COMPLEX PROBLEM DEFINITION AND KNOWLEDGE INTEGRATION PRACTICES : CASE STUDY ON TEMPORARY EXPERT TEAMS

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Abstract

Title Complex Problem Definition and Knowledge Integration Practices: Case Study on Temporary Expert Teams

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Recent literature suggests that tackling complex, ill-structured problems is becoming the domain of temporary expert teams. Despite the buzz around such teams, our conception on how they turn complexity into solvable problems is still underdeveloped.

This thesis intends to add our understanding on how complex problems are defined in temporary expert teams. The teams in the scope of the study temporarily cross organizational or other boundaries to pursue knowledge and innovation. The thesis aims to systematically deconstruct the practices those teams employ in defining a complex problem. The theories on complex problem solving (CPS) and knowledge co-creation are identified central for understanding this topic.

The empirical foundation of the work is derived from a single-case, qualitative process study. The case examined was a sustainability strategy project of an innovation company operating on the energy sector. Ethnographic research data was collected by observing the project team and team discussion, and by reading project documentation and interviewing team members. The core data included seven semi-structured interviews (à 30 minutes), audio recordings of meetings, feedback conversations, and workshops (~ 8 hours altogether), project documents (~ 10 altogether), and dozens of messages posted in the virtual coworking space or in the chat. NVivo 12.0 was used to manage and shape the information.

The results imply that in complex projects success can be reached without an observable problem definition phase. Instead, the defining of the problem forms an intrinsic part of the project activities. The process builds on a holistic approach that considers the external complexity surrounding the project and constantly compares it to the team context. In this case, the problem definition process was best described in terms of design thinking: as active exclusion and inclusion of solution components, and utilization of artifacts as vehicles in creating knowledge. The results suggest that problem definition matures as the team flexibly changes between system, solution, and design lenses to complex situation it faces.

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Tiivistelmä

Otsikko	Monimutkaisten ongelmien määrittely- ja tiedonintegrointikäytännöt: tapaustutkimus väliaikaisista asiantuntijatiimeistä
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Tarkastajat	Professori Kirsimarja Blomqvist ja professori Thomas Olsson

Monimutkaisten ja epämääräisten ongelmien ratkaiseminen on kirjallisuuden perusteella yhä useammin väliaikaisten asiantuntijatiimien tehtävä. Huolimatta aihepiirin innokkaasta tutkimuksesta meillä on yhä varsin vajavainen ymmärrys siitä, miten tällaiset tiimit muovaavat kohtaamansa monimutkaisuuden ratkaistavissa oleviksi ongelmiksi.

Opinnäytetyö pyrkii lisäämään ymmärrystä siitä, miten monimutkaisia ongelmia määritellään väliaikaisissa asiantuntijatiimeissä. Tutkimuskohteena ovat tiimit, jotka ylittävät organisaatio- ja muita rajoja uutta tietoa ja tietämystä tavoitellessaan. Työ pyrkii systemaattisesti erittelemään tällaisten tiimien ongelmanmäärittelykäytäntöjä. Aihepiirin tarkastelussa keskeisiksi tunnistettiin monimutkaisten ongelmien ratkaisemista (complex problem solving, CPS) ja yhteistä tiedon luomista (knowledge co-creation) käsittelevät teoriat.

Työssä tutkittiin yksittäisen tiimin prosessia laadullisesti. Tutkittu tapaus oli energia-alalla toimivan innovaatioyrityksen kestävyysstrategiaprojekti. Kohteesta kerättiin etnografinen aineisto havainnoiden tiimiä ja sen keskusteluja sekä lukemalla projektidokumentteja ja haastattelemalla tiimiläisiä. Datan ytimenä oli seitsemän puolituntista teemahaastattelua, kahdeksan tuntia äänitteitä kokouksista, palautekeskusteluista ja työpajoista sekä virtuaalisessa työtilassa vaihdetut pikaviestit. Aineiston työstöön käytettiin NVivo 12.0:ta.

Tulokset viittaavat siihen, että monimutkaiset projektit voivat onnistua, vaikka niissä ei olisi selkeää ongelmanmäärittelyvaihetta. Ongelmanmäärittely muodostaa ennemminkin elimellisen osan kaikkea projektitoimintaa. Monimutkaisen ongelmaa lähestytään holistisesti: ympäröivää monimutkaisuutta tiimin ongelmanratkaisun paikalliseen kontekstiin verraten. Ongelmanmäärittelyprosessia on luontevinta kuvailla design-ajattelun kautta: aktiivisena toimintana, jossa erilaisia ratkaisun osia otetaan vuoroin mukaan tai siirretään sivuun hyödyntäen artefakteja tiedon luomisen välineinä. Lopulta ongelma hahmottuu ajan kuluessa tiimin käyttäessä vaihdellen systeemiajattelun, ratkaisukeskeisyyden ja design-ajattelun työkaluja monimutkaisen todellisuutensa ymmärtämiseksi.

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Acknowledgements

"Viewing a complex project as complex problem solving (CPS) is more like painting a landscape than the mechanical assembly of an elaborate jigsaw. In a jigsaw, the pieces and their connectivity are known in advance but, in a landscape painting, while the major features may be known in outline in advance, the final connectivity has yet to emerge due to shifting light, clouds, shadows, etc." (Ahern et a. 2014a, 1373)

Writing this thesis was probably the most complex project of my life so far. I took it as a jigsaw at first – wondering why it came with so many extra pieces from other jigsaws I had never seen before. The process included some serious hammering of misfitting pieces, until I finally pulled back and took up the paintbrushes instead. Like in landscape painting, the end result embodies an interpretation of a lone (junior) artist but is strictly related to the lessons learned from previous literature and true masters of the field.

At this point one could breathe a sigh of relief: problem finally solved! However this is not the whole truth. When writing the thesis I learned the true nature of complex problem solving, and it is all about *processes*. Solutions are accomplished but they mainly represent stages in the on-going evolution. The themes in this thesis will undoubtedly follow me throughout my working life – and yours, too. The heart of the knowledge work of today is in enduring the uncertainty and ambivalence in our environments. Luckily enough, we can very often face the escalating pace of change with our best teammates.

I want to thank the examiners of the thesis, my family, my closest friends, my workmates and bosses, my team – all the people who have been so patiently supporting me during the writing process. Especially Suoma, Jukka, Soile, and my beloved father. I would never be at this point without your mindful understanding and help.

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Anu-Liina Ginström

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1. INTRODUCTION

The focus of research on knowledge management (KM) has for long been in the processes and practices *inside the organization* that aim at sustainable gains through the management of intangible assets like knowledge (cf. Grant 1996; von Krogh 1998; Alavi et Leidner 2001; Hussinki, Ritala, Vanhala, et Kianto 2017). KM practitioners have shown great interest in managerial issues such as how to enhance knowledge flows or integrate specialist knowledge stored *within the firm* to perform better on the market. This thinking is widely referred to as *knowledge-based view of the firm*. It regards knowledge as the main source of competitive advantage of the organizations, and organization's prosperity as depending on its capability to manage, utilize, and create knowledge (Grant 1996).

However, a notable body of recent literature suggests that tackling complex, novel, ill-defined, or messy problems is becoming the domain of *temporary expert teams* (Bakker 2010; Baer, Dirks, et Nickerson 2013; Majchrzak, More, et Faraj 2012; Lundmark, Derrick, et Crowe 2016; de Montjoye, Stopczynski, Shmueli, Pentland, et Lehmann 2014; Aggarwal et Woolley 2019). As the pace of change and the complexity of the operational environment increases, it is unlikely that organizations would have the resources needed to solve all the complex problems they face (Bengtsson et Eriksson 2002). Relying on multidisciplinary teams is believed to enable creation of high-yielding, valuable knowledge, and rapid, flexible, adaptive, and innovative responses to the unexpected (cf. Edmondson et Harvey 2018; van Knippenberg et Mell 2016; Kozlowski et Ilgen 2006, 77; Bell et Kozlowski 2002; Aggarwal et Woolley 2019, 1595). This means knowledge integration and co-creation *in cross-boundary teams* that combine experts of many knowledge domains or industries *temporarily*. Digital technology spurs distributed innovations by integrating specialized knowledge, data, and processes of diverse industries or individuals (Yoo, Boland, Lyytinen, et Majchrzak 2012).

Despite the buzz around teams, our conception on how they turn complex, ill-defined situations into solvable problems has remained underdeveloped (cf. Foss, Frederiksen, et

Rullani 2016). This Master's Thesis addresses the empirically little researched topic of problem definition practices in temporary expert teams.

1.1. Research focus and aim

According to many academics, solving complex problems calls for ability to define the problem effectively and collectively (Volkema 1986; Ackoff 1981) and to share the knowledge in the team (cf. Carlile 2004). At the level of practice, how is this done in temporary expert teams? The discussion on the topic is fragmented and lacks integrative framework. Mainstream project management literature offers answers but wells from a world much more stable than the one we see today. In front of complexity, it hopes to reduce contradictions and uncertainty through rigorous planning (Berggren, Järkvik, et Söderlund 2008, S116; Lundin et Söderholm 1995, 448; Ahern, Leavy, et Byrne 2014b, 1423; Engwall 2002, 266). At the same time, the complexity of problems and multiplicity of potential stakeholders together with the time pressure challenge the idea of ex-ante planning. Consequently, the control of complexity and uncertainty and the defining of team task takes place in the *actual team process* instead (cf. Barrett et Sexton 2006; Bakker, Boroş, Kenis et Oerlemans 2013).

This study contributes to the building of conceptual framework on knowledge work in temporary expert teams. Such teams are here referred to as temporary expert teams. The study unveils the micro-level practices and actions such teams employ when defining complex problems they are to solve. The whole of the problem-solving process including final solution or implementation will not be covered.

Previous contributions within social sciences that integrate complex problem definition and knowledge collaboration in cross-boundary teams are extremely rare. This study partly fills this gap. Deeper understanding on the topic is valuable for multiple reasons. Firstly, as pictured in the first chapter, growing complexity of the environment and the escalating pace of change urges cooperation and integration of dispersed expertise in hope to swiftly respond to complexity and uncertainty.

Secondly, problem definition adopted by the team seems to have fundamental consequences for the team's performance and cooperation. Defining problems in haste may lead to over-simplifications which results in less new knowledge, less innovation, and less value-creating potential of the solution (cf. Lyles 2014, 134; Lundmark et al. 2016, 777–778). Too fixed a problem formulation is a trap, too, as it cuts problem solvers off from much needed landscape richness that might help to find the root cause of the complex problem (von Hippel et von Krogh 2016). Many diverse understandings of the problem within a team may lead in task conflicts that consume limited resources, while lack of alternative problem formulations is a challenge as well, since it limits comprehensiveness of the problem formulation process (cf. Baer et al 2013, 205) which is sometimes seen as an antecedent of successful problem formulation activity (Lundmark et al. 2016).

Thirdly, problem definition is linked to the scope of the team and to its ability of recruiting the right experts. Defining the scope too narrowly can lead to inadvertently overlooking the inputs of important participants and defining it too broadly to inclusion of participants less important for achieving the goal (cf. Mortensen et Haas 2019, 352).

In many respects, work in temporary expert teams is a highly creative process, full of aspiration for new solutions and knowledge. In this thesis, the value-creating potential of such teams is located in *the process of knowledge creation.* Problem solving is here seen as one of its sub-processes, *and problem definition as a sub-process of problem solving.* (Fig. 1.)

Figure 1. The process of knowledge creation in teams.

In conclusion, problem definition affects the ability of the team to effectively solve complex problems and adapt to change. The problem definition in the team is linked to the ideal team composition, to the shared understanding of the team on its task, and to the quality of achieved solution (fig. 2). From the KM perspective, problem definition relates to discussion on knowledge creation since it is clearly a part of the knowledge creation process.

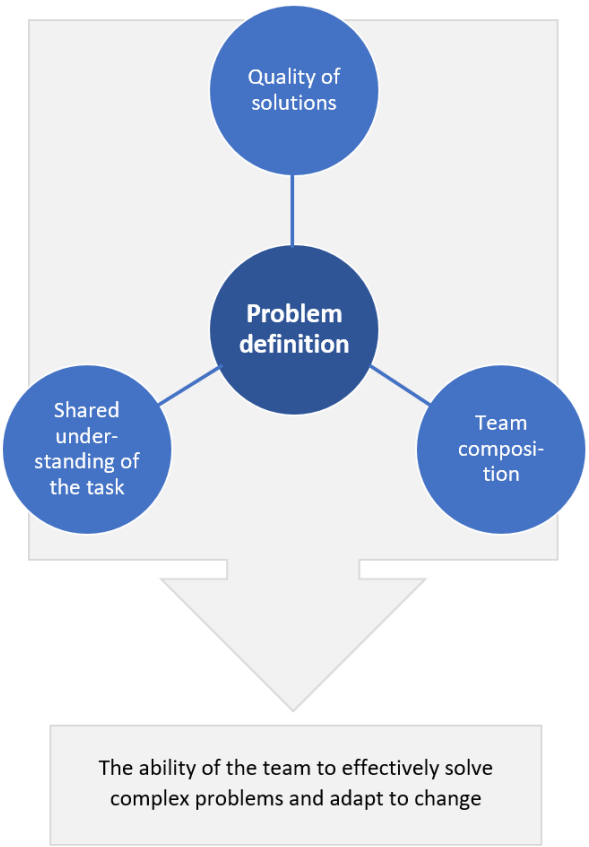


Figure 2. The sphere of influence of problem definition in temporary expert teams.

