

Strengthening Regional Innovation through Network-Based Innovation Brokering

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Abstract

The primary objective of this paper is to demonstrate how regional innovation system theory may be translated into manageable micro-level methods with the potential for strengthening the productive dynamics of a regional innovation system. The paper meets this objective by presenting network-based innovation brokering, a practical method designed by using insights from regional innovation system theory and trust theory. Five cases from two Norwegian regional innovation networks show that in addition to knowledge development and diffusion, network-based innovation brokering strengthened collaborative attitude and trust between members of the regional innovation system. Moreover, it served as an arena for entrepreneurial experimentation, resulting in projects combining two modes of innovation; the Science, Technology and Innovation (STI) mode and the Doing, Using and Interaction (DUI) mode. The method, thus, may be viewed as a useful addition to the inventory of methods used to stimulate innovation in RISs. On a more general level, the paper represents a call to the community of innovation researchers and practitioners to give a higher priority to the question of how to better realize the pragmatic potential of RIS-theory.

1. Introduction

For several decades, innovation theory has been dominated by a family of theories emphasizing the complex and interactive nature of innovation (Moulaert and Sekia 2003; Asheim, Smith, and Oughton 2011). An example is regional innovation system theory (RIS-theory), which highlights the complex and interactive nature of regional processes leading to innovation. This paper addresses the question of how central ideas of RIS theory may be translated into manageable micro-level methods for strengthening the productive dynamics of a regional innovation system (RIS). Despite the fact that RIS-theory has served as the basis for regional innovation policies over several decades (OECD 2010, 2011), this specific question has received conspicuously little attention from the community of innovation researchers (Smith 2012; Woolthuis, Lankhuizen, and Gilsing 2005; Edquist 2005). This paper aims at filling this gap by presenting an example of how a micro-level method for strengthening the productive dynamics of a RIS has been designed on the basis of RIS-theory, with a particular emphasis on the ‘translation process’ from theory to practice. The method is called Network Based Innovation Brokering (NBIB). The paper, thus, addresses innovation researchers with an interest in the practical application of RIS theory, as well as managers, network facilitators and consultants working to enhance the productive dynamics of a RIS.

This paper is based on the idea that the development of methods aiming to alter a field in a systematic way should always be based on the best current theoretical description of the relevant field. Just as a physician needs to know the mechanisms of illness and health when deciding upon the best treatment to give to a patient, a change agent within a RIS - i.e. a person dedicated to enhancing the productive dynamics of the system - should have a thorough theoretical understanding of *his* field, and the methods employed should reflect this understanding. RIS theorists are in an especially favourable position to develop such methods. Thus, method development should be added to the list of essential tasks that RIS researchers should attend to. Doing so would result in a potential value not only confined to the improvements it might produce in the field; in addition, the experiences made when testing out the methods might serve as a basis for further theory refinement (Swanson and Chermack 2013).

The immediate motivation to carry out this study arose when the authors entered into a collaboration on facilitation and research within a regional R&D-project encapsulated within a larger Norwegian national programme called VRI (Research Council of Norway 2011). The

program is based on RIS theory, supposed to serve as the theoretical ground on which policies and practical measures aimed at strengthening the innovative capacity of participating regions are built. Within the programme, an inventory of methods has been set up, including for instance dialogue conferences, foresight and innovation brokering. Parts of this inventory, however, are *de facto* constituted by methods inherited from earlier programs, and based on older innovation theories. An example is Individual Innovation Brokering (IIB), which was adopted from a technology transfer program in the 1970s based on the then dominant linear theory of innovation, according to which innovation should be viewed as the transfer of new technology from R&D-institutions to enterprises (Godin 2006). Insofar as IIB is grounded in the linear logic of this theory, one might hypothesize that it does not optimally contribute to strengthening the system dimension of a RIS. In fact, in the context of VRI, IIB has been criticized for contributing too little in this respect (Jakobsen and Døving 2006; Jakobsen and Stensheim 2007; Wollebæk 2006).

At a general level, this may be viewed as an example of the problem arising when theory and practice are not optimally matched. A central motivation behind the present study is to address this challenge within the context of RIS theory. In presenting NBIB, therefore, this paper reflects on the methodological considerations that have informed its design process. The aim of the design process was to construct a method for better realizing some central dimensions of the pragmatic potential of RIS-theory. The paper therefore also presents a preliminary evaluation of the implementation of NBIB in two networks in a Norwegian region in order to assess to what degree this aim has been achieved. The research questions are as follows:

1. *How may one translate the theoretical insights of RIS theory into manageable micro-level methods that effectively bring out the pragmatic potential of the theory?*
2. *To what extent and in which way can network-based innovation brokering (NBIB) contribute to strengthening the productive dynamics of regional innovation systems?*

The paper is organized in the following manner: In section two, we give a brief presentation of NBIB as a method, along with a brief history of its design. In section three, we explain how the different steps of the method have been theoretically informed. Section three functions therefore as the theory chapter, explaining at the same time how the theory is linked to NBIB. In section four and five, we present five cases in which NBIB have been applied so far, and relate the experiences collected in the process. The aim here is to reach a preliminary

assessment of the pragmatic potential of the method. The paper is then rounded off by a discussion section and a conclusion.

2. What is Network-Based Innovation Brokering?

Network-based innovation brokering (NBIB) may be conceived as a family of methods, along with e.g. project workshops, innovation cafés and partnership days, suitable for establishing collaborative innovation projects (Batterink *et al.* 2010; Parjanen, Harmaakorpi, and Frantsi 2010). The version of NBIB described in this paper, however, was designed by the authors, and was intended as a fresh attempt to translate central dimensions of RIS-theory into manageable micro-level methods in order to better realize the pragmatic potential of the theory. It was deliberately designed to serve as an alternative to Individual Innovation Brokering (IIB), as a response to the criticism directed at IIB for contributing too little to the productive dynamics of a RIS.

In IIB, an individual innovation broker visits regional enterprises in order to identify their innovative potential or challenges. Then, based on his knowledge of relevant R&D-institutions, he facilitates contact between an enterprise and a R&D-institution with the aim of establishing a joint innovation project (Jacobsen *et al.* 2012). A significant motivation behind the design of NBIB was to develop a method that achieves the same aim as IIB, i.e. helping enterprises and R&D-institutions to initiate joint innovation projects, while additionally having a stronger and wider impact on the productive dynamics of the RIS. This explains why the notion of innovation brokering is part of its name. The term *innovation broker* is typically used about individuals or institutions helping enterprises to connect with relevant R&D-institutions in order to solve some R&D-challenge that may lead to a future innovation. Other terms in use are *competence brokers* or *knowledge brokers* (Jakobsen *et al.* 2012; Bergenholtz 2011; Batterink *et al.* 2010, Kirkels and Duysters 2010; Parjanen, Harmaakorpi, and Frantsi 2010). In NBIB, the brokers have a similar function; however, more of their work consists in the facilitation of group processes. In addition, in NBIB the participants are granted greater autonomy as well as greater responsibility for the process.

