Scandinavian Journal of Information Systems

Volume 29, No. 2

Copyright © 2017 Scandinavian Journal of Information Systems. The IRIS Association, Aalborg University, Department of Computer Science, Selma Lagerlöfs Vej 300, DK-9220 Aalborg, Denmark.

Publication date: 31 December 2017

eISSN 1901-0990

Value Creation in Knowledge Networks

Five design principles

Magnus R.P. Hansen and Jan Pries-Heje
Department of People and Technology, Informatics, Roskilde University, Denmark
magnuha@ruc.dk, janph@ruc.dk

Abstract. Knowledge networks enable businesses to enhance their levels of innovation and market competitiveness. In this paper, we propose five principles for designing IT tools that can support the facilitation and improvement of knowledge networks. We also introduce a new value proposition that constitutes a nascent design theory in the domain of knowledge network improvement. The design principles are derived from an iterative process applied in three different case settings. In each case, we apply and evaluate the network nexus tool to determine whether the knowledge network provides value to its participants.

Keywords: Network groups, Knowledge networks, Innovation, Value, Business Strategy, Nexus, Design Science Research.

Accepting editor: Bendik Bygstad

© Scandinavian Journal of Information Systems, 2017, 29(2), 61–79

1 Introduction

Innovation is an idea, practice or object that is perceived as new, while the diffusion of an innovation is the process by which an innovation is communicated via certain channels, over time, among the members of a social system (Rogers 2003). Innovations in information technology (IT) can be either technical or administrative in nature, with the latter involving new procedures, policies and organisational forms that are enabled by new technology (Van de Ven and Poole 1995).

Innovation stems from knowledge and inspiration. Many organisations, therefore, participate in networks (understood as groups of people) to share knowledge and spur innovations (Dolińska 2015). Because of limited resources within organisations, external *knowledge networks* have become popular; they act as a source of knowledge that is oustide the organisation (Chesbrough 2006). Knowledge is an innately human quality; a person must "identify, interpret and internalise knowledge" (Myers 1996, p. 2) to act in line with experience, context, interpretation and reflection (Davenport et al 1998).

Articulated knowledge is expressed in written or spoken form, whereas tacit knowledge is non-verbalised, intuitive and unarticulated (Hedlund 1994; Nonaka et al. 1996). Recent studies on IT knowledge management concede a much broader view of tacit and explicit knowledge compared to traditional discussions (Schacht and Mädche 2013). For instance, a working definition of this view of knowledge is "information embedded in routines and processes which enable action" (Baskerville and Dulipovici 2006, p. 83-105).

However, there is a considerable gap between social knowledge-sharing and knowledge management on the one hand and its transfer externally and internally on the other hand (Schacht and Mädche 2013). The main challenge is the lack of theoretical knowledge on successful management of emergent knowledge for designing "a high-level artefact, able to express and manage existing or emerging knowledge" (Dekkers et al. 2012, p. 1131).

Companies who are members of knowledge networks in the Danish region of Thy (in Northern Jutland) recognised this problem and approached the researchers for possible solutions. Their problems helped define the first theoretical gap that this work addresses: *How can we design for value improvements in knowledge network groups?*

An organisation called Company Forum located in Thy (CF Thy, Danish: 'Thy Erhvervsforum') served as the main case setting, where an IT tool to help the knowledge networks was iteratively designed and evaluated. The process ended with the development of an IT artefact—the network nexus—that bridged the research gap. In the course of development, we also derived five design principles and a fundamental value proposition that together form the framework of a *nascent* design theory in information systems (IS) (Gregor and Hevner 2013).

The remainder of the paper is structured as follows. First, we provide an overview of the relevant kernel theories and the gaps that our research aims to address. Next, we discuss the research method and the study setting where the network nexus was designed. The subsequent section presents the five design principles for developing IS tools that support inter-organisational network innovation. We illustrate the design theory and the principles with the help of case examples and show how the evaluation yielded a third type of value called 'reflective value'. Finally, we discuss the contributions of the results and outline directions for further research on

different *types* of knowledge networks. In this paper, we use the term *knowledge network* in the generic sense and the term n*etwork group* to refer to a specific instance or example.

2 Theoretical background—kernel theories

2.1 Knowledge networks

Knowledge networks are inter-organisational bonds, held together by the professional backgrounds of the participants seeking "access to information, advice and influence, as well as resources held by others" (Cantù et al. 2015, p. 951). They are characterised by horizontal links between representatives of companies, without any direct interdependent relationship (Cambra-Fierro et al. 2011). These networks often focus on developing new ideas through learning, either with the help of an external process consultant, such as a facilitator, or with the help of participants who act as facilitators (McNaughton and Bell 2001).

Batonda and Perry (2003) found that networks evolve in unpredictable and highly volatile states and can be renegotiated as the relationships between the participants develop. The stakeholders involved in a knowledge network include the participants of the network and a facilitator. A network organisation will often orchestrate the networks, focusing less on management and control and more on autonomous progression (Busquets 2010). High-level artefacts are needed to orchestrate the emergent knowledge of the networks. While attempts have been made at creating "technological hubs" (Cantù et al. 2015), these have primarily been designed for virtual communities where technology is the medium for interaction for the network participants (Lea et al. 2006). Other IT examples of artefacts include an application designed by Kristoffersen and Ljungberg (1997) for dispersed networked groups working in common information spaces.

Overall, the existing literature offers no insights into the perspectives of the relevant actors, especially the orchestrating actor or the facilitator responsible for sponsoring the networks. This leads us to the second gap that the present study attempts to address: *How can one design IT-based artefacts that benefit all the stakeholders of the knowledge network (participants, facilitators and network organisation)?*

2.2 Value

Value in IS and marketing literature is typically interpreted as economic value (Möller et al 2005). In a knowledge network context, it refers to added revenue resulting from participating in network groups for competitive advantages (Dyer and Singh 1998).

Bourdieu (1983) distinguishes between three types of value or capital: economic, cultural and social. Social capital is defined as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of mutual acquaintance and recognition." (Bourdieu 1983, p. 249).