Basing on these considerations, it should be a major interest of KM research to grasp the functionality of temporary expert teams defining complex problems. At best, the findings of the thesis ease the launching of complex projects and the orchestration of future teams facing complex problems. The aim of the study is to find and analyze empirical evidence on the problem definition process of a temporary expert team. In the light of such evidence,

the objective is to add our understanding on the role of problem definition for the team's ability to effectively solve complex problems and adapt to change.

1.2. Conceptual framework

There exists no single academic discipline dedicated to complex problem definition, not to mention complex problem definition in temporary teams in particular. Hence, the topic of the study must be approached from several directions, merging elements from knowledge management and knowledge creation literature, problem solving literature, project research, and organization theory. One way to assess the thesis is to understand it as a process of finding building blocks for better understanding of possibilities and challenges in problem definition process of temporary expert teams.

The thesis discusses various definitions which are mainly explained as they are first introduced. However, there are a few key definitions which help grasping the overall scope of the text. They also function as foundation pillars for the theoretic frame outlined more in detail later in chapters 2 and 3.

Projects are organized efforts to perform defined ***tasks*** within a ***time-limited period*** and with some type of resource restrictions (e.g., financial, staff) (Sahlin-Andersson et Söderholm 2002). They are typically performed by ***temporary organizations***: set of organizational actors – ***teams*** – working together in order to solve a complex task (Bakker 2010).

This study discusses ***knowledge-based, temporary expert teams***. The definition distinguishes the organizational form of interest from other possible types of teams. Temporary expert teams as they are seen in this study bring together experts from several disciplines, organizations, or professions to solve together complex problems, and, through this, *to create innovations and knowledge*. Attributes like "cross-functional", "multidisciplinary", "inter-organizational", "cross-company", or "cross-community" portray this kind of organizational arrangements.

In this thesis, the term ***cross-boundary*** is used to put together the diversity of these approaches. It refers to teams that span organizational or other boundaries to pursue knowledge and innovation (cf. Edmondson et Harvey 2018).

Temporary expert teams have to work on ***deep knowledge sharing*** and ***negotiating*** of goals, roles, and responsibilities to accomplish their task. Such activities are firmly present in knowledge-intensive teams in general (cf. Edmondson et Harvey 2018, 354; Majchrzak et al. 2012, 954). According to Lundin and Söderholm, there are two fundamentally different types of team tasks: unique and repetitive (Lundin et Söderholm 1995, 441). Likewise, Edmondson and Harvey distinguish cross-boundary teams from "well-bounded, reasonably stable, and functionally homogenous" teams working within firms (Edmondson et Harvey 2018, 348). To pull these views together, there are temporary expert teams that work on relatively repetitive tasks and fulfill pre-defined plans or protocols that determine team roles, hierarchy, and procedures the team follows (e.g., a roof installation team). This thesis discusses teams that solve more or less ***unique tasks***. The uniqueness of the team task is here seen as a property linked to temporary expert teams specifically.

The key features and challenges in cross-boundary teaming are well illustrated in a case description by Edmondson and Harvey (2018, 347; italics added):

"…participants had to *work across knowledge boundaries* (…) associated with *differences in expertise and organization* in *novel settings*. They had joined a newly formed temporary group, with *fluid membership*, which needed to develop *rapidly into a high-performing unit* to take on an *unfamiliar project*."

All these observations highlight the importance of studying team ***practice***. A practice is considered to be "embodied, materially mediated arrays of human activity centrally organized around shared practical understanding" (Schatzki 2001, 2). Human actions are "performed within a practice and determined by the practice which they are part of" (Goldkuhl 2006, 1–2). Actions, actors (e.g., experts in a team) and action objects (conditions, products, results) form building blocks of a practice (ibid.).

The emergence of new knowledge, innovations or creative solutions in team practices cannot be taken for granted. René Bakker (2010) organizes research on temporary organizational forms around four main themes: time, task, team, and context. Considering this much-cited division, most of the temporary teams share the reality of ***time constraints*** and task-focus. Rest of the features – "team" and "context" – refer to ***vulnerability, uncertainty, and risks*** in team collaboration. Such features apply strongly to teams that work on unique tasks under conditions of uncertainty and novelty. Despite the risks and possibility of conflicts, the teams should be able to set in motion a knowledge creation process. Research suggests several ways to overcome the clash of intersecting social systems within a team, like nurturing of collective states that enhance ***trust, openness, and psychological safety*** (Edmondson et Harvey 2018, 349). Furthermore, ***sociomaterial practices*** like using boundary objects (tools, documentation, models, drawings, charts, software programs, spreadsheets, or events; see e.g., Star et Griesemer 1989; Carlile 2002; Butters et Duryan 2019) may alleviate knowledge transfer and knowledge integration.

The core concept of this study is a sub-process of problem solving – ***problem definition.*** Problem solving and problem definition as a part of it are here understood as being a part of the knowledge creation process. Problem definition is seen as ***a process of gaining consensus within the team on problem(s) it will resolve during its cooperation***.

Earlier studies have focused mainly on problem definition process of firms, not in teams in particular (cf. Mintzberg, Raisinghari et Theoret 1976; Lyles et Mitroff 1980; Büyükdamgacı 2003). Another prominent feature in the research is the somewhat versatile terminology. *Problem structuring* refers to framing and definition of the critical issues that constitute the decision problem and understanding the systematic relationships between these issues (Bell, Pagano, Warwick, et Sato 2019, xix). *Problem structuring approaches (PSAs)* are modeling approaches that "foster dialogue, reflection and learning about the critical issues, in order to reach a shared understanding and joint agreements regarding these key issues" (Shaw, Franco et Westcombe 2006, p. 757). *Problem formulation*, on the other hand, refers to "conversion of ill-structured problems into solvable problems" (Simon 1973).

Baer, Dirks and Nickerson, pointing to original texts of Lyles et Mitroff (1980) and Mason et Mitroff (1981), propose a much wordier conceptualization, naming problem formulation as "a collective activity aimed at translating an initial problem symptom or web of symptoms into a set of questions or alternative formulations of the problem sufficiently well-defined in terms of the causes of the symptoms to enable the search for or generation of solutions" (Baer et al. 2013). Conceptualization in this thesis is consistent with this rather lengthy description, but also with the most recent studies on problem formulation in complex team challenges and their impact on value creation (cf. Lundmark et al. 2016). Following this line of research, ***problem definition, knowledge creation, and value creation are here taken as mutually and dynamically dependent concepts***.

The thesis sheds light on the practices belonging to the problem definition process of temporary expert teams. The phenomenon of interest is examined through four complementary lenses, all represented in problem-solving literature.

Problem-defining teams can be approached as 1) ***solution-oriented*** entities that exist to support the decision-making process of firms and help in finding the optimal solution to a problem as efficiently as possible. Alternatively, they can be seen as units attempting to add understanding of larger systematics behind the problem: 2) ***systems view*** aims at identifying the right problem rather than the right solution, thus hoping to change the system so that the problem will not occur again. Thirdly, teams can be observed from 3) **design perspective**; as hands-on temporary organizations creating new real-life solutions through probing. Finally, temporary expert teams can be studied through 4) ***practice lens***: paying attention to what the team actually does at the very grass-root level. The fundamental insight in this approach is that whatever the case, the cognitive and knowledge diversity of the teams is molded into performance benefits only through shared action and participation, and these are the things to be explored when trying to understand the essence of problem solving. The four approaches are discussed in section 2.2., and team practices are viewed more in detail in chapter 3 of the study.

One more recurring concept in the literature is ***problem space***. In early works on problem solving it is defined to consist of the initial state, the goal state, and all possible states in between those two when moving closer to the solution of the problem (cf. Newell et Simon 1972). This thinking works for fairly well-structured tasks with well-defined goals. Design thinking, on the other hand, is an interplay between *diverging exploration* of problem and solution space and *converging* processes of *synthesizing and selecting* (Gurusamy, Srinivasaraghavan, Adikari 2016). Solving design problems requires the definition of problem space which consists of a plethora of information concerning the problem context that is relevant for understanding the actual problem. In this thesis, the understanding of the definition of problem space comes closer to the one provided by later design thinkers.

1.3. Research questions

A significant part of the knowledge work today takes a form of complex problem solving in temporary expert teams. Nonetheless, we know relatively little about how such teams establish their knowledge creation process, and what is the role of problem definition in it. This thesis wishes to enrich the discussion on knowledge creation by approaching it from the point of view of complex problem definition practices in teams where dispersed expertise is brought together and integrated to effectively solve complex problems.

Work in between permanent organizations results in temporary teams not having the traditional "infrastructure" of high-quality knowledge work. They may lack shared physical space, history, processes, and knowledge assets that could facilitate knowledge integration (cf. Majchrzak et al. 2012, 951). They may lack organizational routines: formal procedures or "company paradigms" suggested by von Krogh (1998, 135–136).

Most of all, their time span is short compared to those of the stable firms. Despite these premises, how do they manage to capture valuable, tacit, and collective knowledge? What is the role of problem definition in it? Research questions are as follows (table 1).

Table 1. Research question (4), sub-questions (1–3), and related research approach.

Research approach	**Research questions**	
Theoretical	1. In organizational research, what are the main logics in discussing problem definition? (Chapter 2)	2. In the framework of practice-based team research, what kind of practices are associated with the work in temporary expert teams? (Chapter 3)
Theoretical & Empirical	3. What is the role of problem definition in the temporary expert teams' process of taking stock of complex, ill-structured situations?	
Empirical	**4.** **How do temporary expert teams define the problem(s) they will solve – which practices constitute the problem definition process?**	

The ultimate goal is to understand how teams transform complex situations into solvable problems fast, yet with incomplete pre-given knowledge (P4). This is done by examining the problem definition process of the team – the practices and actions belonging to it (P2). The thesis also sums up previous academic discussion on complex problem definition in temporary teams (P1/P3). The findings will be reflected to prior theories in order to get a more empirically informed and detailed picture of knowledge work in temporary teams.

1.4. Methodological approach

The contexts in which temporary expert teams operate vary a lot. They may develop strategies or products, design complex traffic plans or health care systems, or work to tame wicked societal or environmental challenges. The communication channels they use range from live meetings to virtual platforms. Gaining the data through large-sample hypothetico-deductive research and studying it through one general theory lens might lead to missing these kind of contextual idiosyncrasies (cf. Ketokivi et Choi 2014; see also Martin et Eisen-

hardt 2010). The vast variation of different kinds of teams together with the relative novelty of the field and limited supply of former theorizing spoke for choosing ***qualitative case study layout***. Case approach is specifically justified when there is, like here, a gap in existing theory that prevents it from adequately explaining the phenomenon (Barratt, Choi, et Li 2011).

Due to aforesaid conditions and tight schedule, a comparative, variance-based research with multiple real-life cases proved to be an unrealistic target. For this, the research took a form of a ***single case* study**. The case was chosen carefully in order to fulfill the desired criteria concerning complexity and cross-boundary features. Finally, the selected case was a sustainability strategy project of an innovation hub operating on energy sector. The project was facilitated by on-demand experts available on a sustainability-related, digital platform. On the platform, organizations can find, hire, and work with the experts they need to create smart and sustainable solutions. The platform promises efficient combining of diverse experts to advice, collaborate, and ideate with specific co-creation tools to innovate and tackle complex initiatives that require specialized expertise fast. The most salient features in the case team were temporariness (the project lasted for 2,5 months), the mixing of experts from several countries and disciplines, the absence of unequivocal project goal in the beginning of the work, and the presence of many kinds of boundaries within the team.

Since the research interest is in understanding the *process* of problem definition – not the preconditions of it, nor the results of it or the verbal problem formulation as such – the thesis forms a ***process* study**. Such studies address questions about how and why things emerge, develop, grow, or terminate over time, as distinct from variance questions that deal with covariation among dependent or independent variables (Langley, Smallman, Tsoukas, et van de Ven 2013). The focus is on temporally evolving phenomena like on transformation of institutions, organizational practices or identities, social construction of cognitive schemas or norms, changing interactions between organizations and their environments, or the project-level dynamics of innovation and learning (ibid., 3–4). In this case, the process of interest is the transformation of a complex and ill-structured situation into solvable problems through the work of an expert team. Since the intention is to examine

the process at the level of micro-level practices, the phenomenon is approached from ***ethnographic* perspective**. Today, ethnography is one of the strongest methods for studying social practices across disciplines in organization and management research (Berthod, Grothe-Hammer, et Sydow 2017, 299). It represents an attempt to understand the behavior and idea systems of the actors in a certain culture, organization, profession, or community (Jönsson et Macintosh 1994, 2–3) from their own point of view (Geertz 1974).