The NBIB process

NBIB consists of three main phases, of which a one-day workshop forms the main core. The whole process is handled by one or two brokers who act as organizers and workshop facilitators. *Before the workshop*, the brokers identify and invite relevant participants representing regional enterprises as well as regional and national R&D-institutions. In the invitation, the whole brokering process is briefly described, along with its aim, i.e. to establish joint innovation projects.

The workshop opens with short self-presentations by the participants including a personal detail such as a favourite hobby or a summer holiday memory. The next step involves generating ideas for joint innovation projects. Several procedures are possible: one involves inviting enterprise representatives to present R&D-challenges they need to solve; another is inviting a major customer (for instance if the enterprises present are sub-suppliers to this customer) to do the same. Yet another procedure entails encouraging the invited researchers to put forward ideas for innovation projects, based on their own research. A combination of these procedures is also possible. After the ideas have been presented, they are discussed and evaluated, and related ideas may be merged to reduce the number of potential projects. The next step then involves the formation of project groups dedicated to the most popular ideas. The participants decide for themselves which project group to join. The brokers facilitate the group formation process, putting weight on ascertaining that the groups have a real chance of becoming productive by including an optimal mix of participants. Ideally, each project group should have representatives from at least two enterprises, and one R&D institution.

So far, the process has taken place as a plenary session. Now, each group withdraws to separate locations to start designing a project plan based on their idea. At the end of the day, the groups then reconvene in a plenary session to report on their progress up to this point, and on their plans for continued collaboration after the workshop.

There are several breaks during the day, in addition to a lunch. The opportunity to engage in informal dialogue is regarded as a significant dimension of the event.

After the workshop, the groups are expected to continue to work with their projects on a self-organized basis. SMEs often find it hard to allocate the financial resources necessary for executing innovation projects; therefore, the funding of projects becomes an issue in NBIB. Available funding may both strengthen the motivation to participate in the process as such, and increase the probability that the initiated projects will be realized. The three main phases of NBIB, with their activities and tasks for the brokers, are illustrated in table 1.

Table 1 in here

3. The theoretical background for the design of NBIB

This chapter explains how the different steps of NBIB are theoretically informed. Thus, it functions as the theory chapter of the paper. The main theories referred to are RIS-theory including theory of the productive dynamics of a RIS, and theory of knowledge development and diffusion, along with theories on trust and collaborative attitude.

Regional innovation system theory

NBIB is designed as a method for enhancing the positive dynamics of a regional innovation system (RIS), thus it is closely linked to the concept of an innovation system. A system may be defined as a group of components serving a common purpose. The components of an innovation system are the actors, networks and institutions contributing to the overall function of developing, diffusing and utilizing new products (goods and services) and processes (Carlsson and Stankiewicz 1991; Bergek et al. 2008). The concept of innovation systems conquered its current position in innovation theory from the late 1980s onwards, focusing initially on national innovation systems (Freeman 1987; Lundvall 2010b; Nelson 1993), then later extending to include also regional innovation systems (Asheim and Isaksen 1997; Cooke 2001).

RIS-theory exists in several versions with regard to content, scope and epistemic status (Asheim, Smith, and Oughton 2011; Asheim and Gertler 2005; Lundvall 2010a). Our position is that even though the system concept may suggest collective and coordinated action, it should rather be conceived as an analytical construct, used to illustrate or understand system dynamics and performance. This implies that the system does not need to exist as fully developed, but just as well as an emerging system with weak or medium strong interaction between its components - cf. Bergek et al. (2008).

Regarding the question of which groups to focus on within a RIS, we concur with the Triple Helix theory maintaining that specific attention should be directed at the three subsystems of 1) university, 2) industry, and 3) government (Leydesdorff and Zawdie 2010; Etzkowitz and

Leydesdorff 2000). In addition, we align ourselves with those emphasizing that within the industry subsystem the interaction between suppliers and sub-suppliers or other customers has a particular relevance for stimulating innovation (Von Hippel 2005; Davies et al. 2011).

The productive dynamics of a RIS

The claim that NBIB may positively influence the dynamics of a RIS opens up for the question of what this dynamics is. In discussing not regional, but technological innovation systems, Bergek et.al. (2008) define the dynamics of the system through seven key processes or functions: 1) knowledge development and diffusion; 2) crises in current business; 3) entrepreneurial experimentation; 4) market formation; 5) legitimation; 6) resource mobilization and 7) development of positive externalities. Based on recent attempts to summarize the status of RIS research (Asheim, Smith, and Oughton 2011; D'Allura, Galvagno, and Mocciaro Li Destri 2012), we suggest that functions 1, 3, 5, 6 and 7 also concur to define the positive dynamics of a RIS. A well-functioning RIS is characterized both by knowledge development and diffusion, entrepreneurial experimentation, legitimation, resource mobilization and development of positive externalities. The reason why we have not included the remaining two functions from the above list is not that markets are insignificant to the dynamics of a RIS, but that market formation is typically not limited to a region. Crises in current business are even less regional phenomena.

We also would like to add to the concept of a positive dynamics of a RIS two “softer”, or more social, dimensions. This is based on the recognition of how innovation is a socially embedded process (Rutten and Boekema 2007; Doloreux 2002). The first dimension that we wish to add is collaborative attitude, the other is trust. Collaborative attitude refers to the general willingness of the members of a system to collaborate. Trust may be seen as a dimension of such an attitude, but it also entails more. Not only does trust between partners make collaborative initiatives more likely, it also enhances the quality of collaborations, for instance by leveraging better and more efficient communication ([blinded for review]; Hardwick, Anderson, and Cruickshank 2013; Levin, Cross, and Abrams 2004). Lack of trust, or downright distrust, on the other hand, causes people to withhold more information and display a more skeptical attitude to others; it may also prevent collaborations from being established in the first place.