In line with this view, Robert Putnam defines social capital as "[…] the collective value of all "social networks" and the inclinations that arise from these networks to do things for each other." (Putnam 2000, p. 19). Thus, one can argue that a knowledge network generates value by building a durable network or relationships of mutual recognition and coordination. Adler and Kwon (2002, p. 17) offer a more generic definition of social capital: "the goodwill available to individuals or groups. Its source lies in the structure and content of the actor's social relations. Its effects flow from the information, influence, and solidarity it makes available to the actor". Recent studies on value creation have expanded the concept of value to an experience that is co-created by the customer, much along the lines of a knowledge network participant who co-creates value with the group (Prahalad and Ramaswamy 2004; Vargo et al. 2008). According to O'Donnell et al. (2001), a network group entails working in an informal and personalised setting, where the participants are the main actors who focus on exploring social, communicative and commercial interests. This view agrees with the findings of Becker et al (2013) who highlighted the importance of redesigning interaction routines as planning, coordination and mutual exchange of information are central to innovation at an inter-organisational level. This view also emphasises the importance of distinguishing between optimal value (which is believed to be objectively measurable) and perceived value (which is subjective) and how these can be balanced. Usually, network participants are strongly focused on the optimal value of the time spent in the network but find it challenging to make the subjective value explicit and assessable. This leads us to the third research gap: *How can value creation, evaluation and balancing be supported in knowledge networks?*

2.3 IS design theories

Within the research discipline of IS design, design theories are believed to be prescriptive, practical, basis for action, principle-led and a dualist construct between solving problems for practice and generalising solutions to classes of problems (Baskerville and Pries-Heje 2010; Gregor and Jones 2007). Markus et al. (2002) emphasised the role of principles in their definition of design theory components: "(1) a set of user requirements derived from kernel theory, (2) principles governing the development process, and (3) principles governing the design of a system (i.e., specifying and implementing its features)." (ibid., p. 182). The main advantage of design principles is that they enable progression from an abstract level of situated implementation to a more generic and applicable level. Gregor and Hevner (2013) refer to this second level as 'nascent theory'.

Principles for designing an inter-organisational IT system that supports knowledge networks are scarce. Lempinen et al. (2012) covered some broad principles, while Becker et al. (2013) outlined two overall design principles for designing IT network artefacts: (1) modular design and (2) social construction. Both studies focused on the initial design stage of the artefact. Covering the lifespan of the collaboration process, Bragge et al. (2011) designed a facilitation process model for repeated collaboration, by brainstorming and filtering ideas for agenda setting. Lea et al. (2006) defined a set of design principles for designing social media tools that encouraged active participation by firms in social business networks. For designing an innovation business network, Smart et al. (2007) proposed seven principles: design for a lifecycle, design for proac-

tive management, design for emergence, design for diversity, design for high involvement, design for diffusion and design for strategic innovation portfolio. Schwabe et al. (2010) identified the issues in designing models without any detailed frameworks and called for collaboration in sharing of mental models. Despite the above efforts, design principles that span the entire network cycle are scarce. This gap in design theories is captured in the following question: *How can one design to support continuous collaboration and emergent knowledge-sharing?*

3 Research method

We chose a design science research (DSR) approach to investigate how one can improve knowledge networks using IT tools. DSR, as opposed to social and natural sciences, understands reality by creating and testing artefacts that serve human purposes and solve human problems (March and Smith 1995; Simon 1996). With a DSR approach, the design solution is evaluated and abstracted to solve classes of design problems (Walls et al. 1992). In this work, we abstracted our design solution to knowledge networks in general, instead of only improving the network group facilitation for a specific case setting.

Design problems vary and require different approaches (Peffers et al. 2008). For instance, wicked design problems refer to a class of problems that has no optimal solutions. Solving them calls for 'nexus artefacts' that integrate conditions, approaches and a decision-making process (Pries-Heje and Baskerville 2008), as explained in the five-step method below:

1. Identify approaches that can be used to solve the problem in the given problem area through a literature review.
2. Analyse the approaches and identify the conditions that match each approach.
3. Construct an artefact that can assess the presence of the conditions in the problem area.
4. Design a process for evaluating the present conditions.
5. Integrate previous steps of approaches, conditions and process into an artefact that can evaluate if the problem has been dealt with.

The five steps represent an ideal approach to constructing the nexus artefact; several iterations are recommended to refine approaches, conditions and the process. We applied the five steps in two iterations to develop three artefacts: one for identifying the present state of a knowledge network, one for identifying the purpose of the knowledge network, and one survey artefact for assessing conditions and approaches.

3.1 Case: Company Forum Thy

CF Thy in northern Denmark is an organisation that aims to support local entrepreneurs and companies through inter-organisational collaboration. It is a network organisation that has more than ten network clusters that consist of minor network groups, with more than 265 small-to-medium businesses (SMEs) as members. The network groups range from large mari-

time business networks to agriculture and accounting networks. Each network group is assigned a facilitator and is funded either through member subscriptions or external sources. CF Thy's main concern was that they were experiencing difficulty determining if their members gained the value they sought from the groups and how to improve on this value.

3.2 Iterating the nexus

In iteration 1, as part of the first two steps of the method, we reviewed literature on the creation and facilitation of business knowledge networks. The review focused on approaches to create and support knowledge networks across organisational borders. To validate and verify the review findings, two focus group sessions involving 10 network participants within CF Thy were conducted (6 participants in one focus group and 4 in the other). The sessions lasted two hours each and were held in April 2015. The focus group participants were selected based on their professional and network experience, and all had to be part of at least 2 network groups. The first focus group had considerable experience with knowledge networks, and most participants had previously been members of the same knowledge network. The second focus group had little professional experience as all the participants were relatively new entrepreneurs with 1-3 employees. The characteristics (inferred from the literature review and later used as conditions for creating the nexus in step 2 as mentioned earlier) of a typical knowledge network group were presented by the facilitators (the two authors), and the focus group participants were asked to identify two characteristics that were considered important in their own network groups. This was followed by a group discussion on each characteristic. At the end of the discussion, 4 characteristics were verified, 3 were introduced and 1 was removed, either because it was highly subjective or because it could be abstracted to another characteristic. The third nexus step was to identify dimensions of each identified characteristic and denote them as conditions. Drawing on the qualitative research method proposed by Strauss and Corbin (1990), we interpreted the characteristics of a knowledge network as its dimensions. Strauss and Corbin (1990) explained that concepts can be viewed as dimensions on a continuum; e.g.; tall, short, thin or obese. The dimensions included; e.g.; 'knowledge level', 'size', and 'activities' that were created and maintained by the network group.

The fourth step involved drafting statements that the network participants could agree or disagree with on a scale of 1-5 via a survey instrument.

In the fifth and final step of the nexus design, the nexus artefact was integrated with an interactive spreadsheet and presenter tool for easier facilitation and evaluation. In May 2015, five knowledge network group facilitators applied the nexus artefact (with help from one of the authors) in their existing network groups. Owing to time constraints, they could sample and comment on only 2-3 dimensions of the artefact, yet all the groups derived valuable inputs on measures that could propel their network groups in a desired direction.

3.3 Formative evaluation

The nexus design was evaluated formatively so that the results could be used in further development and construction (Venable et al. 2014). In the second iteration of the nexus steps (1-4), the conditions, approaches and the decision making-process were refined further towards increasing value. On the basis of expert feedback from previously published articles on knowledge network facilitation (Hansen and Pries-Heje 2016; Pries-Heje and Hansen 2016), additional literature on value and knowledge-sharing was incorporated, and the nexus was tested on two external knowledge network group facilitators for a summative evaluation (Venable et al. 2014). The summative evaluation focused on two aspects: (1) how the solution approaches prompted learning and reflection on the facilitators' own practices and (2) how conditions and benchmarking worked in practice. The first network facilitator belonged to a Danish IT network organisation, and the second network facilitator came from a learning-driven facilitation organisation that facilitated four other knowledge network groups focused on innovation through action research.

