

Conditions Influencing Knowledge Creation in the Early Stages of Research Networks

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Abstract

In today's knowledge intensive industries, the continuous creation of knowledge is argued to be the competitive advantage of organizations. To be able to create knowledge, organizations have begun to operate in networks that offer access to the critical resources and expertise of other organizations. Acknowledging the conditions influencing knowledge creation in such networks has therefore become of crucial importance, especially in the critical early stage of the network development. Consequently, this study aims to describe these conditions in the context of early stage research networks. The theoretical part of this study is based on IMP network theory, which is integrated with additional viewpoints on multi-actor co-operation from the community of practice theory. The empirical part of this study introduces a qualitative single-case study of a university research network, which develops and tests new mobile services. Based on the theoretical and empirical findings, this paper presents a framework of the conditions influencing knowledge creation in research networks in their early stages.

Keywords

research networks, knowledge creation, network conditions, communities of practice

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Introduction

Organizational knowledge and its continuous creation have become widely discussed topics for both academics and practitioners. The idea of knowledge being a resource for organizations is not new, but it is only nowadays that its importance has been recognized. (Hislop 2003; Seidler-de Alwis et al. 2003). In other words, it is argued that knowledge, and particularly innovations based on continuous knowledge creation activities, are the cornerstones of competitive advantage for organizations (e.g. Gold et al. 2001; Nonaka & Takeuchi 1995).

However, in order to create innovations, organizations have begun to operate in networks of multiple actors, ranging from private to public sectors (Dyer & Nobeoka 2000; Powell et al. 1996). This is because networks offer access to an important and vast pool of knowledge and resources that no single organization can acquire individually (Dyer & Nobeoka 2000; Möller

& Halinen 1999, Powell et al. 1996). In other words, today innovations are based on knowledge that is distributed not only within, but also increasingly across organizations (Dyer & Nobeoka 2000; Powell et al. 1996; Swan et al. 1999).

Consequently, it has become vitally important to comprehend how the context of network consisting of multiple types of organizations influence the creation of new knowledge (Porac et al. 2004), i.e. what kinds of elements in a network facilitate or inhibit it (Johnson & Johnston 2004). This study approaches this question from the viewpoint of networks whose primary purpose is particularly to create new knowledge, i.e. *research networks*. In other words, the goal of this study is to define and describe conditions influencing knowledge creation in research networks. This topic is firstly approached from the theories of industrial networks and communities of practice. Secondly, a qualitative single-case study of a university research network is presented to evaluate the theoretical viewpoints.

This study concentrates on analyzing research networks that are in their early stage of development. This is because it is argued that networks are not static entities, but in a continuous process of evolving, and different types of conditions influence knowledge creation in different stages of evolution. (Möller & Svahn 2002). It has been stated that the early stages of network evolution are crucial as they usually determine the success of the network, i.e. how it manages to create new knowledge (Doz 1996). Furthermore, in this study the conditions are discussed at the level of organizations in the network, not e.g. at the level of individual employees (where individual cognitive skills, demographic characteristics etc. would be of greater emphasis).

The next two chapters present the theoretical standpoints of this paper by describing the context of research networks and discussing the conditions that influence knowledge creation in them. After that, a case study of a university research network is presented, and finally a framework of conditions influencing knowledge creation in early stage research networks is introduced.

Knowledge creation in research networks

This chapter introduces research networks and how knowledge is created within them. It also presents the essential viewpoints of the community of practice -literature that can be utilized when studying research network conditions for knowledge creation.

Research networks

The network perspective states that network relationships are developed to gain access to and utilize the resources and capabilities other organizations in the network possess (Håkansson & Snehota 1995). The Industrial Network Theory, developed e.g. by the IMP Group (ibid.), has introduced an actors-resources-activities (ARA)-model (e.g. Håkansson & Johansson 1992) to describe the basic elements of such networks.

According to the ARA-model, networks consist of multiple actors, carrying out multiple actions on multiple types of resources possessed by the actors (Håkansson & Snehota 1995; Håkansson & Johansson 1992). In the network, individuals, groups, organizations, or groups

of organizations can operate as actors. Actors have different types of collaboration relationships with other actors in the network (*ibid.*). The resources are the technical, financial, and intellectual assets the actor possesses (Håkansson & Snehota 1995; Håkansson & Johansson 1992). Notably, in the ARA-model the knowledge an actor has is seen as a resource (Håkansson & Snehota 1995). When actors utilize their resources in a network (combine, develop, exchange, and create them), activities are generated (Håkansson & Johansson 1992).