We do not claim that more trust or more collaborative attitude is always better. Trust should not lapse into naïveté, and collaboration should not exclude competition as another powerful

mechanism for innovation. The point is to promote interactions between actors that have good reasons to interact, such as between firms and universities or research institutes, or between small start-up firms and larger firms (Cooke 2001). Where similar enterprises are involved, the point is to search for a productive balance between collaboration and competition (Dagnino and Rocco 2009). Trust should be developed to a sufficient level as to avoid the negative effects of reduced trust or distrust.

In asserting that NBIB strengthens the positive dynamics of a RIS, we do not claim that it is equally relevant for all the functions or dimensions presented so far. More specifically, we maintain that it has the potential to influence the following functions and dimensions: a) knowledge development and diffusion, b) trust, c) entrepreneurial experimentation, and d) collaborative attitude. This will be further elaborated below.

Knowledge development and diffusion

That knowledge development and diffusion is essential to the productive dynamism of a RIS is today uniformly acknowledged within RIS-theory (Parrilli and Asheim 2012; Toedtling, Asheim, and Boschma 2013). The long-term strengthening of a RIS must therefore involve smart strategies for knowledge management and learning (Asheim and Coenen 2006; Lundvall 1996). Such strategies need also to take into account that knowledge and learning take place in various forms, and that these relate to innovation in different ways, as suggested e.g. by the distinction between know-what, know-why, know-how and know-who knowledge (Lundvall 1996). While know-what refers to knowledge about facts, know-why refers to knowledge about scientific principles and laws, know-how to skills and capabilities, and know-who to knowledge about people and their knowledge.

While know-what knowledge and know-why knowledge are typically codified in textbooks or data-bases that are, at least in principle, universally accessible, know-how and know-who knowledge are typically more socially and culturally embedded forms of knowledge, and to some extent they are also tacit (Argyris 1974; Schön 1983; von Hippel 1994; Lundvall 2010c). Thus, these four forms of knowledge relate to another established distinction within knowledge theory, that between explicit and tacit knowledge. While explicit knowledge is present through linguistic or symbolic representations, tacit knowledge is semiconscious or unconscious knowledge held in peoples' heads and bodies, often in the form of practical skills

or problem-solving strategies performed with little or no explicit attention (Krogh, Ichijo, and Nonaka 2000). Rather than seeing these knowledge forms as representing distinct categories, however, we follow Michael Polanyi in his view that all knowledge has tacit dimensions, and that it exists on a spectrum between tacit knowledge at one end, and almost completely explicit, codified or structured knowledge at the other (Polanyi 1967; Leonard and Sensiper 1998).

According to RIS theory, enterprises' knowledge bases influences their mode of innovation (Coenen and Asheim 2006). If the knowledge base is characterized by explicit – or analytic – knowledge, the STI mode of innovation (Science, Technology and Innovation) dominates. If the knowledge base, on the other hand, is characterized by tacit – or synthetic – knowledge, the DUI mode of innovation (Doing, Using and Interaction) is more significant (Coenen and Asheim 2006). Analytic, explicit and codified knowledge alone, however, is not a sufficient basis for innovation. In order to understand, use or implement explicit knowledge, tacit knowledge in the form of prior skills or competencies is also required (Jensen et al. 2007). Codified knowledge that stands alone, thus, “is not economically useful” (Jensen et al. 2007, 681). Productivity instead presupposes the complementarity of tacit and explicit knowledge (Nonaka and Takeuchi 1995; Leonard and Sensiper 1998), and according to Jensen et al. (2007, 690) “what really improves innovation performance is using mixed strategies that combine strong versions of the two modes”.

The above points are all relevant for the question of how to design smart strategies for knowledge development and diffusion, in order to enhance the productive dynamics of a RIS. Measures that promote the diffusion of only one sort or mode of knowledge, for instance, are obviously far from optimal, and so are strategies that involve only a few members of a system, or keep the knowledge enclosed within too limited boundaries. Due to the multifaceted nature of the knowledge involved, a variety of strategies or practices for knowledge exchange, learning and knowledge development are required.

One also needs to take into account that while explicit, codified or analytic knowledge may be relatively easy to transfer, tacit or synthetic knowledge represents more of a challenge. The same point relates to the tacit dimension of the explicit, codified or analytic knowledge. The social embeddedness of these knowledge forms entails that their exchange can only take place through the medium of social interaction. Strengthening the productive dynamics of an

innovation system, therefore, requires the establishment of appropriate arenas where such interaction may take place.

The NBIB process is designed to promote knowledge development and diffusion at every stage, involving all the four knowledge forms in both their tacit and explicit modes (Lundvall 1996; Coenen and Asheim 2006). The presentations at the beginning of the workshop strengthen the know-who-knowledge of the participants, which is then expanded and deepened through the ensuing dialogue – including the informal kind. The workshop is also designed to encourage the participants to share their explicit analytical technical knowledge (know-that and know-why). This happens for instance when in the introductory plenary session an enterprise representative presents a technical challenge that his/her enterprises is facing, opening up for a discussion on this subject, or when a researcher introduces an idea for an innovation project.

The workshop is also designed to develop and distribute knowledge and skills related directly to the collaboration necessary for joint innovation. This may be conceived as a separate field of mostly tacit synthetic know-how knowledge on how to establish and manage such collaborations ([blinded for review]). In the workshop, this takes place according to the principle of *learning by doing*, as the participants initiate and design joint projects *in situ* during the workshop, with some help from the facilitators and supported by the more experienced participants.

A dimension of this know-how knowledge relates to the capability to communicate across the various cultures encompassed within a RIS and present at the workshop - that is, to diminish the cognitive distance that may exist between for instance enterprise representatives and researchers (Parjanen, Harmaakorpi, and Frantsi 2010). Differences in culture – or cognitive distance – may be a challenge when representatives of different societal fields meet, such as researchers and enterprise representatives (Nooteboom et al. 2007). Reduction in cognitive distance is therefore a prerequisite for successful learning and knowledge exchange. The kind of learning involved in reducing this distance during NBIB is again *learning by doing*, promoted by the actual interaction taking place at the workshop and supported by the facilitators.

NBIB may also be used to allow its members to meet and enhance their regional know-who-knowledge, for instance by inviting relevant members of the regional government as observers. If they attend, all significant components of the RIS - enterprises, R&D-institutions

and regional government - will have the opportunity to strengthen their regional know-who knowledge through the process. The addition of governmental representatives also provides them with the opportunity to achieve a more qualified understanding of the challenges that the local businesses are facing, which may lay the ground for future improvements of the governmental services on offer.