The purpose of the facilitator interviews was to use their experiences to determine how such a tool could add value directly or indirectly by improving their facilitation practices.

3.4 Coding and analysis

All focus group interviews and facilitator interviews were recorded. Notes were taken, coded immediately and discussed between the two authors for better inter-coder reliability (Miles and Huberman 1996).

For analysing the empirical data derived from the focus groups, high-level codes were defined based on both the characteristics presented and on how the participants linked said characteristics, and overlaps in empirical material and the literature were identified (Miles and Huberman 1996). The initially defined high-level codes resembled the characteristics mentioned previously and consisted of; e.g.; 'Facilitator roles', 'Value types', 'Composition', 'Knowledge-sharing' and 'Trust'. For example, the low-level code of 'moving away from being production-minded to reflecting on practice' could be linked to reasons for joining networks and thus be captured in the high-level code of how the different network groups provided value. However, the value dimension was eventually dropped because (a) it was a highly subjective dimension and had high variability among participants, and (b) it formed the crux of any knowledge network group. Thus, instead of focusing directly on value, we used it as a code to see how high-level codes were linked. The list of high-level codes that were used as the basis for the final dimensions of network groups grew to 7 once it became apparent that the Purpose of a knowledge network and the Activities used by a facilitator exerted considerable influence on some of the participants knowledge network groups. As a result, the low-level codes were populated and abstracted into each of the seven dimensions of the nexus tool, on the assumption that the dimensions would support value (see Table 1).

Quote	*Coded as*	*Design consequences*
"If you are not that many participants showing at the meeting, then you can really 'bite'; we have done something called the 'hot seat' where you represented your business and everyone would start asking deep and weird questions." (Participant at Focus Group 1)	Number of participants at the meetings; Activity types at meetings; Sharing critical business information;	Added a new dimension of 'Number and size'; Added a new approach called 'the hot seat'; Added a survey question about 'Comfort with sharing critical business information' under the dimension of 'Sharing and interaction"
'Through this [huge network day at Danish Industry] I have come into this 'informal network' where you meet and speak to informal consultants […] and here I found a good match for my business right now." (Participant at Focus Group 1)	Formal vs. informal networks; Huge network groups as types of networks; Economic value based on business needs;	Added the new dimension of 'Purpose'; Realised that networks can be of different types—some big with a purpose of creating minor network groups; Supporting economic value through business needs and return of investment.

Table 1. Examples of how the empirical data was coded and its consequences for design.

3.5 Summative evaluation

After re-iterating the design of the nexus artefact, we examined two other cases: the Danish Computer Society named 'Danish IT' and the action research-oriented consultancy called 'Learning-Driven Innovation' (LDI). Danish IT is a network organisation with 24 networks, all focusing on contemporary, organisational IT subjects such as business intelligence, service management and enterprise architecture. Each network has an assigned facilitator. LDI is a small to medium sized enterprise (SME) run by a main facilitator specialising in networks that employ action research to further innovation.

The coding mechanisms employed for the summative evaluation of facilitator interviews were based on the pre-defined categories of the nexus components: survey questions, dimensions and benchmarking, and whether the approaches to improve the network groups induced learning and reflection on existing practices and enhanced the usability of the overall tool (see Appendix, Table 2 for an example of how the various participant responses were used empirically).

4 The network nexus

A common issue with group networks was that their value could not be estimated simply from participant responses. The network nexus was designed in response to the challenges with meas-

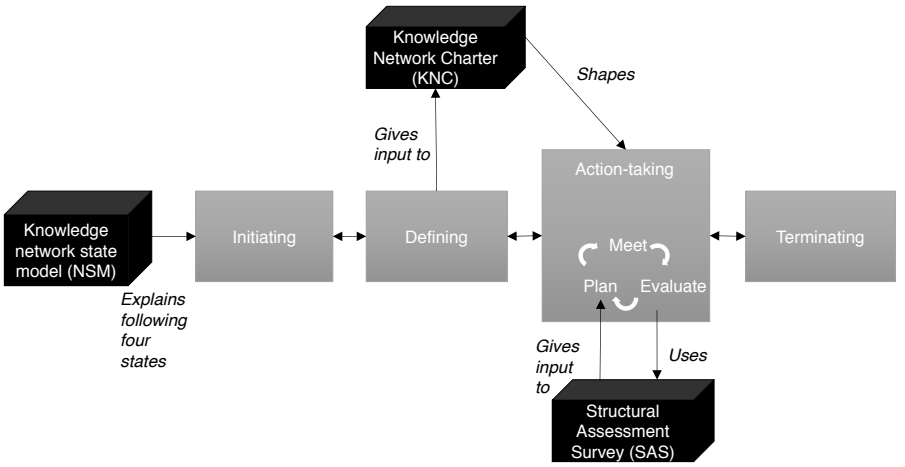

Figure 1. The artefacts (black boxes) of the network nexus and their relations to the different network states (grey, flat boxes).

uring network value directly. It was a formalised information system meant to be used by all the actors of a knowledge network group. The three artefacts of the network nexus were (originally presented in Hansen and Pries-Heje (2016) and Pries-Heje and Hansen (2016)): (a) a knowledge network state model (NSM), (b) a knowledge network charter (KNC) and (c) a structural assessment survey (SAS). They addressed different aspects of the gaps identified previously. Figure 1 shows a representation of the network nexus as well as the relations between the artefacts.

The NSM shows how a knowledge network group would normally progress through four states—from 'initiating' (identifying the need for a knowledge network among interested participants), 'defining' (specifying the need and purpose of the knowledge network), 'action-taking' (engaging in network meetings by planning, meeting and formatively evaluating the process) to 'terminating' (assessing whether the purpose has been fulfilled by summative evaluation, specifying learning points and the value gained and closing the network). The NSM primarily addressed the first gap by providing participants and facilitators a structure for developing a common view about the status of the network group. As such, it aimed to ease the process of initiating the network and sustaining the social capital.

The KNC was a formal model meant to specify the purpose and scope of the network group, similar to a business case or the raison d'être for the network. The KNC addressed the second gap by initiating and providing the economic rationale for starting the network.

The SAS was a tool to assess the state of the network group on 7 dimensions, provide a visual depiction of the network group and offer multiple actions for improving the facilitation of the network group. The SAS addressed the third gap, enabling structural knowledge about the network group to be captured and utilised for enhancing its progress.