A notable characteristic of networks is their complexity, e.g. number of actors and their types, background, and connections (Håkansson & Snehota 1995). The actors of networks are also argued to be interdependent in their operations (Håkansson & Snehota 1995), which are connected in a way that past experiences and operations influence the way the operations are carried out in the future (Håkansson & Ford 2002). In addition, according to Möller & Svahn (2002) different types of networks vary e.g. in their goals (systemic efficiency vs. new offerings), dynamics (from stable to highly dynamic), and the type of knowledge available (explicit vs. tacit). Hence, each type of network produces value - i.e. offerings, systems, knowledge – through different types of joint activities. Möller & Svahn (*ibid.*) argue that networks aiming to create new knowledge (e.g. new technologies, products or business concepts) can be defined as emerging value systems, which are future-oriented, and require perhaps very radical changes in both existing value systems and in the creation of new value activities. These types of networks also have both old and new actors, and are characterized by an overall uncertainty about both value activities and actors.

Knowledge creation in research networks

It is argued that knowledge has both tacit and explicit (Polanyi 1966), as well as individual and social (von Krogh et al. 2001) elements. Tacit knowledge is very personal, rooted in individual's actions and experience, and is hard to be communicated or formalized. Explicit knowledge, on the other hand, is codified, and can be transmitted in formal, systemic language. (Polanyi 1966). Individual knowledge in turn deals with individual observations and actions in the world, whereas social knowledge encompasses for example common rules and forms of practice, as well as traditions (von Krogh et al. 2001). Consequently, it can be noted that knowledge resides in multiple forms, and is more easily accessed from some forms than others.

It is then argued that new knowledge originates from social interactions between people (see e.g. Kulkki 1999; Seely Brown & Duguid 1998; Nonaka & Takeuchi 1995), and that new tacit knowledge deriving from these interactions is the activator of organizational knowledge creation. Nonaka & Takeuchi (1995) have described organizational knowledge creation through a process in which people from multiple levels of organization(s) socialize, conceptualize, combine, and internalize existing tacit and explicit, as well as individual and social knowledge (see Figure 1). New knowledge, which is created through this process, is then “embedded” into products, services, systems etc. (Nonaka & Takeuchi 1995).

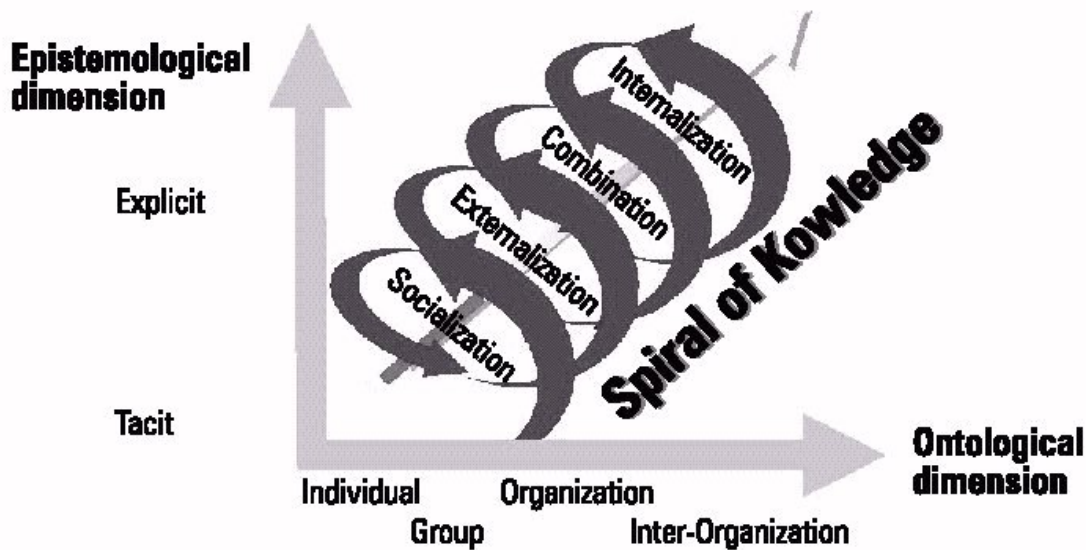


Figure 1. Spiral of knowledge (Seufert et al. 1999).

In addition, in his research on R&D partnerships, Doz (1996) argued that in the early-stages of co-operation, the partners not only create knowledge from their joint offering, but also learn about each other, ways to co-operate and the context in which they aim to co-operate. It can then be argued that the stage of development in which co-operation is, also in research networks, influences knowledge creation and its results (Orlikowski 2002; Doz 1996).