Trust

Trust has been shown to significantly increase the quality of collaboration in networks and other contexts where agents interact ([blinded for review]; Hardwick, Anderson, and Cruickshank 2013; Levin, Cross, and Abrams 2004). Trust is especially essential for knowledge development and diffusion, especially in relation to tacit knowledge (Hatak and Roessl 2010; Krogh, Ichijo, and Nonaka 2000; Mooradian, Renzl, and Matzler 2006). Trust helps to overcome the tension between knowledge sharing and protection (Bogers 2011). Trust, therefore, is also a condition for the positive development of the productive dynamics of a RIS.

There exists little research on how to build trust within RISs. However, the growing literature on trust in networks or clusters (Anderson, Steinerte, and Russell 2010; Abrams et al. 2003, De Noni et al. 2013; [blinded for review]; Vangen and Huxham 2003) may be useful also for understanding the dynamics of trust in larger systems.

A trustor's trust in a trustee may be based on his observation of the personal traits of the trustee, both pertaining to his moral qualities and his competencies (Mayer, Davis, and Schoorman 1995). In addition to such cognitive-based forms of trust, trust may also be more emotion- or affect-based (McAllister 1995; Lount Jr. 2010). In both cases, face-to-face-meetings, or bringing people together in formal as well as informal dialogue, are conducive to trust (Nilsson and Mattes 2015). Also conducive to trust in larger social contexts is ensuring that decisions are fair and transparent, sharing resources and working together in temporary groups (Abrams et al. 2003; [blinded for review]; Holtz 2013; Korsgaard, Schweiger, and Sapienza 1995). Moreover, although trust is typically seen as a precondition for collaboration, the reverse may also be the case: small or seemingly insignificant collaborations may positively influence trust between partners, and lay the ground for further collaboration and trust-building in the future (Yamagishi et al. 2005).

NBIB seeks to build and enhance trust among the members of a RIS – more specifically those who are involved in the NBIB process – by allowing them to meet face-to-face in the same space (Nilsson and Mattes 2015). Moreover, it seeks to speed up the trust generation process by introducing simple but powerful micro-practices.

One such practice is the presentations in the first part of the workshop, and the fact that each presenter is encouraged to contribute a personal detail. The underlying logic is simple, but significant: By giving away some personal information, the participants become more visible to each other as whole persons, and - even more significantly – each participant is able to recognize how the personal information shared convey information on the others' characters, hopefully in a positive sense. Thus, a field is established where initial trust may grow, consistent with the theory that initial trust is typically built on the observation of the character traits of others, or inferences made on the basis of such observations.

The frequent breaks, and the way these are organized, are designed to further leverage trust. The breaks create temporary spaces for informal socialization. Actually, already before the workshop starts, such a space is created by inviting the participants to arrive early, and by having coffee and other refreshments available.

The obvious value of these informal spaces, repeatedly created throughout the day, is to allow people to mingle and involve in small talk, thus providing them with the opportunity to be further acquainted. The refreshments have also a precise function: In all cultures, sharing a meal or a drink has traditionally been viewed as a sign of friendship, and are therefore frequently used to build relationship, also in professional settings (Taminiau and Berghman 2010; Taminiau et al. 2011). We assume that the presence of refreshments works in the same way in NBIB: It invites participants to establish an initial intimacy that is conducive to trust building.

In the workshops where projects are established on the basis of problems brought into the workshop by the enterprise representatives, participants learn to know each other in yet another way conducive to trust. In this case, the participants not only learn to know each other – or more specifically their respective enterprises – through the problems that they present; the very act of disclosing a problem of this nature is a powerful trigger of trust. By doing this, the participants who disclose their problems signal that they do not regard the others present as opportunistic, but that they trust them, and that they may trust them in return.

Research has shown that procedural justice builds trust in groups (Korsgaard, Schweiger, and Sapienza 1995; Holtz 2013). Consequently, in NBIB, a strong emphasis is placed on procedural justice, and also on communicating at all times that the process will be fair, that the interests of the participants will be protected, and that they will not be manipulated into doing or sharing something that conflicts with their interests. In this respect, the invitation is relevant, as it states explicitly how the process will unfold. Additionally, participants are allowed to opt out of the process at any point – and this is communicated early as well. For instance, they are allowed to leave after the first plenary session of the workshop, if it turns out that none of the project groups are of interest, or if for some other reason they do not wish to participate any further. The point of this measure is to reduce the level of perceived risk, by giving the individual participant control of his/her own mode of participation, and taking away any hints of potential manipulation, thus building the necessary trust to get the process going.

The participants are also granted full autonomy in the formation of the project groups, which are based on the interests of the enterprises and researchers present. Again, the aim is to reduce the level of perceived risk, and thus lay a foundation out of which trust may grow.

Collaborative attitude

A region may have a number of enterprises within similar or related industries, and excellent and relevant R&D-institutions, and still have minimal collaboration between them. There may be several reasons for this, such as the existence of a culture of competition in the past. If we look at collaboration as involving skills (Johnson and Johnson 1989), then the lack, or relative lack, of collaboration may also be the result of too little collaborative practice in the past. To realize the potential for innovation that lies in increased collaboration, potential partners must then, so to speak, *learn* to become better at collaborating.

Having a collaborative attitude means being positive towards the idea of initiating collaborations with others. In a stronger sense, it means actively searching for collaborative partners when facing challenges that are better solved in collaboration, than alone.

NBIB may be viewed as an arena for learning to become better at collaboration in more than one sense. In becoming better acquainted through the introductions at the beginning of the workshop, for instance, each participant gets in a better position to gauge how the others may

assist them in realizing some innovative idea, or *vice versa*. A basic collaborative skill is to be able to detect or define common or complementary goals (Johnson and Johnson 1989). The NBIB process is designed to help the participants do that.

If they decide to initiate a collaboration, they also have the opportunity to get a broker to facilitate the process, which increases the probability of a successful collaboration. This is significant, as mastery is positively correlated with motivation; when someone experiences to be good at doing something, it increases this person's motivation for becoming involved in this particular activity in the future (Lawrence and Robinson 2007; Falk and Kosfeld 2006; Carayon 1993; Stanton and Barnes-Farrell 1996; Seligman 1972). By giving participants the opportunity to initiate and complete successful collaborations, therefore, NBIB also enhances the motivation to collaborate more in the future, and, consequently, it strengthens their collaborative attitude.