Ideally, the points of use for the network nexus artefacts would unfold as follows: (1) interest for a knowledge network group would sprout among potential participants; (2) financial support would be provided by an orchestrating actor, and a facilitator would be appointed; (3) the facilitator and initial participants will create an KNC, (4) the facilitator and participants will engage in network group meetings and evaluate the network group continuously. Corrective actions would be taken by the facilitator, if needed, to align with the purpose of the KNC; and finally, (5) once the purpose is fulfilled or if network group does not support the purpose, it will be evaluated and terminated.

5 Eliciting design principles

We derived five important design principles to ensure that the structures of the network group support value creation:

- Principle 1 (P1): The principle of *enabling continuous process improvement*
- Principle 2 (P2): The principle of *creating participatory value*
- Principle 3 (P3): The principle of *visualising dimensional status*
- Principle 4 (P4): The principle of *comparing to contextual ideals*
- Principle 5 (P5): The principle of *visualising potential action-taking*

In the following sections, we explain how our proposed design principles support the creation of economic and social capital and what specific actions can be learned from the design principles when designing for knowledge networks.

5.1 Principle 1: Enabling continuous process improvement

The principle of *enabling continuous process improvement* implies that stimulus, such as facilitation, is needed to create the momentum for a knowledge network (McNaughton and Bell 2001). The principle focuses on supporting both economic and social value by continuously evaluating what the participants gain from the network and interpreting this as social capital. As the participants drive the network forward, they become change agents (Rogers, 2003)—a role that anyone can take but is often performed by the facilitator of the network group. The role implies that the network group must change. While the facilitators are meant to interact with the network, the actual roles and functions of the facilitators are not clear. Thus, the design principle emphasises that someone should conduct formative evaluations and undertake corrective actions as the knowledge network moves forward.

In the study, the artefacts of NSM and SAS supported this design principle. The NSM requires the explicit nomination of a facilitator and describes what the facilitator as a change agent is expected to do. Empirically, this was grounded in the perceptions of the facilitators themselves: "I see a facilitator to be someone who influences a process." (Facilitator 1)

Providing several measures for future improvement of the knowledge network, the SAS supported this principle as a decision-support tool in the action-taking state of the NSM.

During the evaluation stage in iteration 1, Facilitator 1 noted a discrepancy between the formal purpose and the informal success criteria in his network group because the network group had gradually shut itself in without an explicit purpose. As corrective action, he believed that the KNC could be used to reinvigorate the group.

5.2 Principle 2: Creating participatory value

The principle of *creating participatory value* suggests that all relevant stakeholders in the knowledge network group should be involved. Active participation often inspires ownership and as such will support the joint creation of social value. For participants to socially construct mutually agreed upon meaning, norms and values, participation is a key requirement (Dahl et al. 2011). By asking questions and rating the answers, the participants of the knowledge network groups reflect on how to improve the network and understand the future course of action.

The nexus artefacts that supported this principle were KNC and SAS. The KNC helps to determine the purpose of the network group before, during and the time of evaluation. The facilitators strongly welcomed the KNC artefact because all of them had experienced issues with articulating member expectations. One facilitator commented on the difficulties in contacting participants who did not fit in or never showed up. She believed that a formal KNC could serve as a tool for laying down the ground rules.

The SAS supported the principle by combining the results of facilitators and participants and without attaching more importance to any one set of responses. A facilitator noted that she was more interested in engaging in dialogue and discussion with the network participants than gaining ideas for corrective actions and believed that a common assessment would assist her with this.

5.3 Principle 3: Visualising dimensional status

The principle of *visualising dimensional status* highlights the need for a structural overview of the knowledge network in order to assess it and make a decision. Some sort of measurement system can potentially help participants determine whether their investment is worth pursuing and capable of generating economical value. The core idea underlying the development of nexus artefacts is to enable network members to identify conditions and evaluate statements that are based on these conditions. In this study, we identified the dimensions of a knowledge network using literature and empirical data. The dimensions of a knowledge network were 'size', 'purpose and success criteria', 'member composition', 'knowledge level and type', 'knowledge-sharing and interaction', 'facilitation and leadership', and 'activities'. For each dimension, we drafted statements, which were included in the SAS, that helped ascertain whether the dimension was of high (difficult for the facilitator to handle) or low value (easier for the facilitator to handle). (See also Appendix, Table 3 explaining the dimensions retrieved from literature, empirical data and the statements these entailed, and Figure 2 showing the visualisation of the radar chart.)

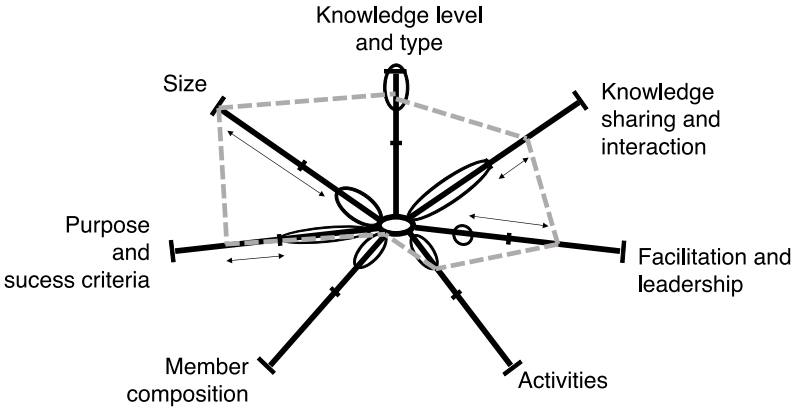

Figure 2. Dimensions plotted on a radar chart as part of the SAS. Bubbles indicate the desired value thresholds for the network group, dashed lines indicate actual values and arrow spans indicate areas of potential improvement.

5.4 Principle 4: Comparing to contextual ideals

The principle of *comparing to contextual ideals* sheds light on the fact that not all dimensions are equal, and their assessment should be strongly matched to the context of the specific knowledge network. That is, the nexus design should consider that two networks with the same value may have different problems. This eliminates the single magic bullet expectation from assessment tools and provides room for more tolerance if needed. The principle boosts economic value for participants because it offers more possibilities for improvement via contextual indicators. It also strengthens the possibility of creating economic value over time for the network organisation. Further, social value can be enhanced by discussing which dimensions are contextual and which are specific for the network group, and thus stronger social feelings can be forged between participants.

This principle was an important learning that emerged from the focus groups as the participants joined networks with very different goals and contexts. The principle was actioned via the SAS, where *tolerance values* were shown along the dimensional axes, rather than ideal points. These tolerance levels should be discussed prior to the assessment. Some of the networks produced cutting-edge innovations for their own business context, such as in the fields of sustainability in the agricultural sector. Other participants were involved in knowledge-sharing and learning about strategic management, and a third network focused on increasing customer bases by sharing customer information through referrals. Thus, the approach to measuring dimensions in absolute terms as high or low values did not make much sense, as some of the dimensional values were less important for certain network groups. In short, the participants' pursuit of value depended to some degree on the type of network. All the participants were part of many

different networks, and all of them noted that they had different focal points and purposes. We will discuss this influence of network types later.