Consequently, this study argues that inter-organizational knowledge creation takes place in interactions between network actors. From the characteristics of knowledge it follows that the knowledge creation process includes many types of knowledge, some types being harder to access than others. Moreover, networks, including research networks, are complex and heterogeneous operating environments, with different types of actors operating in them. Consequently, it is argued in this work that research networks are facing the same types of challenges in their knowledge creation as diverse 'communities of practice', which will be introduced next.

Communities of practice

Communities of practice are small groups of people who work together with a common understanding of the purpose of their work (Seely Brown & Solomon Grey 1998 via Hildreth et al. 2000), and a need to know what the others know, with a primary purpose to create and disseminate collective knowledge (Kramer 1999). Practice plays a crucial role in communities of practice, as they create their worldview, i.e. their knowledge base, through it. The worldview incorporates a shared understanding of what the community does, how to do it, and how it relates to other communities. (Seely Brown & Duguid 1998). Wenger (1998) argues that gaining this shared understanding requires negotiation, which is an ongoing process in communities. Another important characteristic of communities of practice is mutual engagement, i.e. mutually agreed membership in a community, deriving from mutual commitment. Communities of practice have also a shared repertoire, which is produced over

time, and includes e.g. routines, words, tools, ways to operate, stories, gestures, symbols, actions, and concepts. (Ibid).

Consequently, different communities of practice have at least somewhat different ways of working, and therefore collaboration between them is difficult (Muukkonen et al. 2003; Möller & Svahn 2002; Hildreth et al. 2000; Wenger 1998). In other words, the knowledge that communities have is “sticky”; it is not easily shared or communicated, due to its social, community-dependent character (Seely Brown & Duguid 1998). What binds these distinct communities of practice and their knowledge creation processes together then is the larger system they belong to and moreover the joint activities they are performing within that system.

Notably, when studying communities of practice, extra caution is required in the definitions and analyses concerning them (O’Donnell et al. 2003), as it is argued that conventional communities in organizations, such as work groups, teams, or task forces, are not necessarily communities of practice (Seely Brown & Duguid 1998). This is because it is argued that membership in a community of practice cannot be obtained “by command”, i.e. communities of practice cannot be created by at least traditional managerial order (see e.g. O’Donnell et al. 2003). However, because the theory of communities of practice takes a similar standpoint on heterogeneous and complex operating environments than the network theory, the viewpoint of communities of practice is utilized in this work.

Conditions influencing knowledge creation in research networks

The previous chapter introduced research networks as a context for knowledge creation. This chapter will concentrate on presenting the main consequences that this network context brings to knowledge creation. In this work, the consequences will be analyzed through two categories: organizational culture, and organization and management. The former describes operating cultures of the actors and their capabilities to understand each other, i.e. conditions that are more actor-specific. Its viewpoints are introduced through two topics: attitudes towards collaboration and sharing, and common stock of knowledge and requisite variety. The latter category deals with network-specific structural and management practice issues. They are discussed through the topics of knowledge vision, and bridging and shared forums. Notably, the elements of both categories are intertwined in that the conditions categorized under organization and management influence the conditions within organizational culture, and vice versa. For similar types of categorizations, see e.g. Gold et al. (2001).

Organizational culture

The culture of organizations is argued to encompass all the norms and paradigms that guide their everyday behavior, relationships, and life in common (Armbrecht et al. 2001). As it has been shown that different actors in a network have different types of organizational cultures, it can be argued that the elements of culture heavily influence knowledge creation in research networks.

Attitudes towards collaboration and sharing

Collaboration and sharing are argued to be at the heart of knowledge creation (Dyer & Nobeoka 2000). This is because from the characteristics of knowledge it follows that without

collaboration knowledge creation is not possible (Leonard & Sensiper 1998). A culture which encourages sharing and collaboration between individuals is therefore said to be one of the key conditions of knowledge creation (Gold et al. 2001). Firstly, sharing in network relationships is based on openness - that actors do not withhold knowledge and information from others (Gold et al. 2001; Swan et al. 1999) and that knowledge, in one form or another, flows freely between them. Secondly, it is argued that sharing and collaboration require mutual trust (e.g. Seidler-de Alwis et al. 2003; Häusler et al. 1994), and there is actually much evidence that mutual trust between actors is a prerequisite for any deeper co-operation between them (Möller & Svahn 2002).

