpower requirements, the evaluation of the subsidy scheme and some firm characteristics. Nearly 270 of the actors with funded projects took part in the survey. Thus, three quarters of the relevant group of participants are represented in this data. In six networks nearly all partners answered the questionnaire whereas in seven networks the participation quota was less than two third. Especially for very small networks with a low response, the interpretation of data may be limited[2].

It is to be mentioned that the data gives only a limited insight into the process of network building. In the course of time, new members enter the networks, present members leave the club, running projects come to the end and new projects start. For example, between summer 2002 and spring 2003 another 120 projects were started, about one quarter more than in summer 2002. This indicates that the networks involved are still in the process of building up. It is planned to update the official database periodically, to repeat the survey and to connect the results in order to investigate the process of knowledge transfer in the course of time.

6. Empirical findings

6.1 Structure of the projects

As to mid of July 2002, the time of the investigation, 404 projects were funded by the ministry with the amount of more than € 100 mill. which is about 44 % of the potential support volume (table 1). Most of the funded projects are dealing with the aim of developing new products or services (77% of the support volume). Further 9% of the volume finances projects with the aim of identifying and reducing the bottlenecks in human capital the respective region. Most of the participants are companies, and for their projects 64% of the actual support volume is employed. Another 19% of the support volume is used to fund projects run by universities and research institutions. The rest of the support volume is spent to other participants like qualification centers, transfer organizations etc. Broken down by

[2] As the networks consists not only of partners with actual funded projects but also with partners who are applying for projects or play an active role as member of the advisory board etc. a second survey with an reduced questionnaire was conducted at the same time. Out of the 700 network members one third of them took part. In this paper this sample is not investigated further.

networks there are some significant differences: In some networks only one project is going on whereas in others more than 50 projects.

Table 1: Projects funded by the InnoRegio Program mid July 2002

	Supported projects	Support volume	
	N	Mill. €	%
Projects total	404	100.7	100
Thereof:			
Subject of the project			
Network coordination	26	12.1	9
Innovation	312	71.8	77
Services for network partners	35	6.6	6
Vocational training	31	10.1	9
Participant			
Company	238	52.0	64
University	52	15.7	11
Research institution	39	9.7	8
Others	75	23.2	17
Source: BMBF 2002.			

It has to be emphasized that due to the fact that the InnoRegio program is in an early phase of development most of the projects just started in 2002 and still are running. At the end of 2002 about one tenth of them were finished. In the course of 2003 additional one third of the projects will be finished, in the course of 2004 nearly half of them. This means, that at the actual point of time we have no concrete information on the outcome of the projects investigated here.

6.2 Ways and intensity of knowledge transfer

As outlined above in this part we describe the information flow in the local networks. There are different aspects to take into account. First, the intensity and the ways partners get information from other network participants are presented (information inflow), second the intensity of information partners give to other network participants (information outflow).

Information inflow

To know something about the influx of knowledge we posed the following question: "How much information do you get from InnoRegio partners?" with five possible answers from "very few" to "very much"[3]. As table two shows 61% of the partners are getting very much information from other partners in their network, for nearly 30% of the actors the information influx is moderate and 12% of them get only very few information.

Taking into account that not all participants use information from inside the network the question is raised, in how far other sources of information are used. That can show a general view of the information behavior. In principal, participants can rely on the information they

[3] The answers for „very few" and „few" are recoded to "relatively few", the answers for ""very much" and "much" to "relatively much".

get from inside their own organization or company and they also can use information from partners somewhere else. They can use the different sources of information additional to each other or as substitutes. In order to evaluate the intra network knowledge transfer in respect to its overall relevance the different sources of information are examined as well. We posed the following two questions: “How much information do you get from partners inside your company/institution?” and “How much information do you get from partners outside the network?” with five possible answers from “very few” to “very much”.

Table two shows that the pattern of information influx from partners in the own institution/ company is not very different from partners in the network. On the other hand, the information influx from partners from somewhere else is significantly less intense.

Table 2: Ways of information influx – structure in percentage -

	Information got from partners …		
	in the network	in the company/ institution	somewhere else
Intensity			
Relatively few	12	7	43
Moderate	27	30	30
Relatively much	61	63	27
Total	100	100	100
	n=266.	n=264.	n=265.
Source: DIW Berlin 2002.			

In order to examine if the network information can be judged as an additional source of information to others or as a source replacing information from other sources the different ways of getting information are combined with each other. Concerning the internal information source there is a quite clear pattern: Partners in the subgroup with a quite intense intra-network influx get more information from the own organization than partners in the subgroup with low intra-network influx. Participants who get only little information from collaborates also get less information from the own institution or company (table 3). This result indicates a quite close positive cohesion of the intensity between intra-firm and intra-network information flows. Both sources are mostly used as additional sources to each other.

Concerning the second possible relationship, the one between intra-network inflow and information from outside the network, another pattern appears: In the subgroup of participants who got little information from network partners the intensity of information from outside is a bit lower than in the subgroup of participants getting much network information. For the participants with higher network influx there is no difference. This pattern is not significant. It can be interpreted in the way that information flow from somewhere else is rather independent from intra-network information.