5.5 Principle 5: Visualising potential action-taking

The principle *of visualising potential action-taking* suggests that the facilitator should see and show the network the results of their actions, potential difficulties and potential solutions. Potential for action is a pure social value, as the actions are meant to be agreed upon with the participants.

We incorporated this design principle by listing specific recommended actions in a prioritised manner according to the type of network and the current assessment of the network group. For instance, high scores on the knowledge-sharing dimension could indicate a lack of trust, which could be solved by the facilitator by dividing participants into smaller groups to ensure a better personal and professional fit.

Another example was that knowledge circulated within the network was very difficult for the participants to understand. A solution to this was to invite larger, more well-known companies as guest presenters to better contextualise how they adapted and implemented the knowledge. The action was recommended by Facilitators 2 and 4, who often employed this technique.

5.6 Evaluation

The summative evaluation uncovered a third type of value, proposed by individual facilitators in the interests of improving the network. We termed this value as 'reflective value'. Reflective value mainly resulted from the use of the network nexus tool and it boded well for the future of the network group.

Reflective value emerged from the formative evaluations where some facilitators were less interested in the suggested actions for improvement and more focused on using the SAS as a tool for dialogue between themselves and the participants to uncover implicit knowledge. This was mainly because of their professional experience as facilitators.

In the summative evaluation, the facilitator from Danish IT gained new insights but those were based on areas that he had hitherto taken for granted. It was only during assessing his network group that he realised that he could be more explicit in his role changes when he was facilitating. This was primarily because he himself was an expert on the purpose of the network group.

The other facilitator noted the need for "creating time for stopping and reflecting" while identifying many new ideas through using the nexus. Afterwards, the facilitator specifically observed an issue with the purpose of his network group: two prominent members had different ideas about the purpose—one focused on innovation through assisting practitioners in the network, while the other focused more on creating innovative research through practitioners. As such, the facilitator was torn about the activities that he could conduct at the end of the meetings because he was unclear on whether to summarise the network group meeting results as useful to practice or useful to research. The summative results showed that the network nexus tool can be

used for learning, reflection and improvement. Furthermore, the reflective value confirmed that certain dimensions of their network groups had an impact on other dimensions; for example, the lack of a specific purpose influenced the activities that the facilitator could conduct.

6 Discussion

We have identified five design principles that address the gaps linked to three different theoretical areas: (1) creating benefit for all the involved stakeholders in the knowledge networks, (2) supporting value creation and balance in knowledge networks and (3) designing for continuous emergent knowledge collaboration and sharing.

The principles of the network nexus underline the importance of determining the structure of the network groups for generating benefit for all the relevant stakeholders. With our principles, we show that IT can be designed to shed light on implicit structures and thus create value by illuminating tendencies and creating opportunities for reflection for the stakeholders using the tool. Principle 2, creating participatory value, is focused on involving the stakeholders and is partly inspired by the concept of user involvement discussed in the Scandinavian approach of Participatory Design (PD) (Kensing et al 1998). In the PD approach, users are involved in the design process. While our design approach did not involve group participants, we argue that the network nexus can be seen as a supportive participatory design tool, which allows the network group participants to voice their thoughts and redesign the network structure through dialogue with the facilitator. We expand on the traditional DSR process of analysis, design and evaluation because we find that the users themselves design their process throughout the network life.

Previous literature on value creation has focused on a singular type of capital being created based on the context, whether through coordination (Putnam 2001) or through business goals supported by IT (Busquets 2010). Our principles show how the two types of capital, economic and social, are entwined and interdependent and that no absolute balance can be achieved because they are dependent on the various structures and the context of the network group. This explains the limited research on how these two types of capital are mutually related. We add to this explanation by showing how the types of value need to be supported as opposed to being managed. We also identify a third type of value—reflective value—that stems from individual motivation and creates further possibilities for improving the network group if channelled through the right individual. The facilitator of the network group plays a key role (in accordance with principle 1) in diffusing changes among the network group. Further, having a broad list of potential actions (principle 5) highlights the importance of reflection and active learning for facilitators. This is an area that network group theory has hardly focused on, and there is strong potential for using the list of actions as a repository, where further reflective value can be created using the network nexus as a common reference point.

We argue that the network nexus helps strike a balance between different types of capital, ensuring that the stakeholders realise a value, whether economic, social or reflective. However, we also acknowledge that implementing the network nexus in a network setting may make it difficult to distinguish between the value gained from the network group and the value gained from the network nexus. Isolating these values is a major aspect of the research, going forward.

The network nexus as a knowledge product (filling it out) and as a knowledge process (making decisions through dialogue) addresses the gap in IT artefacts for initiating a network group and supporting ongoing collaboration, emergent knowledge maintenance and sharing. We show how IT facilitation tools, such as our network nexus prototype, can combine the knowledge repository and the knowledge process in capturing network data—a goal that was hitherto difficult to accomplish because a network is highly dependent on social dynamics (McNaughton and Bell 2001). Principle 3 on the synthesis of dimensions of a network group indicates that it is possible to interpret structural and procedural elements as explicit and measurable dimensions, even on such difficult social areas as network groups.

This aspect has remained largely unaddressed in IT design, where the artefacts have either stood alone as a virtual platform (Cantù et al. 2015; Lea et al. 2006; Kristoffersen and Ljungberg 1997) or as a management system to store and obtain knowledge (Schacht and Mädche 2013). Integrating the network state cycle with an SAS and KNC was a way to combine these two different types of artefacts.

While the initial design of the network nexus has received positive reviews, work is still needed on the prototype. A longitudinal evaluation of the nexus and a stronger focus on who will derive which type of value are aspects that need to be addressed at a later date. This design of the network nexus was also based on certain limiting assumptions. For example, our approach was a formally structured design approach where dimensions needed to be given a value because it was the only way to construct an artefact that could support anything. However, the power and agency of value creation and sustainability are still under the control of the users of the tool, and this represents a loose end that evaluation may not be able to solve either. This problem highlights certain central issues with identifying value when it is created both through the artefact and through network meeting participation. Prior literature has addressed this by providing very broad principles (Becker et al. 2013) or by confining the design to the initiation phase of the network group (Smart et al. 2007). However, our study goes a step further by including the use patterns into the progress of the network group. We should thus be wary of claiming that the network nexus itself creates value. Rather, we claim that the network nexus can enhance, embed, reinforce and realise the value potential that already exists in the group based on the context and type. As noted, the potential for agency of the network nexus is very high, but so are the emergent use patterns and the freedom to use or not use it as the users see fit. This, we believe, is a design necessity for the use of such tools to flourish, much like the concept of situated design, which requires a design solution to be broad enough to deal with contingencies while still letting the users focus on solving the task that it is intended for (Simonsen et al. 2014).