Thirdly, trust is argued to enhance commitment (Häusler et al. 1994). Möller & Svahn (2002) argue that the commitment of each member of the network to the process of creating new knowledge is an important element in the network. Commitment can be thus referred to as the motivation to participate in joint knowledge creation actions (Dyer & Nobeoka 2000). Fourth, identification with where one stands in the knowledge creating consortium, be it an organization or a network, is argued to increase cooperation among its members (Orlikowski 2002).

Common stock of knowledge and requisite variety

When considering research networks from the community of practice point of view, it can be noted that as different communities have at least somewhat different cultures, difficulties can be expected when they try to collaborate (Möller & Svahn 2002; Hildreth et al. 2000; Wenger 1998; Seely Brown & Duguid 1998). This is because different communities of practice may have different professional languages, routines, priorities, evaluation criteria, and thus different everyday practice (Wenger 1998; Seely Brown & Duguid 1998). They therefore have different “thought worlds” that may hinder common understanding of e.g. the product being co-produced (Olivera and Argote 1999). Hence, knowledge is “sticky”; it is not easily transferred or communicated between distinct communities of practice due to its social, community-dependant character (Seely Brown & Duguid 1998).

Especially in the case of tacit knowledge, some shared system of meaning, “a common stock of knowledge” (Kogut & Zander 1997 via Swan et al. 1999), is argued to be needed for individuals coming from different backgrounds to understand each other (Swan et al. 1999). Möller and Svahn (2002) argue that commonly held knowledge offers a base through which to start collaboration (ibid.), for it offers understanding of what other participants in the knowledge creation process know, how their practices have been formed, and how they are in the process of changing (Muukkonen et al. 2003). A common stock of knowledge is argued to be built on both redundancy (Nonaka & Takeuchi 1995) and a common stock of words (Von Krogh 1998). Redundancy refers to “irrelevant” information that exceeds what is necessary to know for one’s own work (Nonaka & Takeuchi 1995), and a common stock of words refers to commonly shared language (Von Krogh 1998). It can be difficult to obtain as language is in itself ambiguous and context-specific, always requiring some shared background knowledge to be understood. Thus, when interpreted in different communities of practice, a specific message, word, text, etc., does not necessarily have the same meaning. (Heaton & Taylor 2002).

On the other hand, the heterogeneity of a network is argued to protect it from “groupthink” (Orlikowski 2002), taken-for-granted –assumptions about e.g. ways to do things and ways to

see appropriate knowledge (Leonard and Sensiper 1998). Actors coming from different backgrounds will approach specific situations in different ways, and will hence produce more different types of solutions (Olivera & Argote 1999; Leonard & Sensiper 1998; Wenger 1998).

Organizing and management

Before moving on, it is noted that managing in this context refers to facilitating knowledge creation, not actually managing it (see e.g. Armbrrecht et al. 2001). Thus, the issues introduced in this chapter are not to be taken as normative statements (managing), but descriptive perspectives of conditions around knowledge creation (facilitating).

Knowledge vision

Nonaka & Takeuchi (1995) emphasize the role of organizational intention, knowledge vision, in facilitating knowledge creation. Vision is as an organization's (or notably, network's) aspiration to its goals (ibid.). It implies what kind of knowledge should be acquired, created, accumulated and exploited (ibid.), therefore acting as a guide in the organizational knowledge creation process (Gold et al. 2001; Leonard & Sensiper 1998). In addition, in knowledge creating networks the need for common, mutually beneficial goals regarding to the knowledge creation process is said to be of crucial importance (Möller & Svahn 2002; Doz 1996; Häusler et al. 1994). Möller & Svahn (2002) also argue that without common goals, much of the knowledge creating potential of a network depends on the more restricted knowledge base of an individual actor.

Bridges and shared forums

In networks consisting of multiple actors, the definitive problem of knowledge creation can be said to be how to collect and integrate the fragmented ideas and partial visions of its communities (Möller & Svahn 2002). Community of practice literature emphasizes the importance of constructing bridges between distinct communities of practice (Heaton & Taylor 2002; Seely Brown & Duguid 1998; Wenger 1998). There are many different types of definitions of these kinds of bridges. They can be seen as twofold: one dealing with bridging individuals, the other with objects. Firstly, Wenger (1998, 108-110) uses the term brokering when referring to people who are capable of making new connections across communities of practice, enabling coordination, and even opening new possibilities for meaning (thus, creating new knowledge). Secondly, boundary objects are objects each community is interested in, but might interpret them differently. They can be physical objects such as documents, forms, and lists; technologies or techniques shared by communities; as well as e.g. contracts and processes between them. (Wenger 1998, 106-108). Through boundary objects communities can develop an understanding of what is common and what is distinct between them, their practices, and world view (Hildreth et al. 2000; Seely Brown & Duguid 1998).