Distrust or lack of trust has a detrimental effect on collaborative attitude. Therefore, the micro processes included in NBIB to enhance trust are also relevant in the present discussion on how to build more collaborative attitude.

Entrepreneurial experimentation

Entrepreneurial experimentation implies probing into new technologies and applications that should at some point be introduced to the market with market success or market failure as possible outcomes (Bergek et al. 2008). NBIB promotes entrepreneurial experimentation by inviting enterprises to enter into joint innovation projects with R&D institutions, based on technologies or scientific knowledge that may be more or less unknown to the enterprises. NBIB may also reduce the risk involved in such experimentation by helping enterprises form alliances and collaborations that disperse the risk among the partners. Risk reduction may also take place by introducing into the NBIB process financial instruments, for instance in the form of funding.

Preliminary summary

In this section, we have described how NBIB was designed as a fresh attempt to translate central dimensions of RIS-theory into a manageable method in order to better realize the

pragmatic potential of the theory. A significant motivation behind the design of NBIB was to find a method that achieves the same as IIB, i.e. help enterprises and R&D-institutions initiate joint innovation projects, while additionally exerting a stronger and wider impact on the productive dynamics of the RIS. In elaborating this idea, we have presented a concept of the productive dynamics of a RIS with an emphasis on seven functions and dimensions, and we have explicated how NBIB was designed to enhance four of these: knowledge development and diffusion, trust, entrepreneurial experimentation and collaborative attitude. We have also provided our theoretical arguments for why this design was chosen, i.e. how and why various parts of NBIB are conducive to these outcomes. A summary of the theories, their key references, and their relevance to NBIB, is provided in table 2.

Table 2 in here

In the next section, we will present a preliminary evaluation of how NBIB meets these expectations based on five cases in which the method has been implemented.

4. A preliminary evaluation of NBIB

In order to assess the potential use of NBIB, this section will present a preliminary evaluation of the implementation of NBIB in two networks in a Norwegian region. The evaluation has the form of a multiple case study involving five cases. The findings serve to answer the second research question of this paper: To what extent and in which way can network-based innovation brokering (NBIB) contribute to strengthening the productive dynamics of a RIS?

The Cases

The cases are localized in the [blinded for review] region in Norway. Four of the cases took place within a regional network of small and medium-sized enterprises (SMEs) in the water technology industry – [blinded for review]. Since 2007, [blinded for review] has been one of the main areas of activity for VRI [blinded for review]. The fifth case included SMEs from a regional cluster in the electronics and micro-technology industry. All the workshops were facilitated by the same pair of brokers, i.e. the authors of this paper. Table 3 below provides

an overview of the workshops with number of participants, proportion of enterprises and researchers, number of project applications and number of projects funded.

Table 3 in here

All five cases had the same basic design, the third and fourth in a slightly modified form. In the third case, there had been active recruitment of researchers with a special expertise in micro- and nano-technology. As this technology was new to most of the other workshop participants from the water technology industry, more time than usual was allocated for the researchers to present and explain their field of expertise. Moreover, in the project design formation phase the main emphasis was to form project groups focussing on how to include the new technology in product developments.

In the fourth case, in addition to the attendance of [blinded for review] members, privileged attendance had been granted to four major customers, i.e. four regional public water suppliers. At the workshop, each of these customers was allotted extra time to define their perceived future needs for technological development. This was then used as a starting-point for a discussion on how the other participants, enterprises and researchers, might form project groups with the aim of searching for new solutions to these challenges.

In all the cases, the project groups had the opportunity to apply for funding from a regional R&D fund. The maximum amount of funding available was in the region of 25 000 euro per project.

Data Collection and Research Method

In order to evaluate the five cases, data were collected through interviews, questionnaires, workshop observations, field notes, overviews of the participants, funding applications, result reports and a master's thesis ([blinded for review]). In the first two cases, data were collected through telephone interviews sometime after the workshops. For the subsequent cases, questionnaires were designed based on the questions that had been used in the interviews. These questionnaires were distributed to the participants immediately after the workshops ended, and were answered *in situ*. Because some participants left before the evaluation took place, or chose not to answer, the response rate is 48 %.

A number of dimensions were defined by the researchers for measurement. The emphasis was placed on dimensions that according to RIS theory are conducive to the productive dynamics of RISs, such as trust, knowledge transfer and collaboration. In the interviews and questionnaires, the participants were asked to estimate – on a five-point Likert scale – how the relevant dimensions had developed during the workshop. For instance, they were asked to assess their level of trust towards the other participants before and after the workshop. Also included in both the interviews and questionnaires were open questions, allowing more in-depth answers.

Being involved in the design of NBIB, its implementation and its evaluation, the authors of this paper staged a process that combines action, research and reflection. According to Reason and Bradbury (2008), these are the very features of action research. The resulting project is therefore a combination of action research and more traditional social research based on data collection and analysis.

5. Findings

Project initiation

The immediate aim of NBIB is to establish innovation projects through collaboration between enterprises and researchers. Table 3 provides an overview of not only the number and type of participants at each workshop, but also of the number of projects initiated. Summarized, 98 individuals (69 enterprise representatives and 29 researchers) participated in the five cases, 23 applications were submitted and 18 projects received funding. Of these, 12 entailed collaboration with a regional R&D institution, while seven entailed collaborations among two or more enterprises. Sixteen projects covered technological innovation and two covered organizational innovation, and while two projects included the DUI mode of innovation only, the other 14 projects included a combination of the DUI and the STI modes of innovation. In table 4, we present a selection of four of the projects that were initiated, introduced for illustrative purposes. It provides an overview of project titles, participants, mode of innovation and project outcome.

Table 4 in here

As table 4 shows, the projects have resulted in solving technical, process-related and organizational challenges in the involved firms, as well as the discovering of new market opportunities. They have led to the establishment of new external contacts, a demo-prototype, publications in scientific journals, new regional, national and EU-funded research projects, and increased know-what, know-why, know-that and know-who competence. In one case, also, a new firm was established.

Knowledge development and diffusion

As observers of the workshop, we could note that all the forms of knowledge were shared and/or developed. Know-who knowledge was expanded, as people who had not met before learned to know each other through the presentations and in the following dialogue. Also, when discussing technical challenges or ideas, such knowledge was being shared when someone referred to a non-present person with an expertise relevant to the topic being discussed, or offered tips on whom to contact in order to get more help. When we look at the answers to the question of how well the participants *knew* the others before and after the workshop, the average increase in the questionnaires was up 1.2 points, from 2.5 to 3.7.