Another assumption was that the structure and formalised patterns were all solutions to the problem of improving the network nexus. This partially stemmed from the initial case organisation because they were unstructured in their network group approach. It was also an inherent design assumption as the researchers have an IT background. For data and knowledge to be explicit, formalised structures are a fundamental building block in the design of systems.

The final assumption of the design was that the dimensional values were either good (low value) or bad (high value). However, the results showed that certain types of networks could handle higher values well while others were troubled by the low values. This indicates that knowledge networks can be divided into types according to their purposes, for example, experience-sharing networks, learning networks, knowledge networks etc. A certain type of network

with unique tolerance levels for the dimensional values could then be pushed in the desired direction of the facilitators. However, this interpretation leads to a fundamental question about the network nexus: can a network group belong to more than one type and can it move towards other types of networks? This is an area of research that should be explored further.

7 Conclusion

This study set out to improve the value creation of inter-organisational knowledge networks using a DSR approach. Value was defined based on prior research on social and economic capital and the idea that customers can co-create value. Our proposed solution was to develop a network nexus consisting of three IT artefacts that could be used by facilitators and network participants to evaluate and improve the knowledge network on an ongoing basis.

The design and testing of the artefacts led to the development of a nascent design theory consisting of five principles for designing IT tools that support value realisation in knowledge networks. This contribution addressed three gaps identified in the literature: (1) creating benefit for all the stakeholders involved in knowledge networks, (2) supporting value creation and balance in knowledge networks and (3) designing for emergent knowledge collaboration and sharing. The five principles, (1) the principle of *enabling continuous process improvement,* (2) the principle of *creating participatory value*, (3) the principle of *visualising dimensional status*, (4) the principle of comparing to *contextual ideals* and (5) the principle of *visualising potential action-taking,* were inferred from the proposed artefacts formatively. They showed the potential to balance the value derived by the participants and facilitator of the knowledge network. Furthermore, the evaluation of the tool helped identify a type of value inherent to the participants: an individual motivation and reason to reflect on one's own practices and assumptions. We found that this value type was connected to economic and social value, and that providing time and space for reflection using the network nexus could support this type of value.

Limitations of the study include testing the network nexus longitudinally and evaluating it in different network groups, preferably with easily accessible IT tools such as mobile applications. We hope that future research will focus on these aspects.

References

Adler, P. S., and Kwon, S.-W., (2002). Social capital: Prospects for a new concept. *Academy of management review,* (27:1): 17-40.

Alt, R., and Klein, S., (2011). Twenty years of electronic markets research—looking backwards towards the future. *Electronic Markets,* (21:1): 41-51.

Barrett, M., and Walsham, G., (1995). Using IT to support business innovation: a case study of the London insurance market. *Scandinavian Journal of Information Systems,* (7:2): 3-22.

Baskerville, R., and Dulipovici, A., (2006). The theoretical foundations of knowledge management. *Knowledge Management Research & Practice,* (4:2): 83-105.

Baskerville, R., and Pries-Heje, J., (2010). Explanatory Design Theory. *Business & Information Systems Engineering,* (2:5): 271-282.

Baskerville, R., and Pries-Heje, J., (2014). Design theory projectability, In: *Information Systems and Global Assemblages. (Re)Configuring Actors, Artefacts, Organizations: IFIP WG 8.2 Working Conference on Information Systems and Organizations, IS&O 2014,* B. Doolin, E. Lamprou, N. Mitev, and L. Mcleod (eds.), Springer, Auckland, New Zealand, pp. 219-232.

Batonda, G., and Perry, C., (2003). Approaches to relationship development processes in inter-firm networks. *European Journal of Marketing,* (37:10): 1457-1484.

Becker, J., Beverungen, D., Knackstedt, R., Matzner, M., Müller, O., and Pöppelbuß, J., (2013). Designing Interaction Routines in Service Networks. *Scandinavian Journal of Information Systems,* (25:1): 37-68.

Bloom, B. S., Krathwohl, D. R., and Masia, B. B., (1984). *Bloom Taxonomy of Educational Objectives,* Pearson Education, Boston.

Bordieu, P., (1983). Ökonomisches Kapital, kulturelles Kapital, soziales Kapital. In: *Reinhard Kreckel (Hg.), »Soziale Ungleichheiten« (Soziale Welt Sonderband 2) ,* Göttingen, pp. 183-198.

Bragge, J., Tuunanen, T., Virtanen, V., and Svahn, S., (2011). Designing a Repeatable Collaboration Method for Setting Up Emerging Value Systems for New Technology Fields. *Journal of Information Technology Theory and Application,* (12:3): 27.

Brown, J., and Duguid, P., (1991). Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation. *Organization science,* (2:1): 40-57.

Busquets, J., (2010). Orchestrating smart business network dynamics for innovation. *European Journal of Information Systems,* (19:4): 481-493.

Cambra-Fierro, J., Florin, J., Perez, L., and Whitelock, J., (2011). Inter-firm market orientation as antecedent of knowledge transfer, innovation and value creation in networks. *Management Decision,* (49:3): 444-467.

Cantù, C., Ylimäki, J., Sirén, C. A., and Nickell, D., (2015). The role of knowledge intermediaries in co-managed innovations. *Journal of Business & Industrial Marketing,* (30:8): 951-961.

Chesbrough, H. W., (2006). The era of open innovation. *Managing innovation and change,* (127:3): 34-41.

Connell, J., and Voola, R., (2007). Strategic alliances and knowledge sharing: synergies or silos? *Journal of Knowledge Management,* (11:3): 52-66.

Davenport, T. H., De Long, D. W., and Beers, M. C., (1998). Successful knowledge management projects. *Sloan management review,* (39:2): 43.

Dekkers, R., Kühnle, H., Cheikhrouhou, N., Pouly, M., Huber, C., and Beeler, J., (2012). Lessons learned from the lifecycle management of Collaborative Enterprises Networks: the case of Swiss Microtech. *Journal of Manufacturing Technology Management,* (23:8): 1129-1150.

Dolińska, M., (2015). Knowledge based development of innovative companies within the framework of innovation networks. *Innovation: Organization & Management,* (17:3): 323-340.

Dyer, J. H., and Singh, H., (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of management review,* (23:4): 660-679.

Ghisi, F. A., and Martinelli, D. P., (2006). Systemic view of interorganisational relationships: An analysis of business networks. *Systemic Practice and Action Research,* (19:5): 461-473.

Gregor, S., and Hevner, A. R., (2013). Positioning and presenting design science research for maximum impact. *MIS quarterly,* (37:2): 337-355.

Gregor, S., and Jones, D., (2007). The anatomy of a design theory. *Journal of the Association for Information Systems,* (8:5): 312-335.

Gruenfeld, D. H., Mannix, E. A., Williams, K. Y., and Neale, M. A., (1996). Group composition and decision making: How member familiarity and information distribution affect process and performance. *Organizational behavior and human decision processes,* (67:1): 1-15.