In addition to creating and facilitating bridging activities, from the nature of knowledge creation process it follows that certain common forums for sharing and joint work is needed. In shared forums common goals and shared identities are created, responsibilities defined, and coordination mechanisms for cooperation established. (Möller & Svahn 2002; Dyer & Nobeoka 2000). There are several types of these shared forums, such as conversations, visits, and meetings. They can take different forms, such as face-to-face conversations, immersions

(an individual visiting another community in an apprenticeship kind of way), and delegations (several communities gathering to one shared meeting). (Wenger 1998, 112-113). Notably, information and communication technologies, such as databases, Internet, Intranets etc. can also be used as shared forums to share (explicit) knowledge (Armbrecht et al. 2001; Gold et al. 2001).

To conclude, several conditions from both cultural and organizational viewpoints can be argued to influence the knowledge creation of a research network. Next, an empirical case study of a research network developing new mobile services is presented, and its findings are discussed.

Case: Rotuaari research network

This chapter introduces the empirical case study network. The data was gathered from the Rotuaari research project network, which aims to develop and test new context aware mobile multimedia services to consumers. Rotuaari's actors come from the University of Oulu and its industrial and government research partners from device manufacturers to municipal research organizations (for more information, see Ojala et al. 2003). *This work concentrates on studying a focal research network within the university*, which is in a central position in the whole network, as it is responsible for the actual development of mobile services. Its tasks are divided into three categories: development, operation, and evaluation of context-aware service systems; execution of field trials; and constructing and observing the business network that includes all research parties, business partners, content providers, and end-users. During the data collection period the case network was in its initial stages of operations and had just conducted its first mobile service piloting.

Methodology

This study is conducted as a single-case study. A case study "investigates a contemporary phenomenon within its real-life context" (Yin 1995, 13), and was regarded as suitable for the use of this work, as it enables the collection of multiform information from the phenomenon under study (ibid). This is required to be able to identify and describe the conditions influencing knowledge creation. A case study is also suitable in situations where the boundaries between the context and the phenomenon under study are not evident (Yin 1995).

Several types of data collection methods can take place within case studies (Yin 1995). This study utilized two data collection methods: participant observation and interviews of the members of the research network. Participant observation was used because it offers the researcher the possibility to observe profoundly the everyday operations of the phenomenon under study, and to gain access to various types of information. Interviews were then used as a source of multiple viewpoints of the phenomenon under study and to give explanations of the events taking place. Altogether 10 semi-structured interviews with the key personnel of the case network were conducted. Participant observation (meaning the researcher was a member of the project group and the group knew that the researcher was an observer) took place in the same timeframe as the interviews (in total five months of data collection) to deepen the understanding of the network, and to observe its everyday operations. During participant observation the researcher also had access to the archival material and email lists

of the case network. The data analysis was conducted through content coding and theme-based categorizing.

The case network

There are eight work packages at the university that contribute to the operations of the network. They represent four different faculties from engineering and programming to economics and business administration and education technology. The personnel of the work packages consist of researchers from professors to doctoral students as well as undergraduates. Each work package is formally led by a work package leader, and the sizes of the work packages range from two to 21 members. Notably, the project network also has a responsible director and project manager, who come from the university and are members of their own work packages.

The goals of the project network were created jointly by its actors. In addition to general goals, each work package has its own goals to be concluded within the project. They were created in parallel with the overall goals of the project network. The goals are described in an official project plan. The schedule and operations of the network are evaluated, discussed and refined once a month in formal meetings. One general notion of the project network is that its operations are culminated in field trials, where the technologies, applications, consumer behavior, and network operating can be studied in a real environment, with real test users and service providers using real devices and applications. All work packages usually take part in the development and conducting of field trials in some way or another.

When considering the work packages from a community of practice point of view, some interesting notions can be made. Firstly, each work package represents researchers from a similar theoretical background (e.g. education technology, human-computer-interaction), and the researchers of the work packages are all members of the corresponding faculty or research group (e.g. faculty of education, usability laboratory). Secondly, the members of the work packages work together and are collectively responsible for the outcomes of their work. Thirdly, in addition to the general project goals, each work package has clearly individual goals for the project, thus none of them totally overlap with another. Fourth, the members of each work package have learned over time, and through their similar educational and/or working backgrounds, a certain type of vocabulary and certain theories and frameworks to use when working. They have all centered on their own research questions and theories-in-use, and will interpret data, information, and knowledge more or less through these frameworks. Finally, both work package-specific and general project information is shared in work packages through practice: collaborative work, formal meetings, informal discussions, and via email and shared databases. Notably, the work packages and their goals have been, however, created formally by managerial discussions, which distinguish them from the strict definition of a community of practice.