The **research data** consisted of real-time observing and making fieldnotes on case-team's work. Team discussions on the digital platform, in the meetings, chats, etc. and the project documents produced by the team were collected and analyzed as well. Interviews with team members formed a complementary part of the collected data. Data analysis was based on related processes of *describing phenomena, classifying it, and seeing how the concepts the researcher creates interconnect* (cf. Dey 1993, 30). Data analysis was based on **Gioia methodology**. Following Gioia, Corley, et Hamilton (2013), it began with coding of the first-order codes and second-order themes and ended up with naming of the aggregate dimensions and building of a tentative theoretic model grounded in the data.

1.5. Thesis structure

Chapter 1 discussed the limitations of the traditional KM framework in terms of understanding temporary expert teams. The need for complimentary view was identified. In addition, the chapter presented the conceptual framework, methodological approach, and research problems. ***Chapters 2 and 3*** will elaborate further the theoretical framework, seeking to integrate relevant research on complex problem definition in temporary teams.

Chapter 4 reports the empirical research, describing what, why, and how was collected as research data and how the data was analyzed. The evaluation of reliability, validity, and credibility of the research is also included in this chapter. ***Chapter 5*** provides synthesis of the research findings and conclusions based on them, whereas ***Chapter 6*** compares them with findings from other research and provides suggestions for future research. Implications of the findings for practitioners and innovation policy are discussed as well.

2. THEORETICAL BACKGROUND

We know a lot about teams: on their effectiveness, as well as on knowledge diversity, knowledge integration, or knowledge boundaries which may affect their performance. Organizational problem solving is a well-explored field as well. All these research lines form the basis of understanding temporary expert teams. Our conception on complex problem definition in such teams is still underdeveloped, however. In order to bring light to it, this chapter outlines the general logics in discussing problem definition in organizational research. This enables better theoretical framing of problem definition efforts of teams.

Among knowledge management (KM) researchers, the discussion on teams seemed for long to encompass merely teams *within* organizations (cf. Nonaka et Konno 1998, 41: "Within an organization, knowledge-creating teams or projects play key roles in value creation"). This kind of teams can be enduring, even permanent. Among the first to draw attention to *temporary* organizational forms were Goodman and Goodman (1972, 1976). Interest on "cross type of temporary expert teams", in turn, like cross-company, cross-community, cross-disciplinary and so on, has been in steady growth during the last 20 years (cf. Denison, Hart, et Kahn 1996; Bakker 2010; Wageman, Gardner et Mortensen 2012). This research line has covered themes like leadership (e.g. Nordbäck 2018), knowledge sharing and knowledge coordination (e.g. Kim, Jarvenpaa, et Majchrzak 2008; Schaffer, Lei et Reyes Paulino 2008; Kanawattanachal et Yoo 2007), trust (e.g. Kasper-Fuehrer et Ashkanasy 2001; Robert, Dennis, et Hung 2009), innovation (e.g. Tucci, Chesbrough, Piller, et West 2016; Edmondson et Harvey 2018; Nordbäck 2018) and knowledge creation (Chamakiotis, Dekoninck, Panteli 2013) in temporary, cross-boundary expert teams.

What is lacking in previous research, is a firm linkage of research on temporary, cross-boundary expert teams on the one hand, and research on complex problem definition on the other hand. In this thesis, the essence of the problem definition in such teams is believed to come out in team practices: through observing what the team actually does during its existence. These practices are reflected to what we know about complex problem

solving in general and in temporary teams in particular. This chapter offers a quick mapping of the literature on complex problem solving (CPS), focusing specifically on what it has to say about the *defining* of complex problems. The dominant lines of research on the topic are identified among organizational studies. Throughout the discussion, the feasibility of various theoretic frames will be reflected to the context of temporary expert teams.

2.1. What is a complex problem and why does it matter?

Fischer, Greiff, and Funke (2011) note that the discussion revolving around CPS dates back to 1970s, when there was "a shift of emphasis from simple, static, well-defined and academic problems (…), to more complex, dynamic, ill-defined, and realistic problems". Those days, Russell L. Ackoff introduced the concept of "mess": a set of external conditions that produces dissatisfaction which is fundamentally caused by *a system* of problems that cannot be decomposed into independent parts (Ackoff 1974 & 1981). Drawing on Ackoff's "mess", Donald Schön presented the metaphors of "real-life swamp" referring to complex or messy problems, and "the reflective practitioner" referring to experts wading through the swamp to find ways to adapt to the continuous change (cf. Ramage et Shipp 2009, 290, 292). Situations on the swampy lowlands may resist technical analysis or solutions but reveal problems of greatest human concern, whereas easier problems, however great their technical interest, can be unimportant to the larger society (Schön 1984, 42).

Fundamentally, the work in temporary expert teams builds on creating the missing knowledge over the project lifecycle through problem solving with tacit foreknowledge (cf. Polanyi 1967). In this sense, Schön's thinking of experts as key figures in formulating and solving complex problems is pioneering. He elaborated the idea on *reflection in the midst of action*: professionals discovering a solution through *identifying and framing the complex situation and actively engaging with it*, making use of their *former knowledge and experience* (Schön 1983, 1987). The same reasoning echoes in multiple later contributions which stress the role of shared action (Lundin et Söderholm 1995), intensive social interaction (Bakker et al. 2013, 384), or collaborative problem framing and problem formulation (cf. Baer et al. in 2013 on "collaborative structure inquiry") within expert teams. These actions

promote reflection, sense-making, and learning (Lindqvist et Söderlund 2002, 288; Ahern et al. 2014b, 1427) and gradually add the team's understanding of its task (cf. Engwall 2002).

Complex problems are commonly defined as being unstructured or non-linear. They are typically not resolvable in purely quantitative terms, and there are no rules to state whether a problem solution is acceptable (cf. Grünig et Kühn 2017, 40). Given this, there are no ready-made analytic procedures available or to be developed to solve them (ibid.). This entails using heuristic decision-making procedure, which again entails using rules of thumbs, simplification, and limiting search for solutions (Feigenbaum et Feldman 1963; Mintzberg et al. 1976, 247) – procedures often associated to temporary teams (Bakker et al. 2013). The advantage of heuristic approach is the absence of formal application restrictions and the relatively low application costs, but on the other hand there is no guarantee of finding an optimal solution (Grünig et Kühn 2017, 38). Typical of complex problems is that the solution must serve a variety of organizational objectives, there is a high degree of interdependence between parts, they are not readily understood and solved by one person or group, and they are caused by a changing external world or the pressure to combine existing ideas in a new way (Ahern, Leavy, et Byrne 2014a, 1375). Differences between projects revolving around uncomplicated versus complex problems are reflected more in detail in table 2.

The term *wicked problem* refers to complex or dynamic problems that cannot be tamed without changing the society that produces them (Rittel 1972; Hocking, Brown, et Harris 2016, 25). Deriving from Ackoff (1974) and Camillus (2008), Hornett & Daniels Lee (2017, 28) state that wicked problems are novel and seemingly without a precedent and appear to be impossible to solve. They defy a single definition (Hocking et al. 2016) and can be impervious to modelling (Hornett et Daniels Lee 2017) or definite computational formulation (Elia et Margherita 2018, 279). They demand imagination, complex cognitive skills, and high-level strategic thinking (Hornett et Daniels Lee 2017, 28). Alford and Head (2017, 397–398) stress their intractability, open-endedness, and unpredictability, naming examples like global warming, drug abuse, child protection, natural disasters, or growing number of refugees.

Table 2. Mapping differences of uncomplicated projects vs. dynamic co-creation processes. (Adapted from Ahern et al. 2014a and Cleden 2009.)

Uncomplicated project	Complex problem solving
Planned / Planning	Emergent / Learning
The plan	Continuous planning
Centralized knowledge management	Distributed knowledge management
"Known knowns" (detached from the knower)	"Known unknowns" (risks), "unknown knowns" (untapped knowledge), and "un-known unknowns" (uncertainty)
Abstract	Lived planning process
Organization	Organizing
Little knowledge change	Lot of knowledge change
Structured / Linear	Unstructured / Non-linear
Pre-given inputs, outputs, and targets	The team (community of learners) creating the missing knowledge; possibility for innovation

Typical wicked problems are multidimensional policy problems that cannot be addressed without incorporating into decision-making both governmental and non-governmental actors and a vast network of societal stakeholders to reflect the diversity of relevant views and affected values, and to reach the fragmented, local knowledge (Daviter 2017, 574). Hence, wickedness fundamentally derives from the goal and values conflict among the stakeholders (Rittel 1972; Barlow 2001, 4). Conflicts are associated to and sustained by constantly changing environment, where causalities are blurred, uncertainty unresolvable, and interests incompatible (Raisio, Jalonen et Uusikylä 2018). Ahern et al. (2014a, 1375) refer to chaotic nature of wicked problems and considers them as crisis management issues and less relevant for complex project management. In 2020s, however, complex problems of the organizations are more and more irreversibly connected to wicked problems of the society, and there seems to be little reason to separate them from one another. As noted by Raisio et al. (2018, 8): the complex interdependencies of phenomena and issues produce a steadily growing number of new and interconnected problems. Any problem may be linked to a larger entity that is more than the sum of its parts. Thus, both complex and wicked problems are increasingly becoming the domain of cross-boundary expert teams.

Under the CPS literature, the conceptualization around complex problem definition is still not fully established. Definitions like "problem structuring", "problem formulation", or "problem defining", for example, have been used somewhat inconsistently – even within the same text, like in Lyles et Mitroff (1980, 102; italics added):

"Few attempts have been made to study the critical first stages of problem solving, that is, the process by which alternative views or definitions of a problem are generated and selected for further consideration in arriving at *a formulation of the problem*."

Above, problem formulation is seen as the *end stage* of the process. A little later (ibid., 104, italics added) problem formulation is seen as the *process itself*, referring to it as

"…a questioning or challenging of the current state of affairs in order to arrive at one or all of the following: well-defined goals or objectives, a better understanding of the current situation, or an awareness of potential opportunities. Problem formulation, *as a process taking place over a period of time*, involves first sensing the existence of a problem, then identifying contributing factors and, finally, reaching *a definition of the problem*."

In this thesis, *complex problem definition* is understood in a way similar to how *problem formulation* is described in the latter extract: as a lengthy *process* that involves several phases. The process is believed to consist of mutual organizing, negotiating, and sense-making around the problem in a team of experts. This requires continuous interaction – discussions and dialectical interplay – and integration of diverse knowledge within the team. Such team practices are widely seen to form the basis for knowledge creation in organizations (Nonaka et Toyama 2003; Carlile 2004; Majchrzak et al. 2012) and, through it, for creative new solutions (Lundmark et al. 2016), products (Carlile 2004; Enberg, Lindqvist et Tell 2006), innovation (Edmondson et Harvey 2018), or tacit learning (Ahern et al. 2014b, 1427), and, ultimately, for value creation (cf. Lundmark et al. 2016, 778; see also Baer et al. 2013).

2.2. Locating teams & complex problems within the organizational research

In a nutshell, combining experts from heterogeneous backgrounds, professions or industries is believed to enable innovation, learning, and fast solving of complex problems (Denison et al. 1996; Bakker 2010; Baer et al. 2013; Lyles 2014; Lundmark et al. 2016; de

Montjoye et al. 2014; Wageman et al. 2012). However, nebulosity around complex problems impedes clear problem definition in advance. For this, the teams must keep organizing, integrating, and creating knowledge throughout their life span in order to clarify their goal and to reach it (cf. Ahern et al. 2014b, 1424; Engwall 2002, 273). At project end, knowledge exists that was not there at initiation (Engwall 2002, 263), nor could it be planned in advance. Instead, the knowledge is acquired during the project execution (ibid., 273). It is only relatively recently that a formal definition and an integrative process theory of complex problem solving (CPS) has taken shape (Fischer et al. 2011). What comes to problem definition as a distinct part of problem solving and to knowledge-based teams as drivers of the definition process, an integrative theory framework has not even come into being yet. The ingredients of such framework, however, have been evolving for decades.

Table 3 recapitulates the basic approaches in organization research that contribute to understanding CPS and problem definition in temporary expert teams, and, through this, answers the research question 1. In this thesis, these lines of thinking are classified as ***1) solution-, 2) system-, 3) design-, and 4) practice-focused approach to complex problems***.