Explicit analytic know-what and know-why knowledge was shared in the more technical discussions, both in the introductory plenary sessions and later in the project groups. In the project groups, the learning became even more dynamic and intensive as the participants frequently entered into spontaneous brainstorming processes involving highly specific and advanced technical details. In some cases, participants who for some reason did not choose to commit to a project still joined in these group sessions, and contributed eagerly to the dialogue by sharing their ideas and expertise, or by taking on the role of an informal “coach” for the process.

Tacit, synthetic know-how knowledge was developed as the participants – by taking part in the brokering process – learned *in practice* how to design joint innovation projects. This involved for instance the skills needed to write an application for funding, or to communicate with representatives of other professional fields with all the challenges that such communication entails. Some participants also reported that participation in the brokering

process had given them new and useful insight in the functioning of their local regional innovation system.

Finally, by reading and evaluating the project applications, the representatives of the regional government institutions who participated in the regional VRI board increased their know-what and know-who knowledge relative to the field in which they were set to operate.

Trust and collaborative attitude

Some of the enterprise representatives who attended the workshops knew each other in advance, as their companies were already part of the invited network. Still, at every workshop a considerable number of participants did not know any of the others, either because their enterprises were new to the network, or because the attending enterprise representatives had not participated in network events before. When asked to what extent they trusted the other parties present, most of the respondents reported an initial high level of trust before entering the workshop. Those who did not report the maximum value at the outset stated that their trust had increased during the workshop. Summarized, the average increase in trust for all participants and all workshops was 0.4 points - from 3.8 to 4.2 - on the five-point Likert scale. Furthermore, in the answers to the open question of whether the workshop had had any useful output in addition to the technical/professional aspect, 82 % of the respondents stated that participation in the workshop had contributed positively to build relationships and trust. The social dimension also scored high when participants were asked why they had decided to take part in the workshop in the first place.

These answers conform well to what the facilitators could observe during the process: In all the breaks, the participants engaged in lively discussions; many also stayed behind after the official program had ended, enjoying intense conversations with other participants ([blinded for review]).

To strengthen the productive dynamics of a RIS, its members need to collaborate, and the NBIB workshop aims especially at initiating and reinforcing collaboration between enterprises and R&D institutions. The average positive *attitude* towards such collaboration increased in all the five cases. The average value for the enterprises' attitude towards collaboration with researchers increased by 0.2 point - from 4.3 to 4.5. The corresponding

value of the researchers' attitude towards collaboration with enterprises increased by 0.3 point - from 4.4 to 4.7.

Entrepreneurial experimentation

Of the 18 projects that received funding, 16 covered technological innovation; as such, they represent in some way or another entrepreneurial experimentation, or they have the potential to result in such experimentation. Of these projects, three also introduced an enabling technology new to the industry, i.e. micro- and nanotechnology. We deem it likely that few of these projects would have been initiated had it not been for NBIB. Also, in spite of the fact that the funding granted in the five cases was considered relatively small, it was judged significant enough to prompt participation. In particular, the smaller SMBs found the funding useful, as it reduced some of the financial pressure involved in initiating the project, and thus contributed to reducing the risk involved.

Differences between the cases

Although the five cases had basically the same design, there were some minor differences between them. The first two cases and the last one were more "open", in the sense that every participant had equal opportunities to present challenges and ideas as starting points for possible group formations. In the third and fourth case, some members had been allotted more time to present themselves at the beginning of the workshops. In one case, these were large customers to the industrial participants present, and in another case, they were researchers with an expertise in micro-nano technology. In addition, the fourth case differed because of a higher number of participants than the others.

Did these differences influence the process, and if so, how? In all the cases, the overall satisfaction with the workshop was good, with an average of 4.3 (still on a five-point Likert scale). The lowest satisfaction was found in the fourth case, with an average of 3.8. The participants of this workshop were also slightly less satisfied with the facilitation. They found the initial dialogue less useful and they were more dissatisfied with the relevance of the researchers present. In addition, some enterprises that they had hoped would be participating had failed to attend. Furthermore, the participants complained that no one seemed to take

project ownership in the group-formation part of the workshop, and that the resulting groups were too small to be productive. The scores on trust and relation building were, however, similar to those of the other cases.

The fifth case yielded a higher average score in the overall satisfaction with the workshop. This is also the case where the positive attitude towards R&D had the steepest increase during the workshop, as reported by the enterprises. Again, the scores on trust and relation building were similar to those for the other cases. We will elaborate further on these findings in the discussion below.

6. Discussion

The evaluation of the five NBIB cases suggests that the movement from theory to practice involved in the design of NBIB has been a success: in addition to the generation of innovation projects responding to the challenges of regional enterprises, new relations between RIS-members have been established, existing ones have been reinforced, and trust has improved. Furthermore, NBIB has acted as an arena for knowledge development and diffusion, for the fostering of trust and collaborative attitude, and for entrepreneurial experimentation.

What impressed us most as designers, facilitators, and observers was the intensity and multifaceted nature of the processes going on in the relatively short duration of the NBIB workshops - that is, how productive it was. Although this is not the place to carry out a full-scale comparison between IIB and NBNB, it is well known that in IIB the broker often visits several enterprises before a R&D-project is established, and that a significant amount of resources are spent even before the brokering process may begin (Jakobsen et al. 2012). In addition, even when a project is initiated following an IIB initiative, its positive effects outside of the project group are limited. For instance, while the innovation broker builds an extensive network of a growing number of enterprises and R&D-institutions, the corresponding know-who knowledge remains within the broker, and is not distributed to larger parts of the system. Furthermore, even if a relationship develops between a particular enterprise and a R&D-institution, no additional relation- or network-building takes place. Finally, while the innovation projects may involve learning and knowledge sharing for the parties involved, there is no additional spillover of learning to the larger innovation system.

In a typical NBIB, a number of project groups are established in a short time and with seemingly little effort, with the groups even getting extra time to start working on their project plans. Equally important is what occurs during a NBIB workshop in the field of relationship-building, trust-building, knowledge development and diffusion and entrepreneurial experimentation. We conclude, therefore, that NBIB strengthens the productive dynamics of the RIS involved.

The main explanation for the productivity of a NBIB workshop, as we see it, is the power that lies in bringing so many people from the RIS into the same space, along with the selection criteria for recruiting participants, and, of course, the design of the workshop. The selection criteria for recruiting participants imply that invitations are issued to enterprises and researchers from the same region. Additionally, the aim is to gather a group with ample potential for new and productive connections between actors in joint collaborations.