“I think it is sort of under construction; we are still sketching the way this really works in practice, what it means to us, and who is responsible for it.”

In addition, as the quote above indicates, the case project was still in its early stages at the time of data collection. Therefore, the co-operation between work packages was still evolving, and the negotiation of rules and ways to operate was in progress. However, it was noted by the interviewees that through joint actions they were constantly learning more and more about

ways to operate within the project, and about each other. Consequently, both interviews and observations indicated that the knowledge that was created in these early stages was mostly knowledge of the network itself - its communities, codes of practice, environment etc. - though the network created knowledge of its primary outputs (i.e. new mobile services) as well.

Organizational culture

“It [the network atmosphere] is humoristic, dynamic, and even though we’re different types of people coming from different disciplines, the collaboration has a good spirit in it, even though we would disagree in some issues.”

Findings from the organizational culture point of view are summarized in Table 1.

Table 1. Conditions in organizational culture

<p>ORGANIZATIONAL CULTURE</p> <p>Attitudes towards collaboration and sharing:</p> <ul style="list-style-type: none"> - Collaboration a way to connect resources, gain access to critical resources, achieve better results and share workload - Collaboration viable especially in field trials, other forms and channels for collaboration evolving, as work packages are still forming their opinions about the network - Informal, positive, and enthusiastic atmosphere was seen to facilitate collaboration - Openness <ul style="list-style-type: none"> - Possibility to ask for and get answers facilitates collaborative working right from the early stage - Mutual trust <ul style="list-style-type: none"> - A basic level achieved, needs time to evolve - Commitment <ul style="list-style-type: none"> - Commitment visible right from the early stages - motivation to collaborate in order to achieve work package-specific goals - Good atmosphere has influenced the level of commitment - Identity <ul style="list-style-type: none"> - Roles and responsibilities are still evolving <p>Common stock of knowledge and requisite variety:</p> <ul style="list-style-type: none"> - Work packages have different types of expertise, interests, working methods, rules, languages, etc. <ul style="list-style-type: none"> - Knowledge gaps that hinder effective collaboration - Creating a common stock of knowledge begun when the project was officially launched and evolves continuously <ul style="list-style-type: none"> - Common stock of knowledge is created by joint practices - Common knowledge is created from the distinct work packages and the project in general - Acknowledging differences and misunderstandings is a prerequisite for creating a common stock of knowledge - Multiple viewpoints and types of expertise are argued to lead to more extensive results
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Firstly, all the interviewees argued that collaboration had helped their work packages to achieve more extensive results than if they would have worked alone. In particular the organization of big field trials was regarded as an important joint operation. Even though the channels for other types of collaborative actions were still evolving, it was pointed out that the network had a very good working atmosphere, which enhanced joint knowledge creating activities. It influences the willingness of people to share and commit to the process, and the way trust is formed between the members. Moreover, it was noted that the courage of people to express their ideas, insights, and gut-feelings - all sources for new knowledge - depends on the atmosphere.

“When there are different disciplines, there can be something that you don’t immediately fully understand, and of course the basic assumptions, the study questions, and the problem-solving methods are different.”

With regard to the diversity of the work packages, it was evident in the case network that work packages coming from different disciplines lacked a commonly shared professional language, ways to work, and hence an overall commonly shared stock of knowledge. Naturally, in the initial stages, where one’s ideas are still blurry and evolving, communicating them to others is even more difficult. The case network’s common stock of knowledge was however evolving through joint practices and negotiations. A very important notion was that misunderstandings did not inhibit the network operations if they were acknowledged and discussed. This, however, was not easy and some misunderstandings were not noticed at all, as one interviewee indicated:

“They interpret it each in their own ways, and then they don’t see it themselves that they haven’t understood it in the same way we do. Maybe it’s actually more dangerous, since they don’t see it [the different definition] - it doesn’t stand out from the flow of information.”

Organizing and management

Table 2 summarizes the main findings from the organizing and management viewpoint.