The first one turns our attention to *efficiency* of decision-making and processes in the organizations. This stream of research originally springs from the management science and is devoted to finding *the one best solution* in any situation. *The second* stream represents a problem centered *systems view* to reality. It stresses the role of broader context, complex networks and their interrelations, and long-term societal developments behind a complex problem. Instead of searching for one solution it expects to find many intertwined problems and admits that the solutions may lead to emergence of new ones.

The third one stems from systems view but while systems thinker looks at problems from bird's-eye view, design thinker looks at them inductively in their natural environment, paying attention to the engagement of many stakeholders and specialists. *The fourth* stream dives into the actual problem-solving activity without taking normative stance to its goodness. Interests are in the real practices and actions of problem-solvers.

Table 3. Four approaches to complex problem solving and problem definition in temporary expert teams. (Source: Author's development.)

	Solution	**System**	**Design**	**Practices**
Ethos	Efficient and effective achievement of objectives follows from good business insight based on adequate information, carefully specified goals and targets, and choice of appropriate methods.	Social and economic problems cannot be addressed in isolation. Formulating the right problem is the most important in strategic decision making. Problem solving entails learning ("learning organizations").	Prototyping, modelling, or synthesizing new real-life solutions overcomes the multifaceted morass of complex problems. Problem formulation is reached by reframing complex situation & trying *several possible solutions* to it.	By describing and conceptualizing work practices as constellations of actors, actions, and action objects we add our understanding on temporary expert teams in their daily work.
Value orientation	Managerial. Concerned for objectivity and rationality. Constant effort for improvement and growth.	Systemic problem structuring approach values commitment and justice of the problem-solving efforts.	Practical / Pragmatic. Normative in a sense of pointing out how a certain complex problem ought to be solved.	Sensitivity. Recognizing / interpreting multiple realities within any group of humans.
The core of research interest	Making **right decisions**, optimizing operations. Rational approach is believed to lead to **the best solution effectively & efficiently**.	Finding the **(strategically) right problems** amid complex systems of problems / web of symptoms or stakeholder relations.	Finding **viable problem-solution pairs** through experimenting of design professionals and through engaging stakeholders.	**Action:** participation, collaboration, and engagement between people who solve problems. Human experience.
Theoretical lenses	Management Sciences (MS); Operations Management (OM); *Hard* Operations Research (OR); Problem *solving*	Systems thinking; *Soft* Operations Research (OR); Problem *Structuring*	Engineering design	Action science; Symbolic interactionism; Practice theory
Line of reasoning / Research question examples	Analytical: how does this function – what follows what? Operational: how to manage, control, or develop business operations or processes? How to optimize or control organizational structures / enhance effectiveness?	Synthetic: as a whole, what is this like? E.g., What produces problems and why/how are they interconnected? Strategic: how do organizations identify and formulate the right problems?	Inductive: how to solve a specific problem? What can we learn of this solution concerning the whole / other similar cases?	How do people make sense of the problem together in a natural setting through routines, conversations, using documents etc. How does their knowledge, views, interpretations, or experiences impact to what they do?
What is knowledge?	An object that can be possessed, transferred, conserved, and exploited.	Understanding on how things influence one another within a complex system & ability to solve problems based on this information.	Knowing that is embodied in the processes and products of designing and skills of a designer.	A social construction achieved through mutually experiencing the real life or sociomaterial practices.
Key words	Resources and results; mechanisms, technics, optimization	Policies, stakeholders, interrelations, holism	Human-centered innovation, prototyping, developing	Social interaction, action, mental models, materiality
Some seminal scholars	Early works of Russell L. Ackoff	Russell L. Ackoff, Donald A. Schön; Peter Checkland	Herbert Simon, Horst Rittel, Richard Buchanan, Nigel Cross	Theodore Schatzki, Paula Jarzabkowski

While the first stream stresses the outcomes of the problem-solving process and to the inputs needed to achieve it, the second dives deep into contextual factors behind the problem. The third one seems to merge together the first two, and the fourth is concerned over what happens on the grassroot level "between the inputs and the outputs" – during the actual team process. The four approaches are not to be seen as mutually exclusive. Rather, their boarders are overlapping and blurred, and they offer complementary insights to complex problem definition in organizations. In next sections, the first three of the approaches and their implications for problem definition in temporary expert teams will be dealt more in detail. The fourth – practice perspective – is identified as being the most central approach to the understanding of the topic of the study, and also cross-sectional vis-à-vis the other three approaches. For these reasons, it will be dealt separately in chapter 3.

2.2.1. Solution focus to problem definition

The research emphasizing business decisions and optimal business solutions covers a full spectrum of studies on modeling or solving problems. Their topics reach from industry problems (e.g., Annamalai, Kamaruddin, Azid et Yeoh 2013) to designing or controlling business processes or supply chains (e.g., Gallien, Graves et Scheller-Wolf 2016). A study by Ali, Zuparic, Macleod, La, and Yue (2017) reports on a mixed method approach for studying complex socio-organizational phenomena where problems is ill-defined and decision support needed. Gralla, Goentzel, and Fine (2016) explore emergency situations in which teams employ mechanisms for rapid, concurrent problem formulating and solving for urgent and ill-defined operations management problems.

This kind of studies have origins in operations research (OR) or operations management (OM), or in management sciences more in general, which all share *the faith in tools and techniques* providing *decision support for business managers or engineers* responsible for productivity. Their multidisciplinary approach aims at solving real life problems and increasing efficiency by offering specific solution-oriented decision-making techniques as synthetic aids to management (Fuller et Mansour 2003). Such techniques do not replace human decision making, but assist it by providing quantitative insights (ibid., 424–423).

OR is technically and mathematically oriented discipline which involves modeling situations or problems and finding optimal solutions (Anderson, Sweeney, et Williams 2002). It wells from early *scientific management* (Fuller et Mansour 2003; Viljoen et van Zyl 2009) and has a tendency of reducing problem solving into condensed formula (e.g. *what-why analysis* by Annamalai et al. 2013, or *multi-objective optimization*) or quantitative models for e.g. forecasting, programming, simulation, or optimization (Fuller et Mansour 2003, 423).

OM, having origins in the industrial revolution and early factory systems, is influenced by *scientific method* (Fuller et Mansour 2003, 422; Chase, Aquilano, et Jacobs 2001). It is an activity-oriented discipline concerned about managing of production resources critical to strategic growth and competitiveness of an organization (Fuller et Mansour 2003, 422). Textbook technics like financial analysis, quality control, forecasting, capacity planning, productivity and work measurement, linear programming, or scheduling systems (Chase et al. 2001) reflect the breadth of OM throughout the lifecycle of a productive system (Fuller et Mansour 2003, 424). OM emphasizes the *managerial and procedural aspects* of operations, and decision making from a behavioral or human aspect, as opposite to OR that stresses mathematical and statistical modeling (Fuller et Mansour 2003, 425; Chase et al. 2001). In OM, defining or solving problems is not a mere technical issue, but also a matter of leadership skills – an inclination seen in e.g., Grunig et Kuhn (2017) or Hornett et Daniels Lee (2017). Leaders play a central role in planning and carrying through operations, motivating participants, avoiding conflicts, suggesting procedures, or engaging stakeholders.

With their tools for optimizing and control, OR and OM strive for uncovering truth about the natural world. They share a conviction that the reality can be captured in one objective problem statement waiting to be solved with the help of e.g., modeling. The problem-solving process eliminates personal biases or emotions that hinder decision-making. (Fig. 3.)

The thinking springs from positivistic tradition that highlights the importance efficient *solving* of relatively tightly framed production or developmental problems. OR and OM are known for their success in supporting tactical and operational decisions (Viljoen et van Zyl

2009, 4) on ad hoc basis (Fuller et Mansour 2003, 423). Modeling and simulation are good tools for testing alternative courses of action (Fuller et Mansour 2003, 425). Seeing psycho-social and socio-technical aspects of e.g., job design, work methods, or work measurement – issues stressed in OM – helps to deal with variety of managerial problems (ibid.).

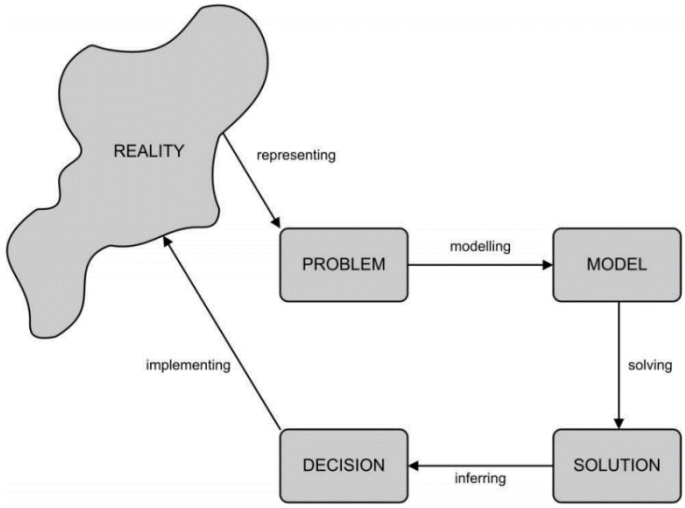


Figure 3. OR / Management Science problem solving approach (Rardin 1998).

Modeling real-life problems can help in making them more visible and concrete. This may guide the team's observation of the reality, thus helping to build consensus on what measures to take. Temporary expert team dealing with recurring, well-defined problems which lend themselves being modeled probably benefit the most of solution-oriented decision-making techniques. Such techniques give valuable information also for teams that aim to improve productive functions or processes, or to fulfill long-established protocols. It has been strongly debated, however, whether OR or OM can add value at a strategic and more comprehensive level, when complexity and horizontal and vertical integration to surrounding systems increases (cf. Viljoen et van Zyl 2009, 4; Fuller et Mansour 2003, 423). Failures may result when trying to construct large scale strategic models by pasting together a myriad of smaller operational models (Viljoen et van Zyl 2009). Applying quantitative measures into complex problem solving does not automatically mean quality decisions, but it rather stipulates substantial investment to human interaction. For example, linking OR techniques and real-life problems requires a lot of interaction between the problem

solvers and the developers of decision-making techniques (ibid.). To put it short, OR and OM in their authentic forms offer limitedly tools for addressing multidimensional or intertwined problems, where diversity of possible problem definitions or solutions increases.

During the 1970s and early 1980s, the shift of emphasis from simple, static, and well-defined problems to more complex and ill-defined ones led to identification of *systems of problems* that cause messy situations which cannot be decomposed into independent, clear-cut problem formulations. Quantitative methods were the original mainstay of OR practice, but now a number of OR authors began to distinguish between *hard* (quantitative, expert-driven, problem-solving) and *soft* (qualitative, participative, learning-focused) OR approaches (Foote, Gregor, Hepi, Baker, Houston, et Midgley 2007, 646; Checkland 1981). This led Rosenhead (1989) to talk about *problem structuring methods* when referring to exploratory and participative approaches ("soft OR") as distinction to *problem solving methods* which take the problem as given and prioritize finding solution to it ("hard OR") (cf. Foote et al. 2007, 646). For example, Bell and Morse (2013) immerse in psychodynamics and facilitation of problem structuring groups. In order to shed light to team effectiveness amid complex socio-organizational phenomena and ill-defined problems, Ali et al. (2017) complement the quantitative insights with softer approaches derived from behavioral and human sciences – a path first opened in seminal work of e.g., Kozlowski & Ilgen (2006). The awakening to limitations of strictly quantitative, engineering-orientated approaches in front of complex problems appears also in the inputs of management scientists of the era. They too began to stress the role of *problem formulation* in driving strategic renewal in organizations (see. e.g. Kilmann et Mitroff 1979; Lyles et Mitroff 1980; Sims et Jones 1981; Volkema 1986).

The scholars referred to in this section share the devotion to organizational effectiveness. Their concerns are in optimization of *solutions and decisions* of the organizations. Due to increasing complexity of the problems of post-industrial society, from 1970s onwards a growing number of scholars enlarged their scope to solving wider *policy problems*, and to organizational *change* and *learning* enabled through problem solving. The view opening at this turning point had a new denominator: *systems thinking*.