Hanna, V., and Walsh, K., (2002). Small firm networks: a successful approach to innovation? *R&D Management,* (32:3): 201-207.

Hansen, M. R. P., and Pries-Heje, J., (2016). Out of the Bottle: Design Principles for GENIE Tools (Group-Focused Engagement and Network Innovation Environment), In: *Proceedings of the 11th International Conference on Design Science Research in Information Systems and Technology, DESRIST 2016, St. Johns, NL, Canada,* pp. 131-146.

Hedlund, G., (1994). A model of knowledge management and the N-form corporation. *Strategic management journal,* (15:S2): 73-90.

Hevner, A. R., March, S. T., Park, J., and Ram, S., (2004). Design science in information systems research. *MIS Quarterly,* (28:1): 75-105.

Hovorka, D. S., and Pries-Heje, J., (2013). Don't ignore the iceberg: Timely revelation of justification in DSR, In: *DESRIST2013. Proceedings of International Conference on Design Science Research in Information Systems,* J. v. Brocke, R. Hekkala, S. Ram, and M. Rossi (eds.), Springer, Helsinki, pp. 228-241.

Jack, S., Moult, S., Anderson, A. R., and Dodd, S., (2010). An entrepreneurial network evolving: Patterns of change. *International Small Business Journal,* (28:4): 315-337.

Kensing, F., Simonsen, J., and Bødker, K., (1998). Participatory design at a radio station. *Computer Supported Cooperative Work,* (7:3): 243-271.

Kirkels, Y., and Duysters, G., (2010). Brokerage in SME networks. *Research Policy,* (39:3): 375-385.

Klerkx, L., Hall, A., and Leeuwis, C., (2009). Strengthening agricultural innovation capacity: are innovation brokers the answer?. *International Journal of Agricultural Resources and Ecology,* (8:5/6): 409.

Kolb, A. Y., and Kolb, D. A., (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of management learning & education,* (4:2): 193-212.

Kristoffersen, S., and Ljungberg, F., (1997). DARWIN: Message pad support for networked, dispersed groups. *Scandinavian Journal of Information Systems,* (9:1): 5.

Lea, B. -R., Yu, W. -B., Maguluru, N., and Nichols, M., (2006). Enhancing business networks using social network based virtual communities. *Industrial Management & Data Systems,* (106:1): 121-138.

Lempinen, H., Rossi, M., and Tuunainen, V. K., (2012). Design Principles for Inter-Organizational Systems Development--Case Hansel, In: *DESRIST 2012. Proceedings of International Conference on Design Science Research in Information Systems,* K. Peffers, M. Rothenberger, and B. Kuechler (eds.), Springer, Las Vegas, pp. 52-65.

March, S. T., and Smith, G. F., (1995). Design and natural science research on information technology. *Decision support systems,* (15:4): 251-266.
Markus, M. L., Majchrzak, A., and Gasser, L., (2002). A Design Theory for Systems That Support Emergent Knowledge Processes. *MIS Quarterly,* (26:3): 179-212.
McNaughton, R. B., and Bell, J., (2001). Competing from the periphery: Export development through hard business network programmes. *Irish Marketing Review,* (14:1): 43-54.
Miles, M. B., and Huberman, A. M., (1994). *Qualitative Data Analysis: An Expanded Sourcebook,* Sage Publications, Beverly Hills.
Mitchell, J. C., (1974). Social Networks. *Annual Review of Anthropology,* (3:1): 279-299.
Möller, K., Rajala, A., and Svahn, S., (2005). Strategic business nets—their type and management. *Journal of Business Research,* (58:9): 1274-1284.
Myers, P. S., (1996). Knowledge management and organizational design: an introduction. In: *Knowledge management and organizational design,* P. S. Myers (ed.), Butterworth-Heinemann, Boston, pp. 1-6.
Nonaka, L., Takeuchi, H., and Umemoto, K., (1996). A theory of organizational knowledge creation. *International Journal of Technology Management,* (11:7-8): 833-845.
O'Donnell, A., Gilmore, A., Cummins, D., and Carson, D., (2001). The network construct in entrepreneurship research: a review and critique. *Management Decision,* (39:9): 749-760.
Peffers, K.,(2008). Editorial: IS Research Using Theory from Elsewhere. *Journal of Information Technology Theory and Application,* (9:2): iii-iv.
Polanyi, M., and Sen, A., (2009). *The Tacit Dimension,* University of Chicago press, Chicago and London.
Porras, S. T., Clegg, S., and Crawford, J. T., (2004). Trust as networking knowledge: precedents from Australia. *Asia Pacific Journal of Management,* (21:3): 345-363.
Prahalad, C. K., and Ramaswamy, V., (2004). Co-creating unique value with customers. *Strategy & leadership,* (32:3): 4-9.
Pries-Heje, J., and Baskerville, R., (2008). The design theory nexus. *Mis Quarterly,* (32:4): 731-755.
Pries-Heje, J., and Hansen, M. R. P., (2016). Net Up Your Innovation Value, In: *Nordic Contributions in IS Research. SCIS 2016,* Springer, Cham, pp. 70-85.
Putnam, R. D., (2001). *Bowling Alone: The Collapse and Revival of American Community,* Simon and Schuster, New York.
Rogers, E. M., (2003). *Diffusion of Innovations,* Free Press, New York.
Schacht, S., and Mädche, A., (2013). How to Prevent Reinventing the Wheel?--Design Principles for Project Knowledge Management Systems, In: *DESRIST2013. Proceedings of International Conference on Design Science Research in Information Systems,* J. v. Brocke, R. Hekkala, S. Ram, and M. Rossi (eds.), Springer, Helsinki, pp. 1-17.
Schwabe, G., Bretscher, C., and Schenk, B., (2010). Designing for Light-Weight Collaboration: The Case of Interactive Citizens' Advisory Services, In: *DESRIST 2010. Proceedings of International Conference on Design Science Research in Information Systems,* R. Winter, J. L. Zhao, and S. Aier (eds.), Springer, St. Gallen, pp. 449-460.
Schwarz, R., (2002). *The Skilled Facilitator: A Comprehensive Resource for Consultants, Facilitators, Managers, Trainers, and Coaches,* John Wiley & Sons, San Fransisco.
Simon, H. A., (1996). *The Sciences of the Artificial,* MIT press, Cambridge.

Simonsen, J., Svabo, C., Strandvad, S. M., Hansen, O. E., Samson, K., and Hertzum, M., (2014). *Situated Design Methods,* Mit Press, Cambridge.

Smart, P., Bessant, J., and Gupta, A., (2007). Towards technological rules for designing innovation networks: a dynamic capabilities view. *International Journal of Operations & Production Management,* (27:10): 1069-1092.

Strauss, A. L., and Corbin, J., (1990). *Basics of Qualitative Research,* Sage Newbury Park, California.