The intensity of the learning and the knowledge-sharing taking place at the workshop obviously also has to do with the number of participants involved in the process. As each participant brings into the workshop a certain amount of knowledge, the total sum of knowledge present radically exceeds what any single agent could possibly possess beforehand. Therefore, in presenting a challenge or in posing a question in the context of a NBIB workshop, the probability of receiving potentially helpful information increases dramatically. This harmonizes with what was observed, both in the plenary sessions and in the smaller groups: people presenting challenges sometimes receives cascades of useful tips or information on how to solve specific parts of the challenge.

The willingness to contribute in this sense, obviously, relates to the presence of trust. According to the evaluations, the workshops were characterized by an initially high or growing trust among the participants. What actually caused trust to grow during the workshops cannot be immediately deduced from the questionnaires or the interviews. Based on observation, however, the part of the presentations where the participants had to share a personal detail seemed to create a friendly and relaxed atmosphere. One could clearly see how the small stories from the participants' summer holidays – about walking in the mountains, renovating the house or becoming a father, etc. – brought forward smiles and even laughter, creating a social space that made it easier to share and discuss also other topics in the following dialogue. The concepts of identification-based trust and swift trust may serve to describe the relevant dynamics of the trust here produced: swift in the sense that it arose

rapidly, and based on the recognition that one had certain qualities in common. Moreover, the project groups during the workshop function like temporary groups with time pressure, which has been found to be conducive to swift trust formation (Meyerson, Weick, and Kramer 1996). Trust research has also proven that *trust engenders trust* (Dunn, 2005; Lount jr. 2010). Creating small moments of trust-building at the beginning of a dialogue may therefore start a virtuous circle of continuous trust evolvment. The initial trust engendered through the presentations at the beginning of the workshop, with its personal dimension – however weak – acquires therefore even more significance.

In this respect, the honesty that was sometimes displayed in the opening round of the workshop, when participants decided to disclose their enterprises' technical challenges, also stands out as significant. In a competitive setting, such a disclosure entails the risk that others may use it opportunistically, for instance by leaking the information to potential customers in order to undermine their confidence in the enterprise in question. In actually sharing such information, the participants therefore signal that they do *not* perceive the others as opportunistic competitors; on the contrary, through their openness they imply that they trust the others *not* to misuse the information, and that they themselves can be trusted in the same way.

A potential problem in measuring trust is that the results may be positively biased by the respondents' wish to appear more trustful than they are, and to hide their distrust correspondingly. In this respect, it is illustrating that the two examples of lack of trust that we came across in the five cases, were disclosed in personal conversations outside of the formal workshop context. In both cases, the persons in question admitted to holding back information in the plenary sessions due to its potential high value to their companies, and from fear that others might take advantage of it. It might well be that more participants did the same. On the other hand, it would be wrong to assume that optimal trust in a setting like NBIB should involve full disclosure and no holding back of information whatsoever. The optimal trust level should rather be conceived as the level where participants disclose the right amount of information relative to the context they find themselves in. In a NBIB process, this means disclosing the information necessary to initiate collaborations.

In a more private context, one may then reach the degree of trust necessary to disclose more; this is also the reason why it is important during a NBIB workshop to offer the chance to

engage in both formal and informal dialogue, and to switch between plenary sessions and smaller groups.

In addition to the potential risk involved in disclosing information in a project formation process, there is also the risk that participants in an established collaboration may act opportunistically by hi-jacking the process and harvesting a disproportionately larger share of the profit. In this light, it should come as no surprise that some of the enterprises made clear, before or during a NBIB workshop, that they would not welcome a specific competitor as a collaboration partner, or that they had made an agreement to collaborate with a certain constellation of enterprises before entering the workshop. Such resolutions were received rather casually by the other participants, and did not seem to generate any negativity. The explicit rule that each participant had full autonomy in the project formation process probably helped to downplay their significance. Neither did such episodes seem to have had a lot of influence on the general trust between the participants as expressed through the interviews and the questionnaires.

If we consider entrepreneurial experimentation as a significant function partially defining the positive dynamics of a RIS, we may conclude that most of the projects created in the five cases represent such experimentation. If we limit the notion of entrepreneurial experimentation to cases where a radically new technology was introduced, the number of examples is reduced. However, if desired, NBIB may achieve more in this respect through a more inventive selection of researchers and type of expertise to be included in the workshop.

Comparing the five cases of the present study with each other, the fourth case stands out as perhaps the most interesting, but also somewhat puzzling from a process perspective. As the number of researchers present at this workshop was higher than usual, and their range of expertise was correspondingly wide, it seems unlikely that the lower satisfaction with this workshop be really due to the selection of researchers, as the feedback suggested. A more tenable explanation may be found considering its larger number of participants (42), which may have contributed in making the process harder to control/supervise, and therefore less rewarding. Probably the facilitators should also have been more alert in the group formation phase: The fact that some of the groups were too small to be productive, and that some of them had no researchers as among its members, was obviously not optimal.

We regard the above considerations as proof of how essential facilitation is for a successful outcome of a NBIB. Implementing NBIB on a general level, so to speak, does not suffice.

Inviting members of the RIS into the common space represented by the workshop guarantees nothing in itself. Every part of the process need to be organized and facilitated properly.

Based on the experiences from the fourth case, we learned for instance not to allow a group to start working on a project plan until the group composition makes it probable that they have the resources to succeed. If the facilitators have doubts as to the functionality of the group, they should asked whether others might want to join the group, or whether the group members would perhaps do better in joining other groups instead. As facilitators, we also learned the value of being more active in visiting the groups during their work sessions, and in facilitating these sessions if necessary.

This was all implemented in the fifth workshop. We also believe that - to some extent - this accounts for the greater satisfaction expressed by the participants in this case. Because the water technology network was still in an early phase of its development when the first two workshops were organized, few other arenas for getting together had been established at the time. This may account for the higher perceived usefulness observed in the first two workshops; for a number of the participating enterprises they *de facto* served as their entry into the network.

This paper is based on the thesis that the development of methods aiming to alter a field in a systematic way should be based on the best current theoretical description of the relevant field. More specifically, this paper maps out the attempt of the authors to construct a method for realizing the pragmatic potential of RIS-theory. The underlying assumption that this starting-point yields better methods and - consequently - better results can hardly be definitely proven or rejected through a case study research design. However, we take the positive outcome of the evaluation of the five NBIB cases and its interpretation in the present section as a preliminary confirmation of the thesis.