2.2.2. System focus to problem definition

Ackoff (1994, 185) notes that managers are not only confronted with separate problems but with situations that consist of complex *systems* of strongly interacting problems. These large dynamic systems of problems Ackoff sees as *messes*, and unique problems as abstractions extracted from complex reality (cf. Ackoff 1981, 356). Complexity, novelty, and uncertainty challenge the analytical solution centered approach. *Systems practitioners* assess messes with terms of *synthesis* (Ison 2017, 129) instead. Ackoff's division of *resolving*, *solving*, or *dissolving* problem clarifies the distinction between solution and system orientation in problem solving. In solution orientation, solving the problem aims at optimization and growth, whereas in system orientation *dissolving* the problem reaches for systemic change and development so that the problem will not arise again (Ackoff 1981). To make sense of the complexity, systems thinker looks at it in "terms of wholes and relationships rather than splitting it down into its parts and looking at each in isolation" (Ramage et Shipp 2009, 1), and focuses on cyclical and dynamic processes rather than on linear causes and effects (Capra et Luisi, 2014). Building on Jackson (2003) and Walonick (1993), Mugadza (2015) characterizes "system" as being formed of nonlinear interactions of its components. Systems thinking is a framework for seeing interrelationships rather than things, patterns of change rather than static snapshots (Senge 1990). It is a teaching of how multifaceted problems are tackled in their entirety, through pattern finding and enhanced understanding of the whole problem space. Table 4 outlines some of the basic ideas in division of problems in systems thinking.

Table 4. Dividing problems in systems thinking. (Source: Author's development.)

Resolving simple problems	**Solving tame problems**	**Dissolving wicked problems**
Relying on past experience and current trials and errors. Using common sense and subjective judgements.	Selecting the best possible outcome, optimizing. Thoroughly researching and gathering information.	Changing the system so that problem will not arise again.

Analysis
Short-team

Synthesis
Long-term

When it comes to problem definition in temporary expert teams, two branches of systems thinking stand out in particular. *Soft and critical systems approach* arises from dissatisfaction with the capacity of systems engineering and OR techniques to take account of the reality of human systems (Ramage et Shipp 2009, 6; Jackson 1990, 146) and criticizes problem solving through engineering, forceful planning, and top-down general solutions (cf. Rittel et Webber 1973; Head et Alford 2015, 713). Multiple perspectives, power, intractable problems with no simple solutions are brought up instead (Ramage et Shipp 2009).

Learning systems approach, in turn, fuels discussions on linkage of complex problem solving and learning organizations. Its essence is in the conception of subjective mental models (Meadows 2008, 172) of the reality that must be reflected in order to find new and creative ways to produce or develop a system (Mononen 2017, S4533), or to achieve deep learning that enables system changes (Mononen 2017; Jackson 2003; Senge 1990).

Both branches replace functionalist endeavor for objectivity with more subjective paradigm. “Systems” and “problem-contexts” are in the mind of the observer and not in any real-world “out there” (Jackson 1990, 136). In line with this notion, complex or wicked problems will not be solved, nor defined without first addressing the value perspectives that frame the understandings of issues and their possible solutions (cf. Head et Alford 2015, 723). Similarly, a team will not reach the state of deep learning without first reflecting and possibly changing worldviews and mental models during its effort to create new ways of producing or developing a system (cf. Mononen 2015, S4533; see also Argyris, 1977; Jackson 2003; Senge, 1990).

Systems thinking is applied to investigate phenomena in multidisciplinary and holistic ways and to build comprehensive understanding of the complexity of wicked problems, or to balance with multiple views of the reality among many stakeholders (Head et Alford 2015). It acknowledges different ways of thinking, as well as conflict and tension between conceptual frameworks (Houghton, 2009). Through its holism, systems thinking fosters creativity that increases when all its methods and perspectives are integrated (Jackson 2003). System

focus means looking at the entirety of which the problems make a part of, trying to understand it in order to change it so that problems will cease (cf. Meadows 2008, Ackoff 1981). This entails proceeding from problem definition to recognizing the *system* in which the problem occurs and *the goal state* in which it will not – and engaging various specialists and organizations to reach sustainable outcomes.

In the end, systems thinking is a problem-centered framework for defining and solving very complex and wicked problems. Despite being problem-centered, it directs our attention from plain problems into deepening collective understanding on the causes of them. When making the mental models of diverse stakeholders more explicit, any community builds an infrastructure necessary for *changing* the system and *learning* to cope with similar situations in the future. This stipulates systemic changes instead of curing single symptoms of the problem. Alongside *synthetic* systems thinking, the increased complexity of modern-day problems fueled another, prevalently *inductive* approach: *Design thinking*.

2.2.3. Design focus to problem definition

Design approach to problem solving in organizations is complicatedly related to both managerial (2.2.1) and systems approaches (2.2.2). It shares the solution-centered stand of the first but accepts the systematicity behind the problems. The focus in design thinking is on the search for ways to tackle the wicked problems of modern-day life (cf. Mugadza 2015; Buchanan 1992). Designer's way to do it is to *intentionally conceptualize and plan the artificial: material objects and human-planned systems* (cf. Buchanan 1992). Design connects practice- or planning-oriented experts in the fields of e.g., architecture, engineering, industrial design, or urban design. The designers' engagement to problem solving appears in the development of communications, products, services, technologies, and complex systems or environments which incorporate knowledge from many fields (ibid.).

The early studies on design thinking focus on identifying the specific tools and methods to solve *management problems* (Elsbach et Stigliani 2018) or designing organizations as a part of *strategic management practice* (Auernhammer et Leifer 2019). Designers utilized tools

traditionally used in designing commercial products, processes, or environments (Elsbach et Stigliani 2018). However, as the complexity grows and problems become harder to define, pure managerial faculty is no more enough; designers need skills to perceive wholes and ability to contemplate phenomena from several perspectives (Mononen 2017, S4529). This brings design thinking towards systems view, but while systems thinking is a way of looking at the world and understanding the nature of its diverse systems, design thinking is an iterative *process*, resulting in the *creation* of something new (ibid., S4531). Systems thinking is also less applicable for dealing with the political and communicative aspects of wicked problems (Head et Alford 2015, 724), whereas design thinking seems to pave the way for collaborative relationships through which a shared understanding on the nature of complex situation and an agreement on solutions can be achieved among diverse parties.

Since 1960s, Horst Rittel elaborated the idea of *cooperative reframing and solving of wicked problems* through interaction and deliberation between many parties of the problem with their conflicting values and knowledge areas (cf. Rith et Dubberly 2007; Hocking et al. 2016). The reframing of problems may lead to new innovations (Rith et Dubberly 2007). The essence in Rittel's thinking is in the transition from the first generation "generalists" – single specialists resolving complex problems from top-down systems perspective – to *collective thinking and learning of diverse experts* and the extensive involvement of people affected by the problems (cf. Rittel 1972; Hocking et al. 2016). In such human-centered approach to innovation, designer has a role of a "midwife" rather than an expert (Hocking et al. 2016). Designers are solution-led rather than problem-led, keen to modeling, pattern formation, and synthesis (Cross 2006, 2, 78). They seem to "arm" the theoretic system focus with practical solutions bringing the systemic change into actual being. Top-down systems-thinking and bottom-up design thinking complement each other, as it is impossible to innovate solutions without understanding the system in which they will be run in.

What is the role of problem definition for design thinkers? As noted by Buchanan (1992) and later by e.g., Pusca and Northwood (2018), part of them flag for *linear model for design process*. The process is divided into *analytic problem definition* and *synthetic solution phases*.

The first one entails exploring the problem space and adding understanding of the problem before the actual development process (Gurusamy et al. 2016). This happens through exploring various scenarios, earlier use cases, and user needs, and learning about them (ibid.). Respectively, exploring the solution space promotes creative ideation and conceptualization process by considering a number of options and choosing a solution that best meets the needs of the users (ibid.). This synthetic phase combines and balances various requirements into a final plan on how to carry the solution into production (Buchanan 1992, 15).

This is, however, seldom the logic of the actual sequence of decision making in front of complex problems, where the information can be confusing, clients are many, and decision makers have conflicting values. In such circumstances, designers do not typically proceed by first attempting to define their problems rigorously; on the contrary, it might look as if they jumped straight to the solutions before fully formulating the problem (Cross 2006, 78). In Rittel's words: "you cannot understand and formulate the problem without having solved it" (Rittel 1972, 393). Thus, among design thinkers, problems can also be defined in relation to ideas for their solution: by creating matching problem-solution pairs when moving rapidly to early solution conjectures which are used as means of exploring and defining problem and solution together (Cross 2006, 79). The problem space is explored to recognize a partial structure in it; then initial ideas of implications of this structure within the solution space are generated; finally, the design concept of the possible solution is formed based on this understanding (Cross 2006). The concept, or a prototype, is applied back to the original problem space to consider implications and extend the structuring of the problem space. Hippel and Krogh (2016) seem to refer to a similar phenomenon in their theorizing on problem solving without problem formulation. They propose that a need and a solution can be discovered *simultaneously* as need-solution pairs. The coupling of the two is previously unknown for the inventor in this particular context, and problem identification, if done at all, comes only afterwards. Hence, formulating a need and a problem are one process (ibid., 211). Instead of first formulating the problem and then proceeding to search for solutions, people continuously scan their mind and the environment for suitable need-solution pairs that might fit their context (ibid., 213).

The ideas of problem-solution or need-solution pairs and design thinking more in general challenge the formal problem-solving research and practice which assume problems being identified *before* proper action, and problem-solving process being targeted to an optimal solution to a particular problem. The reasoning around design-related approaches is all but monolithic, however. While most of the design thinkers stress the experts' conscious relation to problem definition – the progressive re-specifying of the problem during the search for solutions –, some like Hippel & Krogh highlight the serendipity of the process. In general, designers "exercise the freedom to change goals and constraints, as understanding of the problem develops and definition of the solution proceeds" (Cross 2006, 78).

The idea of gradual problem-setting or "reflective practice" was originally proposed by learning-systems thinker Schön (1983). To him, problem setting is "the process in which, interactively, we *name* the things to which we will attend and *frame* the context in which we will attend to them" (ibid.). This pulls together the problem formulation aspects of design behavior. Designers *select* features of the problem space to which they choose to attend (naming) and *identify* areas of the solution space in which they choose to explore (framing) (Cross 2006, 80). The success in utilizing problem framing depends on the *experience* of the design professionals and on the way *the framing is used*; groups that try several frames or develop many solution concepts seem to be more successful (ibid., 80–81).

Temporary expert teams are likely to have only little time to meet the expectations and may jump into solutions before an elaborated problem formulation. In the light of prior literature, the shortage of resources, most of all time, is likely to spur the exploiting of designerly ways of problem-solving. This stipulates precision in identifying and activating the right stakeholders and the right experts with relevant experience. Hence, the team composition and the ability of the team to design solutions despite the high amount of complexity go hand in hand. The research on *organizational design* strives for unveiling which kind organizational forms or division of labor best helps in harnessing the external knowledge sources vital for solving complex problems (cf. Foss, Lyngsie et Zahra 2013; Ali et al. 2017, 920–922).

2.2.4. Practice focus to problem definition

The more one moves from left to right in table 3 above, the further apart from planning-oriented rationalism one gets. Problems that are unstructured, non-linear, and touch many parties, require on-going knowledge sharing and negotiating of goals, roles, or responsibilities beyond the borders of functions, organizations, or disciplines. Understanding these micro-level social activities is utterly relevant for understanding cross-boundary teaming and fast knowledge integration or knowledge creation in temporary expert teams. It is hard to address them solely by exploring project plans or normative solution models the organizations apply in their operations. Hence, the last approach to complex problem definition concentrates on the practices of temporary expert teams during their cooperation. The research covering these themes targets at *understanding social interactions* and *social artifacts* belonging to problem-solving process, and their relation to *knowledge creation*. This adds our awareness of the *social creative practice and social aspects of knowledge*.

Edmondson et Harvey (2018) encapsulate the "practice-turn" in prior research:

> "Prior research on teams and diversity has emphasized a cognitive view of knowledge, treating it much like information that can be transferred from one individual to another individual or to a group of individuals, largely ignoring knowledge's contextually-embedded nature (Lave & Wenger 1991). In contrast, scholars adopting a practice lens stress that not everything we do or understand can be explained by the knowledge we possess (Brown & Duguid 2001). From this standpoint, knowing and doing are interconnected through people's work practices (Gherardi 2000) and localized in particular contexts (Sole & Edmondson 2002)."

To some extent, interest in team practices is a crossing theme in all the approaches dealt earlier. Practices can be observed from OM perspective (Gallien et al. 2016). Increased complexity of business environment led to rise of soft OR methods. Such methods accept the ambiguity of complex situations by being plural, iterative, both quantitative and qualitative, and acknowledge the different perspectives of different stakeholders (Coburn et Stirling 2019, 65) and the need for participatory approaches (Rosenhead et Mingers 2001). Practices are a central interest for designers as well (Cross 2006).

The rationale in exploring practices varies, however. Scholars anchored in managerial perspectives are prone to look for ways to enhance effectiveness and study practices if it serves this aim. By contrast, much of the recent research on knowledge creation examines almost exclusively human practices. Such research bases on *practice theories* which see practices as the constitutive element of social life (Seidl et Whittington 2014). This perspective rejects the normativity of traditional rationalism. As stated by Sydow et Braun in 2018, it "focuses on how actors, including project managers acting with interorganizational relations, actually do behave in real-life situations instead of describing how they ought to behave". The importance of studying team practices in particular is highlighted as the control of complexity and uncertainty and defining team tasks becomes more and more a question addressed during the team process rather than in advance, e.g., in detailed project plans.