Sveiby, K.-E., (1996). Transfer of knowledge and the information processing professions. *European Management Journal,* (14:4): 379-388.

Tsoukas, H., (2009). A dialogical approach to the creation of new knowledge in organizations. *Organization Science,* (20:6): 941-957.

Van de Ven, A. H., and Poole, M. S., (1995). Explaining development and change in organizations. *Academy of management review,* (20:3): 510-540.

Vargo, S. L., Maglio, P. P., and Akaka, M. A., (2008). On value and value co-creation: A service systems and service logic perspective. *European management journal,* (26:3): 145-152.

Venable, J., Pries-Heje, J., and Baskerville, R., (2014). FEDS: a Framework for Evaluation in Design Science Research. *European Journal of Information Systems,* (25:1): 77-89.

Walls, J. G., Widmeyer, G. R., and El Sawy, O. A., (1992). Building an information system design theory for vigilant EIS. *Information systems research,* (3:1): 36-59.

Zhao, X., Frese, M., and Giardini, A., (2010). Business owners' network size and business growth in China: The role of comprehensive social competency. *Entrepreneurship & Regional Development,* (22:7-8): 675-705.

Appendix

	Activity type	*Evaluation Criteria*	*Participant types*	*Participant back-grounds*	*Length (minutes)*
Formative evaluation in iteration 1	Focus group 1	Identifying and verifying dimensions and network types	6 knowledge network participants	CEOs, 20+ years of experience in businesses of the fishing industry, agriculture and mobile service	120
Formative evaluation in iteration 1	Focus group 2	Identifying and verifying dimensions and network types	4 knowledge network participants	Entrepreneurs, 5+ years of experience with start-ups, construction and engineering, arts and printing and accounting	120
Formative evaluation in iteration 1	6 semi-structured interviews	Testing nexus, exploring actions	5 network facilitators (FAC1-5)	1-10 years of experience with facilitation, backgrounds ranging from professionals to non-experts, 2+ network groups of various types	430
Summative evaluation in iteration 2	1 semi-structured interview	Testing nexus in IT context, potential for general use in larger network, usefulness through reflection	Network facilitator 6	2+ years of facilitation experience, expert in the field of ITIL and service management, 2 minor network groups	90
Summative evaluation in iteration 2	1 semi-structured interview	Testing nexus in networks for action research contexts, usefulness through reflection	Network facilitator 7	10+ years of facilitation experience, 4+ large network groups focused on innovation	90
Total			- 10 knowledge network participants - 7 facilitators		730

Table 2. The participants interviewed, how they were used, their backgrounds and the length of interview

Dimension	*Definition*	*References*
Size	Size correlates to network group health. More participants mean difficult facilitation. Critical mass must be met to counter participant cancellations.	Ghisi and Martinelli (2006); Jack et al. (2010); Mitchell (1974); Zhao et al. (2010)
Purpose and success criteria	Expectations of formal agreements on explicit purpose and economic success. Explicit purpose and success criteria makes it easier to finance.	Hanna and Walsh (2002); Jack et al. (2010); Möller et al. (2005)
Member composition	Composition is the combination of participant backgrounds, competencies, experiences and line of business. Solving tasks can be difficult based on the composition of the group.	Ghisi and Martinelli (2006); Gruenfeld et al. (1996); Klerkx et al. (2009)
Knowledge level and type	Knowledge is the main purpose of a knowledge network. Explicit and decontextualised knowledge is easier to share and understand. Knowledge ranges from remembering, applying, reflecting and constructing.	Cook and Brown (1999); Bloom et al. (1984); Nonaka et al. (1996); Polanyi and Sen (1996); Sveiby (1996)
Knowledge sharing and interaction	Knowledge sharing works only if a high level of trust is present. Common purpose, social practices, dialogue and reflection are needed among participants for knowledge sharing to work	Brown and Duguid (2001); Connel and Voola (2006); Jack et al. (2010); Clegg and Porras et al. (2004); Tsoukas (2009)
Facilitation and leadership	Facilitation (external or internal) is a requirement. Roles of the facilitator can range from *process consultant,* expert consultant, neutral coach, expert trainer, or decision-capable leader.	Hannah and Walsh (2002); Kirkels & Duysters (2010); Schwarz (2002)
Activities	Activities at the meetings holds the meetings together. Range from being unpredictable and dissimilar during or between meetings to requiring fixed and predictable agendas. Activity types include problem solving, decision making, conflict handling, knowledge sharing, or experimenting.	Connel and Voola (2006); Cook and Brown (1999); Jack et al. (2010); Kolb and Kolb (2005); Möller et al. (2005); Schwarz (2002)

Table 3a. The dimensions of a knowledge network, the definition of each dimension based on literature, support from the initial focus group results, and an example of a statement of how the highest value was stated in the SAS. Note that some of the literature supported multiple dimensions

Dimension	*Empirical support from focus groups (FG1 and FG2)*	*Statement for the highest value of this dimension. The network…*
Size	FG1: Participants felt frustrated when people did not show at meeting; e.g.; worst if 1/3 did not show. Smaller groups with 10 or fewer participants were vulnerable.	*"…contains many members (20+) cancellations are often more than a third at each network group meeting."*
Purpose and success criteria	FG1: Dissatisfaction occurred among participants if purpose of a group changed too much over time and this phenomenon was not articulated.	"*…has an implicit purpose, no success criteria and with little common agreement and/or even conflict."*
Member composition	FG1: Some participants wanted diversity of member backgrounds and others actively pursued homogeneous network groups (this later shaped design principle 4).	*"…has participants with heterogeneous backgrounds, experiences, and line of businesses."*
Knowledge level and type	FG1 + 2: Some participants had created new knowledge products, others valued sharing of experiences while another third was more interested in learning new crafts. All participants agreed that it depended on the purpose of the specific group.	*"…produces new, contextualised and innovative knowledge that needs to be tested in a real-life setting to be evaluated properly.*"
Knowledge sharing and interaction	FG2: Trust is the most important aspect for feeling comfortable sharing information but takes time and dedication.	*"…participants do not trust each other with confidential information and the meetings contain very little sharing of stories and experiences.*
Facilitation and leadership	FG1 + 2: Depending on each network group, facilitator roles vary, important to be an expert and other times important to push the process. All participants disliked facilitators changed roles or took over the agenda.	*"… facilitator changes roles during and between meetings, particularly the role as an expert without articulating it."*
Activities	FG1 + 2: Depending on the network purpose, some participants desired fixed agendas while others wanted room for improvisation. All participants agreed that activities should be consistent with the purpose and the participants of the network.	*"… meetings contain different types of activities with varied meeting agendas with no explicit aim.*"

Table 3b. The dimensions of a knowledge network, the definition of each dimension based on literature, support from the initial focus group results, and an example of a statement of how the highest value was stated in the SAS. Note that some of the literature supported multiple dimensions