7. Conclusion

This paper has provided an account of the development of a method – NBIB – designed to strengthen the productive dynamics of a RIS. Special emphasis has been placed on explicating how insights from RIS theory, including trust theory, have been translated into practical measures, thus answering the first research question: *How may one translate the theoretical*

insights of RIS theory into manageable micro-level methods that effectively bring out the pragmatic potential of the theory?

The evaluation of five NBIB cases indicates that the movement from theory to practice involved in NBIB has been a success: In addition to knowledge development and diffusion, NBIB served to strengthen collaborative attitude and trust between members of the RIS, and it served as an arena for entrepreneurial experimentation. We have also provided our theoretical arguments for how and why various parts of NBIB are conducive to these outcomes.

Finally, NBIB seems to invite enterprises to initiate projects drawing upon two modes of innovation; Science, Technology and Innovation (STI) and Doing, Using and Interaction (DUI). As we have seen, the combination of these modes is highly conducive to the innovation performance of enterprises. NBIB therefore constitute a method that effectively brings out the pragmatic potential of RIS theory.

The answer to the second research question: *To what extent and in which way can network-based innovation brokering (NBIB) contribute to strengthening the productive dynamics of regional innovation systems?* is that the method seems to be efficient for fostering knowledge development and diffusion, trust, entrepreneurial experimentation and collaborative attitude among regional enterprises and R&D institutions, and to some extent also regional governmental units.

This paper has theoretical and practical implications. Theoretically, the paper represents a call to the community of innovation researchers and practitioners to give a higher priority to the question of how to better bring out the pragmatic potential of RIS-theory. This involves both examining how well existing methods for RIS-interventions are theoretically grounded in RIS-theory, and developing new, better-grounded methods that may function more effectively. Practically, NBIB offers itself as an effective method that may easily be put into practice. The method may be useful for regional policy makers and SME networks. It may also be useful for regional R&D institutions or universities, who aspire to play a more active role in reinforcing and contributing to the RIS of which they are part.

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Table 1. The main phases of NBIB

Main phases	Activities	Tasks for the brokers
Before the workshop	Relevant enterprises and researchers are identified, and invited to the workshop.	The brokers scan and select participants, and form the invitation.
Workshop	Ideas for innovation projects are shared. Project groups are established. The groups start to design project plans. Trust is actively enhanced through presentations, informal breaks/conversations, etc.	The brokers facilitate the plenary processes, and assist the project groups.
After the workshop	The project groups work independently on their projects.	The brokers assist the project groups if asked to.

Table 2. Summary of theories used in the paper, selected key references and relevance to NBIB

<i>Theory</i>	<i>Selected key references</i>	<i>Relevance to NBIB</i>
Regional innovation system	Etzkowitz and Leydesdorff 2000 Cooke 2001 Asheim and Gertler 2005 Asheim, Smith, and Oughton 2011 D'Allura, Galvagno, and Mocchiari Li Destri 2012	NBIB connects relevant members of a regional innovation system, in particular from industry, university and government.
The productive dynamics of a RIS	Bergek, Jacobsson, Carlsson, Lindmark, and Rickne 2008.	NBIB influence positively the following functions and dimensions of the productive dynamics of a RIS: a) knowledge development and diffusion b) trust c) entrepreneurial experimentation d) collaborative attitude
Knowledge development and diffusion	Polanyi 1967 Nonaka and Takeuchi 1995 Coenen and Asheim 2006 Jensen, Johnson, Lorenz, and Lundvall 2007 Parrilli and Asheim 2012 Toedtling, Asheim, and Boschma 2013	NBIB is designed to promote knowledge development and diffusion at every stage, involving several knowledge forms in both their tacit and explicit modes.
Trust	McAllister 1995 Abrams et al. 2003 Levin, Cross, and Abrams 2004 Blinded for review 2012 Hardwick, Anderson, and Cruickshank 2013 Nilsson and Mattes 2015	NBIB builds trust by allowing participants to meet face-to-face in the same space, by inviting them to give away some personal information, by letting participants from different organizations work together in small temporary groups with time pressure (swift trust), and by creating informal space for socializing. Relevant is also procedural justice and transparency.
Collaborative attitude	Johnson and Johnson 1989 Falk and Kosfeld 2006	NBIB functions as an arena where collaborative skills are learned or strengthened, for instance, by assisting the participants in finding common or complementary goals.

Table 3. Participants, respondents, applications, projects and funding in the five cases.

Case	Number of enterprise represent- tatives present	Number of enterprises present	Number of researchers present	Number of respondents	Number of project applications	Number of projects funded	Total funding (in 1000 €)
1	12	6	3	4	6	4	45
2	10	7	4	5	6	5	65
3	10	8	5	12	4	4	75
4	26	18	9	16	4	3	75
5	11	11	8	10	3	2	50
Sum	69	50	29	47	23	18	310

Table 4. Projects, participants, mode of innovation and outcome

Project title	Participants	Mode of innovation	Outcome
Increased water purification capacity at a hazardous waste firm	A private firm processing hazardous waste A private water purification firm A public university	Mainly DUI Some elements of STI	Increased water purification capacity at the waste firm Discovery of purifying polluted water as a new market opportunity for this firm Establishment of a new relationship between this firm and a related firm outside of Norway Increased know-what, know-why and know-that competence for all participants and increased know-who competence among them
Microfluidic system for the real-time monitoring of waterborne pathogens in drinking/bathing water	Two (competing) private water purification firms A regional public university college	Mainly STI Some elements of DUI	A demo-prototype of a biological water alarm system is under development (spring 2015) The establishment of a new firm Six publications in international scientific journals Four follow-up research projects; two funded from a regional research foundation, one from the Research Council of Norway, and an EU Horizon2020 SME project in collaboration with a water firm Increased know-what, know-why and know-that competence for all participants and increased know-who competence across them
Collaboration in fast-growing enterprises	A private water purification firm A research institute	Mainly DUI Some elements of STI	An organizational innovation that was judged to be a necessary condition for further expansion of the firm Increased know-what, know-why and know-that competence for both participants, and increased know-who competence across them
Combining two purification processes (UV-light and marble sand) at a drinking water plant	A public drinking water plant Two (competing) private water purification firms A public university	Mainly DUI Some elements of STI	The combination of the two purification processes has radically improved the purification process with reduced need of chemicals and plant maintenance. Increased know-what, know-why and know-that competence for all participants and increased know-who competence across them