2.3. Pulling together the diversity of approaches

In this chapter, four prevailing approaches were identified in discussion on problem solving and problem definition in the organizational research: ***solution, system, design, and practice approach***. The last one, practice approach, is cross-cutting with respect to the others, since solution, system, and design orientated research may all adopt practice position to their field of study.

The solution centered view is well justified when thinking of efficient handling of recurring business and management problems. These include problems in the industrial or production processes or in business management. Solving such problems serves decision makers responsible for optimization and growth of the business or production. The shift of emphasis from simple, static, and well-defined problems to more complex and ill-defined ones from 1970s onwards proved the mechanistic solution models outdated. The later systems and design thinkers started to consider wider web of highly interconnected problems when taming wicked, ill-defined, and unstructured problems. This kind of problems typically ripen slowly and have possibly never been solved before. Solving them calls for activation of larger groups of societal actors.

In the end, almost irrespective of the focus chosen, the problem definition can be seen to take a form of a process whereby the problem gradually reveals itself as a function of team interaction. Explaining how temporary expert teams actually operate, as well as understanding the possibilities to develop them, requires delving into the details of team practice. Since team practices are identified such a central factor in understanding temporary expert teams and complex projects they get involved to, the practice perspective will be approached separately and more in detail in the following chapter.

3. PRACTICE VIEW TO COMPLEX PROJECTS

In traditional theories of the firm, decisions precede action and are seen to cause it (Lundin et Söderholm 1995). In the theory of temporary organizations, however, "action", as opposed to "decision", is a more central component since such organizations are motivated by the need to perform specific actions in order to achieve their goals (Lundin et Söderholm 1995; Goodman et Goodman, 1976). This challenges the idea of planning teamwork in advance or seeing it as a panacea for reducing interdependencies and errors typical of temporary teams (cf. Berggren et al. 2008).

In today's projectized organizations decisions can follow action, and action is a necessity for defining and delimiting the temporary organization, addressing the task set out, and finally for terminating the organization (cf. Lundin et Söderholm 1995, 438–489). From this perspective, one cannot properly understand temporary expert teams without examining practices and actions occurring in them. This chapter addresses the theories of social practice from the point of view of complex problem solving in temporary expert teams. By doing this, this chapter offers answers to the second research question concerning the practices associated to work in temporary expert teams.

3.1. From planning-oriented rationalism towards celebrating social practice

Traditional project management literature stresses the planning done in advance: before the actual teamwork takes place. Respectively, practice-oriented team research stresses the role of activities, processes, and knowledge flows in the actual team process. The synthesizing and the integration of the knowledge and ideas in the team can be best addressed by observing team interaction which turns the complexity into new solutions, innovations, or organizational learning.

The role of social interaction in cross-boundary temporary expert teams is addressed in ***the literature on knowledge-boundaries*** (e.g. Edmondson et Harvey 2018; Majchrzak et al.

2012; Carlile 2004; Schreyögg et Sydow 2010), ***team-based knowledge creation or creativity*** (e.g. Baralou et Tsoukas 2015; Ben-Menahem, von Krogh, Erden, & Schneider 2016; Aggarwal et Woolley 2019; Okhuysen et Bechky 2009), ***complex problem formulation in teams*** (e.g. Baer et al. 2013; Lundmark et al. 2016), and ***complex project management*** (e.g. Ahern et al. 2014a&b; Berggren et al. 2008; Engwall 2002; Enberg et al. 2006).

All these approaches pay attention to the informal and emergent aspects of knowledge creation in teams. They seem to part from the same basic idea of temporary project organizations as an organizational form for integrating diverse and specialized intellectual resources and expertise in a task-specific, flexible, and resource-efficient manner. They take teamwork (or project delivery) as a mutual organizing or sense-making around a complex problem. This process may result in generation of creative new solutions (Lundmark et al. 2016), products (Carlile 2004; Enberg et al. 2006), innovation (Edmondson et Harvey 2018), or tacit learning (Ahern et al. 2014b, 1427). The fundamental insight in all these approaches is that the cognitive and knowledge diversity in temporary expert teams is molded into performance benefits through *shared action and participation*. The two lead to knowledge exchange and knowledge integration; to transforming of specialized knowledge possessed by individuals into an integrative cogenerated solution (cf. Majchrzak et al. 2012, Carlile 2004). A rough draft of the process is presented in figure 4.

The theoretic cornerstones of the phenomena are set in the ***knowledge creation theory***. It addresses processes by which individuals and groups, in dialectical interplay, create knowledge and utilize the past knowledge stored in the organizational memory, thus contributing to innovation, change, value creation, and organizational performance (Lyles et Schwenk 1992). Knowledge is seen to exist *tacitly* – tightly tied to practices, social systems, and individuals (Nonaka et Toyama 2003). Its creation starts with *socialization*, by "converting new tacit knowledge through shared experiences in day-to-day social interaction" (ibid.). This is followed by externalization, combination, internalization, and yet again socialization of knowledge (ibid., 5).

The spiraling process transfers tacit knowledge within individuals into external knowledge of the firm (Nonaka et von Krogh 2009; Nonaka, Kodama, Hirose et Kohlbacher 2014), selectively combining it and connecting it to the shared knowledge base (Lyles 2014). Seeing knowledge as attached to people (embodied) and practices (embedded) (von Krogh & Geilinger 2014; Nonaka & Takeuchi 1995) stresses the role of social interaction in transforming knowledge into performance benefits (cf. van Knippenberg et Schippers 2007; Edmondson et Harvey 2018).

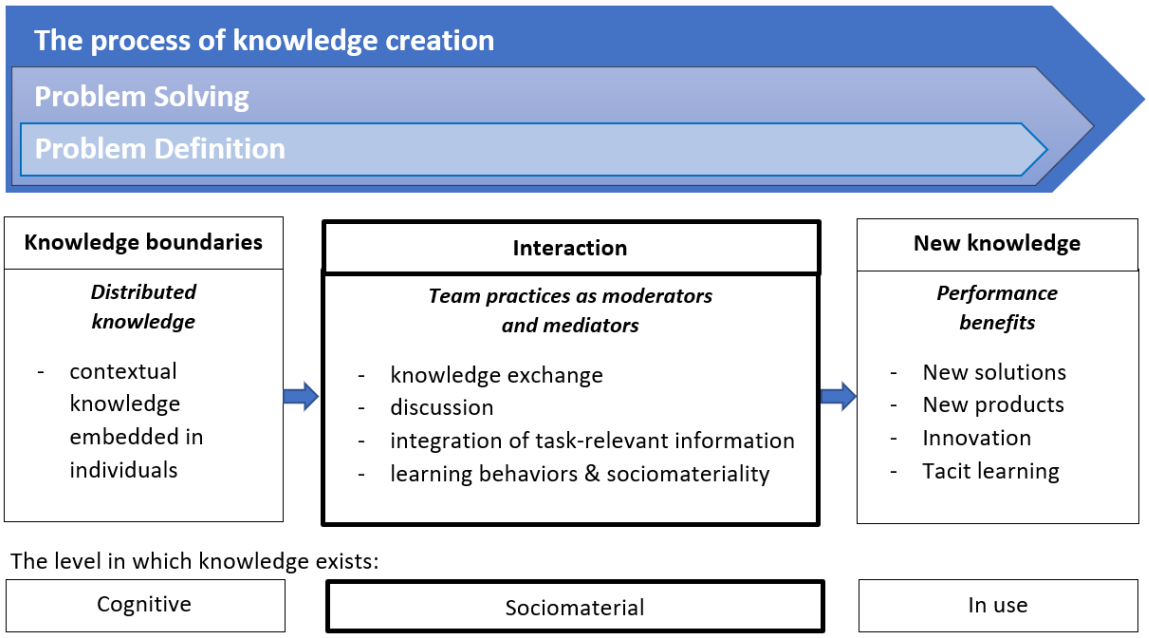


Figure 4. The process of knowledge integration and knowledge creation in a temporary expert team. (Source: Author's development.)

Respectively, social interaction constitutes the foundation of team-based problem solving. Goodman & Goodman (1976, 495) note that members within a temporary system must keep interrelating with one another to arrive at viable solutions. It is through interaction the team turns complex problems into a catalyst for knowledge creation, learning, and innovation. Knowledge creation is by nature a time-consuming and fragile process (cf. von Krogh 1998; von Krogh et Geilinger 2014). In temporary expert teams specifically, it also stipulates successful teaming (Edmondson et Harvey 2018) and fast integration of diverse

knowledge domains (cf. Majchrzak et al. 2012) despite the task uncertainty (cf. Ben-Menahem et al. 2016) and intrinsic knowledge uncertainty (cf. Ahern et al. 2014a).

3.2. Example articles handling complex problem definition practices

Only very few if any empiric studies have elaborated the question of problem definition practices in temporary expert teams in particular.

Büyükdamgacı (2003) does examine how to improve effectiveness and evaluation of problem definition but does not observe team practices in particular. Nevertheless, his study offers some insights for further research. He goes through methods designed for *improving problem definition in the firms* and compares two of them: Purpose Expansion (PE) and Strategic Assumption Surfacing and Testing (SAST). By synthesizing the two he presents a PEplusSAST procedure which bases on thorough mobilizing of stakeholders. First, homogenous subgroups are formed to identify stakeholders and their values and purposes. The findings of the groups open the dialectical debate on whether there are conflicts among those values or purposes. Secondly, heterogeneous subgroups integrate a list of purposes of the decision makers that are put in a hierarchy. The highest possible is selected as the target purpose and a problem definition. Managers are advised to give the process a clear direction, avoid bias, stick to facts, cherish shared vision and values, and to look at the situation from as high above as thinkable, defining the problem very broadly (cf. leadership skill narrative mentioned on p. 20).

Baer et al. (2013) build *theory-based micro-foundations for strategic problem formulation in heterogeneous teams*. “Strategic” is to be understood similarly as “complex”, since the authors categorize strategic problems as “complex and ill-structured by nature” (ibid., 198). The focus is in *evaluating and improving the success of the problem formulation activity*. They propose comprehensiveness as a primary metric to judge the success, since comprehensive problem formulation is likely to discover the root causes of a particular problem context (ibid., 199). According to the authors, the impediments of problem formulation comprehensiveness result from heterogeneity of information sets, cognitive structures,

and objectives among the team members. They suggest a structured process of *collaborative structure inquiry* model (CSI) to mitigate those impediments. CSI is a theoretic model of a problem formulation process. It divides problem formulation in two phases: *framing* and *formulating* the problem. In the framing phase, the team identifies all empirical regularities, i.e., symptoms of the supposed problem, and discusses each of them and their correlation until consensus is reached on whether it makes a part of the set of correlated symptoms. Next, the problem is formulated by identifying all root causes of the web of symptoms. In the latter phase, the ground rules and the consensus agreed in the framing phase prohibit the rambling discussion of potential solutions. The team lists and discusses all causes that could explain previously identified symptoms, and each of the causes represent alternative problem formulations. (Ibid., 206–208.)

Both Büyükdamgacı and Baer et al. seem to second the solution-oriented thinking that primarily aims at optimal decisions and effectiveness at the managerial level. The practice-side of the measures proposed gets less attention. For example, should not the rule of staying at the high level of abstraction in PEplusSAST procedure lead to skipping tricky questions in order to avoid conflicts? On the other hand, the prioritizing of profound problem formulation before going into solutions separates these approaches from design thinking.

The role of problem formulation comprehensiveness is challenged in a study by **Lundmark et al. (2016)** – one of the very few empiric studies on problem definition in teams. Lundmark et al. examine the impact of problem formulation comprehensiveness to the degree of novelty and value of proposed solutions. In their study, 27 virtual teams of three randomly assigned students were given different amounts of problem formulations concerning the same wicked problem in a large consumer electronics retail firm. Teams were instructed to virtually collaborate and develop a solution. The results show that it was not the number of formulations the teams were given but the time they spent looking at them and talking on them that explained the novelty and value of the solutions. Pupil dilation of the participants was monitored, too, demonstrating a greater cognitive effort in high performing teams. The study confirms the central role of interaction within a team.

Finally, **Foss et al. (2016)** explore how modes of communication shape problem-formulating behaviors in the free open-source software (FOSS) communities. In these communities, problem-solving activities form around multi-individual, self-organizing projects aimed at solving a particular development problem in a team-based manner. The study seems to draw closer to the practice-based view to problem formulation, but the approach is strictly quantitative. Basing on the data of the activities of over half a million developers during two years of time, the study explored the way individuals communicate and its influence on the project behaviors they engage in. The conclusion was that an open-ended communication mode with little a priori structure is the best mode for communicating about new problems or formulating them, and for generating new strategic opportunities, while more structured, artifact-based communication fits subproblems better or is related to project joining behaviors: when member's join already existing projects to work on subproblems defined by someone else. The focus was on communities, but Foss et al. seem to suggest that the findings would fit into the context of temporary expert team as well (cf. ibid., 2590).