Table 3: Intra-network information influx by information influx from other sources - percentage of all partners -

	Information got from Anorexia partners			Total
	Relatively few	Mode-rate	Relatively much	
Information got from partners in the company/ institution				
Relatively few	23	10	3	7
Moderate	26	34	28	30
Relatively much	51	56	69	63
Total	100	100	100	100
Chi-Squared=16.8; p=.002; n=262.				
Information got from partners somewhere else				
Relatively few	47	46	41	43
Moderate	33	27	31	30
Relatively much	20	27	28	27
Total	100	100	100	100
Chi-Squared=1.5; p=.831; n=264.				
Source: DIW Berlin 2002.				

Information outflow

Second, we asked for the information that other partners in the network receive from the partner inquired. The question runs: "Do you support InnoRegio partners with information?" with the same answer scale as in the questions mentioned. According to table four half of the partners reported to give very much to other partners whereas 11% give only little information away. By combining the findings we are able to identify participants, which get much (little) information and at the same time give much (little) information and thus an indicator to classify participants being strongly (weakly) integrated into the network. Table four shows a quite clear pattern: Those who get much information from other partners also give much information to other partners and those who get little information also give little information.

Table 2: Information flow from and to partners in the network - percentage of all partners -

	Information got from InnoRegio partners			Total
	Relatively few	Mode-rate	Relatively much	
Information given to InnoRegio partners				
Relatively few	23	17	6	11
Moderate	33	44	37	38
Relatively much	44	39	57	51
Total	100	100	100	100
Chi-Squared=14.0; p=.007; n=258. Source: DIW Berlin 2002.				

6.3 Some findings on the pattern of intra-network knowledge influx

This part analyses one specific aspect of information flow, the intra-network information inflow, more thoroughly. The other aspects described above will remains to further research.

The question is raised what factors influence the intensity of intra-network knowledge inflow. In general, we can differentiate between factors connected to the project itself, the company or institution realizing the project and the network. In the following some of possible determinants are investigated according to their assumed relevance for explaining knowledge transfer.

- Acquaintance of and experience in cooperation among the partners is often expected to be important pre-conditions for knowledge transfer. In projects where partners have already cooperated with each other and thus built up mutual interests and trust the exchange of information will be much easier than in projects where partners cooperate the first time.

  As far as concrete experience in cooperation is concerned, the assumption can be confirmed in our survey. However, simply being acquainted to each other seems not be suffice precondition for information flow (table 3).

- The type of partner can be relevant. Taking an idealistic view of the linear process of creating innovations it can be expected that knowledge mainly flows in one direction, i.e. from universities as a place for basic research to research institutions and companies which normally adopt results of research carried out by universities (Rogers 1995; Dohsi 1988b). This means that the intensity of information getting from other partners in the network ought to be more intense for companies than for universities and research institutions.

  Our survey clearly does not confirm this assumption. In our sample, the information influx is less intense for companies than for research institutes, and for universities it is as high as for companies. Obviously, there are different possibilities for cooperation. One reason could be that knowledge is transferred also between companies or even from companies to universities or research institutes. Corresponding information is not available so that the individual pattern of information exchange remains unknown. However we can add the view of participants giving information to other network partners. It turns out that the outflow of information is much higher from universities than from companies or research institutes. This result supports the above-mentioned assumption.

- The size of the partner institutions may be another relevant factor. It is hypothesized that large institutions can rely on more internal information and know-how than smaller ones and thus their need for an exchange of knowledge in networks is less pronounced in large companies than in small ones (Acs, Audretsch 1990). We test this assumption by using the number of employees as a measure for size.

  The results do not show a clear pattern. There is only little difference in information flow between the size categories. It is may be because of the specific target group of the InnoRegio program. The aim of the program is to strengthen small companies.

This means that by definition rather small companies with up to 50 employees are found in this sample whereas larger companies of size are rare.

Table 3: Intensity of information influx and selected determinants - percentage of all partners -

	Information got from InnoRegio partners			Total
	Relatively few	Mode-rate	Relatively much	
Already acquainted with partners involved:				
Few of them	25	25	50	100
Lot of them	18	34	48	100
Most of them	8	24	68	100
Chi-Squared=12.1; p=.016; n=263.				
Already cooperated with partners involved:				
Few of them	25	35	40	100
Lot of them	12	28	60	100
Most of them	6	22	73	100
Chi-Squared=15.6; p=.004; n=260.				
Type of partner:				
University	13	29	58	100
Research institution	0	26	74	100
Company	24	21	55	100
Others	10	31	60	100
Chi-Squared=11.5; p=.075; n=266.				
Size of company:				
Less than 10 employees	13	30	57	100
10 to 19 employees	12	21	67	100
20 to 49 employees	12	36	52	100
50 employees and more	12	25	63	100
Chi-Squared=2.1; p=.911; n=131.				
Intensity of contacts in the network:				
Low	20	40	40	100
Moderate	12	28	60	100
High	6	17	77	100
Chi-Squared=11.9; p=.018; n=266.				
Location of the network:				
Agglomeration	12	37	51	100
Medium dense region	6	20	74	100
Rural areas	17	32	51	100
Chi-Squared=15.9; p=.003; n=266.				
Complexity of innovation:				
Development of fundamentally new products	9	25	66	100
Substantial improvement of already exiting products	11	24	65	100
Partial improvement of already existing products	16	36	48	100
Adoption of already existing products	33	50	17	100
Chi-Squared=13.1; p=.110; n=248.				
Application for a patent intended?				
Yes	14	26	61	100
No	10	29	61	100
Not foreseeable	11	28	62	100
Chi-Squared=0.9; p=.930; n=264.				
Total	12	27	61	100
Source: DIW Berlin 2002.				