Table 2. Conditions in organizing and management

ORGANIZING AND MANAGEMENT
<p>Knowledge vision:</p> <ul style="list-style-type: none"> - Vast and interdisciplinary network creates challenges to organizing and management - Vision was created at the initial stage of the project - Vision is reflected in the project plan that gives the overall working methods to the project - Sharing and communicating vision, and goals to all parties considered challenging
<p>Bridging and shared forums:</p> <ul style="list-style-type: none"> - Bridging individuals <ul style="list-style-type: none"> - Work package leaders and project management team who operate “in the middle” - Bridging takes place in collaboration between work packages, all members of the project can act as bridging personnel - Boundary objects <ul style="list-style-type: none"> - Shared documents, such as status reports, presentation templates, design specs etc. - Knowledge is created in shared forums: <ul style="list-style-type: none"> - Different types of meetings of the project - Field trials and other connected practices - There are not many shared routines yet, monthly meetings and status reports can be regarded as shared routines - The project uses a shared database for documents and reports - Information, especially time-critical, is also shared via email and other personal communication tools - Efficient usage of ICT technologies requires ease of use

The “knowledge vision” of the case network, i.e. the goals and the expectations posed for the project, was created gradually during the design phase of the project. Various viewpoints from multiple disciplines had created both opportunities and challenges in the designing of a harmonious project plan, which in addition to other official documents defines the vision, goals, and strategies for the project, i.e. the “blueprints”, according to which the project operates. They also set the timetables for these operations, and divide responsibilities between project network actors. Hence, the official documents are an important way to maintain a “common mindset” within the project. The interviewees also emphasized the role of internal

communications. Notably, they stated that different types of ICT tools (emails, intraweb) are a good way to share information, but emphasized that there should not be too many different channels for information sharing:

“It’s dependant on whether one bothers to do the extra work [using ICT tools]; I mean, sometimes it’s too much to use two applications at the same time...”

When considering bridging between work packages, the work package leaders were in the central position in connecting distinct work packages, as they were responsible for the planning and execution of work package operations. What was evident, however, was that there were project personnel who had knowledge of the expertise areas of other work packages. Hence, they were able to operate as boundary spanners between distinct work packages by “translating” the viewpoints of other to his/her own work package in its own “language”. Also different types of presentations, and reports - boundary objects - were regarded as a way to enhance the understanding of others.

“The monthly meetings are beneficial in the sense that you get to know how others have progressed, and well, what they study in the first place.”

Finally, perhaps the most important way to share knowledge and information were work package meetings, both formal and informal. They were seen as places where people can share their problems, evaluate their work, and build commonly known language and ways of working. They were seen as important forums for expressing one’s opinions and viewpoints, learning from past events, and developing operations for the future. It was also observable that in these meetings work packages created possibilities for collaboration by e.g. agreeing to common goals or methods for the upcoming field trials. The more informal meetings were also regarded as spaces for ideation and creative thinking, because they had no formal agenda and it was claimed the multi-disciplinary discussion flowed more freely.

Conclusions

When considering knowledge creation in research networks, several types of conditions can be identified as influencing the knowledge creation process: the context, organization culture, and organizing and management (see Figure 2).