Apart from Lundmark et al. (2016), none of these studies explore *team* practices but rather elaborate the question of problem formulation comprehensiveness or effectiveness. The scope of the literature review must be elevated to the more general level in order to build an integrative practice-based framework of complex problem definition in temporary expert teams. For this, the theoretic inventory is next augmented into studies covering practices in complex team projects on a more general level.

3.3. Practices associated with complex team projects

Practical understanding denotes the abilities of actors to react appropriately to specific situations (Loscher, Seidl, et Splitter 2019). It contains the bodily know-how and implicit knowledge to conduct, recognize, and react to other activities (ibid.). The doings and the sayings of the team members are embedded in a practice through reflexive and shared understanding of the situation. There is always a wide range of different ways to respond to a particular situation – specifically in temporary expert teams which seldom have the

structure of pre-existing protocol to lean on. They must be apt to quickly share deep knowledge and negotiate goals, roles, or responsibilities (cf. Edmondson et Harvey 2018; Majchrzak et al. 2012). This section analyzes and categorizes depictions of team practices closely related to problem definition, looking for tools to explain the definition process.

The literature on complex problem solving and knowledge work in temporary organizations provides ample illustration on such practices. In the light of the prior research, the formulating of *problems, goals, or tasks* seem to evolve in similar ways and form a closely related continuum of team practices. Goals are seen to originate from permanent organizations outside the team (Lundin et Söderholm 1995) and reflect political intentions (Engwall 2002). Like problems (cf. Majchrzak et al. 2012, 953), goals and tasks are seen to be subject to change as they are recurrently redefined, reinterpreted, or demarcated in the team process (cf. Engwall 2002; Berggren et al. 2008). Like when decomposing problems into sub-problems, the team may break down the goals into objectives, sub-objectives, and work-packages (cf. ibid.). Hence, all three: *goals, problems, and tasks, are product of a dialectical process grounded in team interaction.* As stated by Engwall (2002): the project execution is an evolutionary process wherein expectations regarding the outcomes interact with experiences gained from the performed actions. Gradually during the process, the expectations and experiences become coherent, and the goal gets defined (ibid.). The same is most likely to apply task and problem definition, since all three develop in similar ways in team interaction.

Majchrzak et al. (2012) identify at least three streams of research approaching knowledge integration in cross-functional teams. First of them focuses on *creation and sustenance of common task understanding* within teams, and the second on *developing psychological safe work environments*. Thirdly, Majchrzak et al. mention the research of *boundary objects* which serve the integration of differentiated knowledge within a team. Starting from and elaborating further these findings, next sections will approach practice-oriented discussion on complex problem-solving teams by dividing it into three streams: 1.) practices targeted

at *controlling the complexity* of the situation at hand, 2.) practices related to *handling team relationships*, and 3.) practices organized around the *materiality of teamwork*.

3.3.1. Controlling complexity

A common theme in many team depictions is the effort of either team or team manager *to reduce and control complexity* of the complex situation the team is facing. For example, at an early stage of a complex project, *mapping by rhetoric* is a way to make a particular situation to appear real, tangible, *less ambiguous* and difficult to oppose (Lundin et Söderholm 1995, 446). Such a practice nails down the purpose of the team and limits the problem space the team is about to enter. Lundin and Söderholm (ibid.) state that "the ability to handle the temporary organization's rhetoric is of prime importance for anyone trying to influence or govern it". What is synthetized and integrated is easier to depict as soluble and manageable than what is fragmentated or disintegrated. The efforts to synthetize the task and the problem or to create a mutual picture of task requirements can be seen to represent a shared effort to govern complexity the team confronts.

Similarly, dec*omposing the problem* into more manageable subproblems that are easier to address (Simon 1973; Foss et al. 2016, 2592), or *partitioning or narrowing the team task* in order to direct the team's concentration to relevant areas (Lundin et Söderholm 1995) represent ways to constrict either the problem space or the scope of possible solutions.

Basing on the experience on Ericson's complex systems development projects, Berggren et al. (2008) also mention team management practices like top-down redefinition – *lagomizing* – of project goals. This, too, seems to aim at reducing project complexity, but through *transforming expectations* directed towards the project (ibid., S115). Such efforts to reduce complexity secure controlled system delivery on time, but also highlight the action imperative and task orientation typical of temporary teams (Bakker 2010; Lundin et Söderholm 1995).

Even the formerly mentioned CSI process of Baer et al. (2013) has elements of "control" in it. The identification of empirical regularities the team made in the framing phase prohibits

the rambling discussion of potential solutions later in problem formulation phase – which can also function as simplification of the otherwise too complex a situation.

3.3.2. Handling relationships

The team consists of individuals whose ideas, actions, and interpretations of the situation are not automatically in tune. The functioning of the team stipulates active balancing of personal relationships and distribution of information between the individuals. The academic discussion on team relationships covers themes like leadership, motivation, communication, trust, roles, conflict, or cohesion among team members (Lundin et Söderholm 1995, 441; Bakker 2010, 475; both use the word "Team" instead of "Relationships" to recapitulate these topics). For example, *developing psychologically safe working environments* is central for temporary organizations (Majchrzak et al. 2012). Psychological safety and other emergent states like *team cohesion or team potency*, together with *norms and routines* are all necessary conditions for developing and pursuing team goals, and they all emerge through shared experience of teaming (Edmondson 2018).

The literature offers plenty of examples of team practices linked to teaming or developing of team relationships. For example, integration of high-yielding, specialized knowledge embedded in the individuals requires traversing *knowledge boundaries* – differences in expertise within a cross-disciplinary team (Edmondson et al. 2018; Majchrzak et al. 2012). This is seen in team practices like avoiding interpersonal conflict, encouraging creative engagement or flexibility to modify solution ideas, or fostering personal responsibility for translating one's own knowledge into collective knowledge (Majchrzak et al. 2012).

The same endeavor is apparent in *learning behaviors* such as asking questions, seeking feedback, experimenting, reflecting on results, or discussing errors or unexpected outcomes of actions (Edmondson 1999, 353), or in talking about problems and mistakes (Carmeli et Gittell, 2009). *Negotiating team goals, processes, or outcomes* leads to in-depth discussions which force the team members to declare their values, interests, ideas, and knowing (cf. Engwall 2002; Schippers, Edmondson, West 2014). This forms a good team-

building experience, but also enhances deep-knowledge dialogue and blurring of knowledge boundaries which all contribute to reaching a shared understanding of the complex problem as well.

Observing the micro level of team interaction reveals practices directly linked to problem specification. Hargadon and Bechky (2006) note that specialists in problem-solving teams integrate their knowledge with others' knowledge by *revealing implicit assumptions about the problem the team should solve and by working to understand each other's perspective through probing*. This kind of team practices gradually uncover each team members' mental models and possible constraints or priorities respect to each solution, and help to shape potential, shared solution paths of the team (cf. Edmondson et Harvey 2018, 353). Edmondson and Harvey mention that many management scholars summarize cross-boundary teaming "as based on back-and-forth forms of dialog in which each participant *engages with another's perspective in sufficient depth to facilitate the combination, expansion, and reframing of knowledge*" (ibid., italics added; Edmondson and Harvey refer here specifically to Boland et Tenkasi, 1995 and Tsoukas, 2009).

Based on these discussions, it is justified to believe that problem definition in temporary expert teams builds on practices that enhance open dialogue and trust. This enables shared reframing of problem space and gradual shaping of a shared vision on what is the problem to be solved. In many respects, the relationships between the team members form the micro level of previously mentioned systems thinking. According to it, *subjective mental models* of the team are to be first reflected in order to develop a system and learn (see section 2.2.2.). In the end, a collective mental model should be reached. *Team mental models* refer to shared understanding of a team regarding the task requirements, procedures, and role responsibilities (Edmondson et Harvey 2018, 349). Similarly, Sarah Harvey (2014, 332) claims that diversity of the team is most helpful when different perspectives are applied to one focal idea rather than used to stimulate many. According to Harvey, a shared view of the problem and the task among team members, a *creative synthesis* (a conception seemingly closely related to team mental model) acts like a theory for producing ideas and

increases the possibility of breakthrough ideas. To reach this, members *synthesize different understandings or interpretations of a problem or situation by focusing their collective attention, enacting ideas, and building on similarities within their diverse perspectives by discussing, explaining, and translating their ideas* (ibid.).

The need to restructure the complex reality and decompose it into manageable pieces (section 3.4.1.), and the pressure to carry on with time consuming, human-centered transition processes like planning, goal and task specification, teambuilding, or problem-defining or synthesizing (section 3.4.2.) seem to *co-exist in temporary expert teams*. The two may even contradict each other. For example, breaking down the task into independent components and enabling team members to work on "their" own parts can cause teams to miss potential benefits of knowledge diversity attached to individuals of the team (Edmondson et Harvey 2018, 353). On the other hand, the functional diversity linked to only little shared experience may lead to greater task disagreements (Majchrzak et al. 2006, 952).

3.3.3. Working with sociomateriality

Schatzki (1996, 2002) argues that practices and material arrangements necessarily hang together, forming "practice-arrangement bundles". Even in temporary expert teams, most of the practices are sociomaterial by nature: the knowing is bound up in the material forms, artifacts, spaces, and infrastructures through which humans act (cf. Orlikowski 2006, 460).

The team activities within a certain practice may change material arrangements, or artifacts can generate new team activities. Artifacts can be analogue or digital objects, like virtual communications channels or online platforms that encourage collaboration for knowledge and value creation. In the programming communities, code forms a digital artifact (cf. Foss et al. 2016). Baralou & Tsoukas (2015, 593) claim that team members working with the materiality of technology *mobilize* multiple task-related voices when simultaneously interacting in multiple contexts, *alter* the boundaries of communication to suit the demands of the team task, and *textualize* the ongoing experience of interaction with others and artifacts.

Referring to several articles on KM-related journals, Mariano and Awazu (2017) confirm the crucial role of artifacts as vehicles of human activities and mediated interactions which contribute to creation, accumulation, transfer, sharing, or reproduction of knowledge. In other words, knowledge is attached not only to people and practices, but also to artifacts (cf. von Krogh et Geilinger 2014, 156; Nonaka & Takeuchi, 1995).

The view of knowledge adopted in practice-oriented discussions is largely summarized in the argumentation of Wanda J. Orlikowski, to whom knowledge is both performative and representational phenomenon (Orlikowski 2006). From this perspective, knowledge is not an external, enduring, or static substance, but a *dynamic and ongoing social accomplishment*; a capability produced and reproduced in social practices:

> "A practice view of knowledge (Orlikowski, 2002) leads us to understand knowing as *emergent* (arising from everyday activities and thus always 'in the making'), *embodied* (as evident in such notions as tacit knowing and experiential learning), and *embedded* (grounded in the situated sociohistoric contexts of our lives and work)." (Orlikowski 2006, 460)

To three dimensions of knowing (emergent, embodied, embedded) Orlikowski adds the fourth: *the materiality of knowing.* It is reflected in practices like using stories and metaphors or objects such as presentations, diagrams, drawings, prototypes, models etc. to support teamwork (Edmondson et al. 2018, 353; Okhuysen et Bechky 2009).

In the context of problem-defining teams and sociomateriality, two concepts stand out as particularly useful: *boundary objects* (BOs) and *scaffolding*. Any group of people who work together will share a set of assumptions and a language unique to that group. When representants of *diverse* groups come together to solve a problem, they all bring in their own set of beliefs and understanding of the problem or of the desired outcome. This hampers knowledge transfer from one domain to another. BOs are physical objects project-based organizations use when moving knowledge across organizational or other boundaries (Carlile 2004; Butters et Duryan 2019). They represent a piece of shared knowledge or understanding between two or more groups in a form of a report, a physical prototype, a design, business process, tools, documentation, models, drawings, charts, software programs,

spreadsheets, or events. BOs can be of great value for example when the lack of face-to-face communication challenges the knowledge sharing (cf. Brown et Duguid 2001).

“Scaffolds”, on the other hand, is a term commonly used in the construction industry to refer to the temporary structures that support the building in progress. Everyday knowing in practice can be viewed as *materially scaffolded* (Orlikowski 2006). Rapid cocreation of intermediate scaffolds is a central activity in temporary teams which must build a shared view fast (cf. Majchrzak et al. 2012). Scaffolding denotes a broad class of physical, cognitive, and social “augmentations” like processes, structures, and tools that help people solve a problem, carry out a task, or achieve a goal which would otherwise be beyond their unassisted efforts (Wood, Bruner et Ross 1976, 90; see also Clark 1998, 163). For example, developing teamwork by agreeing on sets of deindividualized team roles with a shared responsibility for a whole task can be viewed as one form of a scaffold (Valentine et Edmondson 2015).