- In respect to characteristics of networks, there are some factors to take into account. First, networks in which the general set-up (technical facilities, organization, transparency, trust etc.) for the exchange of information is favorable, the knowledge transfer may be higher than in networks where those pre-conditions do not exist (Wigand, Picot, Reichwald 1997). Complex indicators can measure the general set-up. Here we use a simple estimation of the intensity of contacts between partners by the participants to classify the classification of the networks.

  It turns out that there is a strong and positive relationship: Networks in which it is easy to build up and use contacts the information flow is significantly higher than in those networks with unfavorable conditions.

- Furthermore, the location of a network can be important. It is assumed that networks located in agglomerations favour knowledge transfer more than those located in rural areas. In agglomerations the potential for cooperation is much higher than in rural areas and there it is easier to find appropriate partners than in remote networks.

  In fact, the results of our investigation confirm this view only partly. Obviously networks find in medium dense regions better conditions for knowledge transfer than in agglomerations.

- Last, it is expected that the innovative outcome of the supported projects plays an important role: Highly innovative projects rely on intra-network information more than those with less innovative output. In fact, to measure the innovative quality this is not a simple task. By definition, the aim of the supported InnoRegio projects corresponds mostly to an early stage of research and development. This means that the result of a project is not a prototype of a new product ready for production. Further steps towards the fabrication of new products and its introduction into the market have to be made; the InnoRegio program does not fund this part of the innovation process. From today's point of view it is an open question if the results of the funded projects will automatically lead to successful innovations. The assessment of the success of the projects and the role of knowledge transfer is thus highly speculative. Another obstacle to evaluate the innovation success of the projects is that most of the projects have not been finished yet. However, in order to get some hints about the potential innovative outcome of the projects we asked the participants what kind of results they expect from the today's point of view. The first question relates to their expectations in respect to the degree of innovation: We asked the participants if the project concerned is aiming at the development of substantially new products or at the improvement of already existing products. Second we asked, if they intend to protect their innovation by applying for a patent. It is hypothesized that there is a positive relationship between innovation intensity (and patent application) and the need for intra-network information (Jaffe 1989).

  As the cross tabulation shows two different results: There is a quite clear positive cohesion between complexity of the projects and information flow. On the other hand, there is no relationship between information flow and the propensity for patenting the expected output. This result first supports the assumption that complex and ambitious

innovation is highly correlated with intense knowledge transfer and second that the output of research and development does not automatically leads to patents (Acs, Audretsch, Feldman 1992).

To sum up it could be demonstrated that there is a positive connection between knowledge transfer and experience in cooperation, but obviously no correlation with the size or type of partner involved. In respect to the expected results of the supported projects it could be shown that knowledge transfer is relatively intense in ambiguous projects whereas projects with low innovative output seems to need only little information influx.

7. Conclusions

This paper has first investigated the intensity of intra-network knowledge transfer in contrast to other ways of knowledge transfer. As a main result, knowledge transfer measured by information got from network partners in the networks is quite intense and positively correlated to information flows from inside the own institution as well as information flows to other network partners. On the other hand, information from outside flows rather independently from intra-network information flow. Second, some factors were discussed determining the knowledge inflow from network partners. There is evidence that information influx varies with the internal conditions of the networks (trust, experience) and complexity of the innovation whereas other factors like type or size of partners involved seem to be unimportant. Also the role of the location is not quite clear.

In general, the results strengthen the mentioned assumptions that innovation can be made easier or faster by using information from network partners. They support the assumption that local knowledge spillovers play an important role for functioning regional innovation systems. However there are still some open questions, which lead to a careful interpretation of these results:

First, these results are preliminary as the networks investigated are still in the phase of building-up. It is planned to observe the development of the networks and the changes in the pattern of knowledge transfer over time.

Second, the relevance of other sources of knowledge transfer in contrast to intra-network transfer would be of interest. The question may be raised if information from network partners substitute other sources or serves as an additive source of information.

Some aspects determining knowledge transfer should be further investigated more thoroughly. As space plays a major role as an explanatory factor, the role of the location as well as the distance between partners will be moved in the center stage.

As outlined, we know little about the outcome of projects. Until now, we can only rely on the subjective expectations of the participants asked. In the course of time more and more projects will be finished and their innovative outcome will be better measurable than at the moment.

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