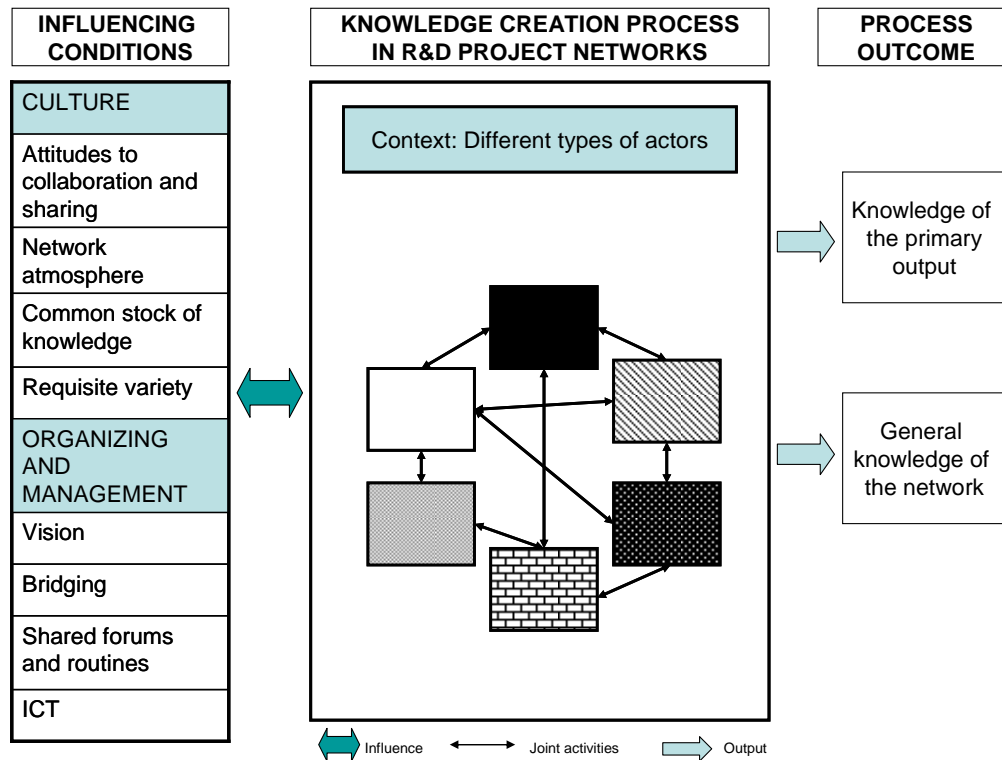


Figure 2. Framework of conditions influencing knowledge creation in research networks

Firstly, this research argues that the context of the network is in itself a condition influencing knowledge creation. It is evident that the early stages in the evolution of a network are crucial in explaining its knowledge creating processes. In the early stages, the network actors learn to co-operate; they are creating knowledge not only on the formal goals of the network, but to a great extent on the network itself. As all the processes and codes of practice are still evolving, this stage of the process offers great possibilities for actors to influence the direction in which the network develops. However, the early stages also pose great challenges, for there is no common understanding among the actors of the network, and this can lead to misinterpretations and false actions based on them.

Secondly, this study suggests from the viewpoints of organization culture and organizing and management, the diversity of actors is a highly influential condition in research networks. It results in diverse ways of operation, and in different types of stocks of knowledge. These differences pose then both possibilities, but also challenges to research networks. What seems to be crucial in these types of networks is to create a basic level of shared understanding of the network itself, the goals it has, and the ways to achieve these goals. Knowledge creation calls for some shared understanding of the roles of the members, their expertise, and ways to do their work. This shared understanding makes it clear to all what can be expected from the network, what the schedule for results is, and what type of collaboration is needed. In this way, it is also easier for the actors of the network to see what kinds of modifications need to take place to ensure that the conditions for knowledge creation would be as optimal as possible. It must, however, also be emphasized that rich and diverse viewpoints on the matters at hand usually result in better outcomes of the knowledge creation process. One important notion is then that networks are in themselves sources of varying viewpoints and ways of operation and in this way serve as a fruitful base for knowledge creation.

Thirdly, the diverse ways of working and communicating are learned through practice - hence the collaboration itself increases the common stock of knowledge. All types of shared documents and artefacts can also aid in building common understanding. The people working in the network have an important role in this process by acting as bridges between different actors. Furthermore, shared forums are also crucial in networks, as they are places where representatives of the actors meet, and share and discuss their viewpoints. In all the above-mentioned issues ICT technologies can be used to assist the sharing of information and explicit knowledge. The role of management and organizing is important, for there are structural solutions with which to assist collaboration and building of shared understanding. It is also the responsibility of management to try to make the goals and strategies, i.e. the overall vision of the network viable and clear to all its actors.

Finally, when considering the usability of community of practice viewpoints in research network studies it can be argued that they enhance the understanding of the conditions in which different types of actors operate. They pinpoint the effects of diverse knowledge bases different actors have, and their influence on the collaborative activities in a network. The concept of 'community of practice' is, however, challenging to management and network studies, as the basic assumption of the concept is that communities of practice are not created by managerial activities. Therefore, it is suggested that more research needs to be conducted on the ways the concept of 'community of practice' could be implemented into management and network studies.

The empirical part of this study was limited to encompass only a university research network. However, research on government-university-industry (GUI)-R&D networks has been argued to be a prominent area of innovation and knowledge creation studies (e.g. Johnson & Johnston 2004). Thus, when considering possibilities and ideas for further research it can be argued that widening the scope of the study to GUI-networks would give more insights to the ways knowledge is created in research networks. In addition, this study concentrated only on the early stages of research network development. Therefore, a process view of the knowledge creating behavior of a network would be an important field of further studies. Both Doz (1996) and Möller & Svahn (2002) have process elements in their studies of knowledge creating behavior of organizations. However, the former studied R&D partnerships and the latter lacks a longitudinal emphasis in the study, i.e. how the knowledge creating behavior and the conditions influencing it change over time. Hence, following the development and change of the network and its ways of operation over time would result in beneficial and important findings for both knowledge management theory and industrial network theory. Consequently, there is a need to know what the important conditions influencing knowledge creation in different stages of the network evolution process are.

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