Orlikowski (2006) picks up ten features of scaffolds: They are *temporary* – erected to support the construction of particular elements and dismantled once they are completed and self-supporting. They are *flexible* – constructed in situ, adapted to fit the local conditions. They are *portable*: relatively quickly and easily assembled and modified on different building sites. They are *diverse* and *heterogeneous* – i.e., there are many kinds of scaffolds for different needs, all composed of multiple different components, reflecting the need and the materials at hand. They are *emergent*, and thus change in form and function as needed to continue supporting the building in progress. They afford temporary *stability*, but they can be *dangerous* – vulnerable to breakdown as temporary, emergent, rapidly constructed assemblages. Finally, they are *generative* since they serve as the basis for creative work, facilitating the performance that would be impractical without material augmentation, and *constitutive* of both human activity and outcomes.

From the point of view of temporary expert teams and complex problem definition, boundary objects and the use of scaffolds both have an instrumental role. BOs can, for example, function as a “living translation” or crossing point of divergent views on the problem space

represented in the team. It helps to visualize the progress of the team and pulls together the domain specific knowledge of it in a palpable form. Scaffolds keep this progression on the right track, providing a framework for the work in progress and diminishing the risk for missing the point when articulating the problem the team should be solving.

3.4. Summary of complex problem definition practices in expert teams

The degree of the complexity of the team task and the capability of the team to formulate a comprehensive set of problems on it seems to form a potential source of high-quality decisions and economic value (cf. Lundmark et al. 2016, Baer et al. 2012). Furthermore, comprehensiveness in problem formulation offers tools for overcoming the complex interdependencies of wicked problems. Hence, the more wicked the challenge and the broader or more inclusive the set of relevant problems formulated around it, the better the chances of resolving the problem and creating knowledge and value. Despite this, the studies relating to complex problem definition practices of temporary expert teams or its impact on value creation are rare. In the limited assortment of prior research, practices involved in complex team contexts are typically identified to organize around 1) controlling complexity, 2) handling team relationships, and 3) working with sociomateriality.

The first one refers to efforts of the team to reduce and control the amount of the project complexity by e.g. restructuring the problem space with the help of cross-domain knowledge gathered in the team, decomposing the problem into more manageable subproblems, or partitioning or narrowing the team task. Likewise, the team activities around synthetizing and integrating the problem space and making the situation to appear less ambiguous as well as lagomizing the expectations towards the project represent practical examples of teams trying to narrow the amount of complexity they face.

Team relationships are connected to the practices of building good team experience and psychological safety: avoiding conflict, encouraging creative engagement to modify solution ideas, fostering personal responsibility for translating one’s knowledge into collective knowledge, and asking questions, seeking feedback, experimenting, reflecting on results,

or discussing errors. The teams negotiate on their goals, processes, and outcomes which gradually exposes the values, interests, ideas, and the assumptions about the problem.

Finally, sociomaterial practices in the teams enable the producing of quality solutions as the use of artifacts contributes to creation, accumulation, transfer, sharing, and reproduction of knowledge. Materiality of knowing is reflected in practices like using stories, metaphors or objects like presentations, diagrams, drawings, prototypes, or models to support teamwork. Project-based organizations use such physical objects as scaffolds to build solutions problems and to move knowledge across organizational or other boundaries.

4. METHODS AND MATERIAL

This chapter reports the actual study phase in a step-by-step manner in order to answer the research questions 3 and 4. The first section introduces and justifies the research approach chosen. The subsequent sections offer the description of the studied case and its participants, and the research data collected around it. The next-to-last section documents the details of research protocols, empirical material interpretation and analysis. It also provides examples and evidence to support the tentative grounded model emerging from the data. The last of the sections goes through the most typical claims on reliability and validity of qualitative case studies, at the same time contrasting them to the choices made in the study at hand.

4.1. Research approach

The study was conducted as a *single-case process study based on qualitative data*. The data was collected and approached from ethnographic perspective, utilizing Gioia methodology as the basic research philosophy in completing the analysis phase. I as the researcher took on the role of a non-participant observer.

Qualitative research refers to several descriptive, systematic research approaches with the objective to understand qualities and the essential nature of a phenomenon within a certain context (Gast et Ledford 2014, 10). Qualitative approach is justified when, like in the study at hand, the research interest is in the micro-level structure of actions and in the meanings that people attach to those actions, and when an experimental research setup with controlled variables is out of reach of the researcher (cf. Metsämuuronen 2006, 88).

Case study design suits well in situations where interests are in a specific, complex phenomenon within its social context (Yin 2009; Baxter et Jack 2008). Through an in-depth inquiry it aims at revealing the essence of the phenomenon in a descriptive, systematic, concrete, and detailed manner (Stake 1995; Yin 2009). Answers to “how” and “why” questions are

desired (Baxter et Jack 2008, 551), and contextual conditions are believed to be relevant (Yin 2009). In their context specificness, case studies cannot offer statistical generalizability, but they offer a way to research human interaction and identify behavioral patterns relevant in certain contexts (Bryman, 1989). Choosing the case study method is well-justified when approaching the complex phenomenon of problem definition so closely tied to human interaction in specific contexts. Eisenhardt (in Gehman, Glaser, Eisenhardt, Gioia, Langley, & Corley, 2018, 4) notes that case study is appropriate for building theory in situations where there is either no theory or a problematic one, or when building theory is related to complex processes where configurations of variables, multiple paths in the data, or equifinality may arise. All these arguments resonate with the premises of the study at hand.

Process studies focus on temporally evolving phenomena and address questions like *how* and *why* managerial and organizational phenomena emerge, develop, grow, and terminate over time (Langley et al. 2013). Alternative would be abstracting out the richness of multiple cases in order to focus on differences between them (Gehman et al., 2018). Most of the qualitative research is contextually grounded and seeks to understand *process dynamics*, not just outcomes. Process studies, however, "take time seriously"; they illuminate the role of tensions and contradictions in driving patterns of change and show how interactions across levels contribute to change (Langley et al. 2013). Seeing human life in terms of flows and change and ongoing process of action is in the heart of practice theory and workpractise theory (Goldkuhl 2006). The thinking has roots in pragmatism and symbolic interactionism (SI). SI is a micro-level perspective in sociology that addresses how society is created and maintained *through repeated interactions among individuals* (Carter et Fuller 2015). Rather than addressing how social institutions define and impact individuals, it shifts attention to the subjective sensemaking (ibid.). This directs our concerns from objective *structure* to subjective *meaning*; on how repeated, meaningful interactions among individuals define the makeup of "society" (ibid.), and on how human behavior is based on interpretations arising within social interaction (Metsämuuronen 2006, 94). Studying team-based problem definition entails observing the micro-level interaction of the team for a lengthy period. This speaks for adopting a practice-based process study approach in the study at hand.

Ethnography is a research strategy for engaged studies of society and culture in action. The ethnographer collects data and gains insight through firsthand involvement and interaction with informants or research subjects (Murchison 2010, 4), relating the words spoken or practices observed in particular social setting to the overall cultural framework within which they occur (Watson 2011, 205). Traditionally, an ethnographic research includes a lengthy period of field research, during which the researcher is present among research subjects to achieve better understanding on thoughts of the members of the community in a specific culture (Rantala 2006, 217; Gummesson 1988, 109). A qualified ethnographic account is believed to describe the community from the viewpoint of its members (cf. Rantala 2006, 217), or to present a systematic narrative of the behavior and idea systems of the actors in a particular culture, organization, profession, or community (Jönsson et Macintosh 1994). This includes describing social patterns or learning from others about their culture (Gummesson 1988, 109), or uncovering the ways in which people come to understand, account for, and act within their day-to-day work (van Maanen 1979). Figure 5 sums up the methodologic choices of the thesis.

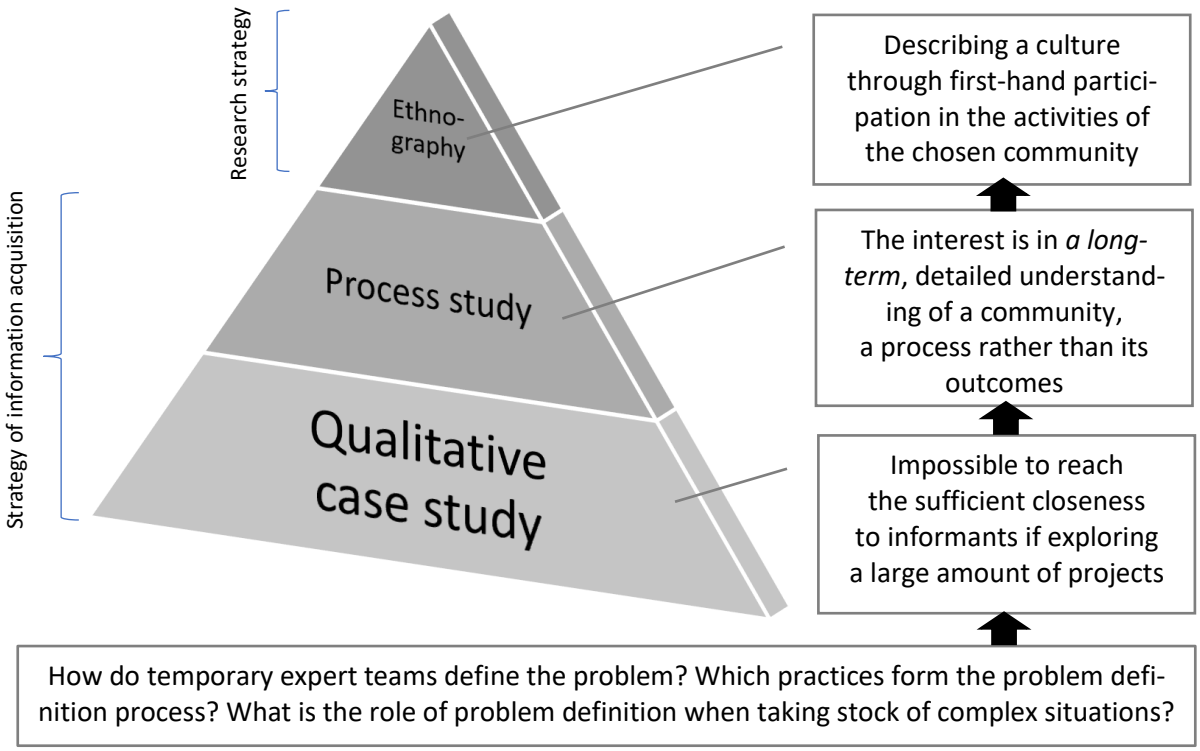


Figure 5. Research method of the thesis.

Having roots in anthropology, ethnography is a sensemaking process of researcher focusing on how people interact and collaborate (Nason et Golding 1998). Participation of the researcher in team activities is one tool to gain information needed. ***Nonparticipant observation*** is another. Unlike the first one, it does not take actively part in the activities of those observed (cf. Pratt et Kim 2012). In this thesis, the latter one is the chosen strategy.

Two methodologic templates stand out among contemporary qualitative studies of strategy and management: *Eisenhardt method* for multiple case studies and *Gioia method* for single case studies (Langley et Abdallah 2011). ***Gioia methodology*** was utilized to carry through the data analysis of this study. As a variant of grounded theory thinking (Gehman et al. 2018, 286) it aims to build theory from the data instead of trying to explain the observations in the light of a pre-chosen theory. Gioia method generally applies an interpretive lens to capture and model the meanings and understandings of the informants regarding organizational events (Langley et Abdallah 2011). A single case is chosen for its revelatory potential & richness of data in order to build a data structure based on progressive abstraction (ibid.; on purposive sampling, see also Peterson 2019, 150). The process starts with open coding of the descriptive *first-order codes* which rise directly from the data and informants, and moves towards more abstract, analytical, and theoretical second-order codes: *themes and aggregate dimensions* which are based on the interpretation of the researcher and form the building blocks of the data-grounded model or a tentative theory (Gioia et al. 2013).

Berthod et al. (2017) note that organizational ethnography looks at how individuals or members of groups enact and alter structures via specific action patterns and social mechanisms. The ethnographic narrative produced from the immersion in one empirical domain reflects understandings of the subjectivities of both the researcher and the researched. Researcher does not seek causal explanations but rather describes how the actors' social experience is aligned, organized, perceived, or reproduced (Jönsson et Macintosh 1994, 7–8). In general terms, ethnography is an attempt to *understand and interpret* a particular cultural system like a temporary organization. Following this research strategy is to assume a ***constructivist, bottom-up approach***: to observe what happens in a team at the microlevel

of social interaction or roles of the individuals. The evolution of higher-order constructs like knowledge creation or innovation is assessed by revealing the praxis of practitioners.

4.2. Case selection

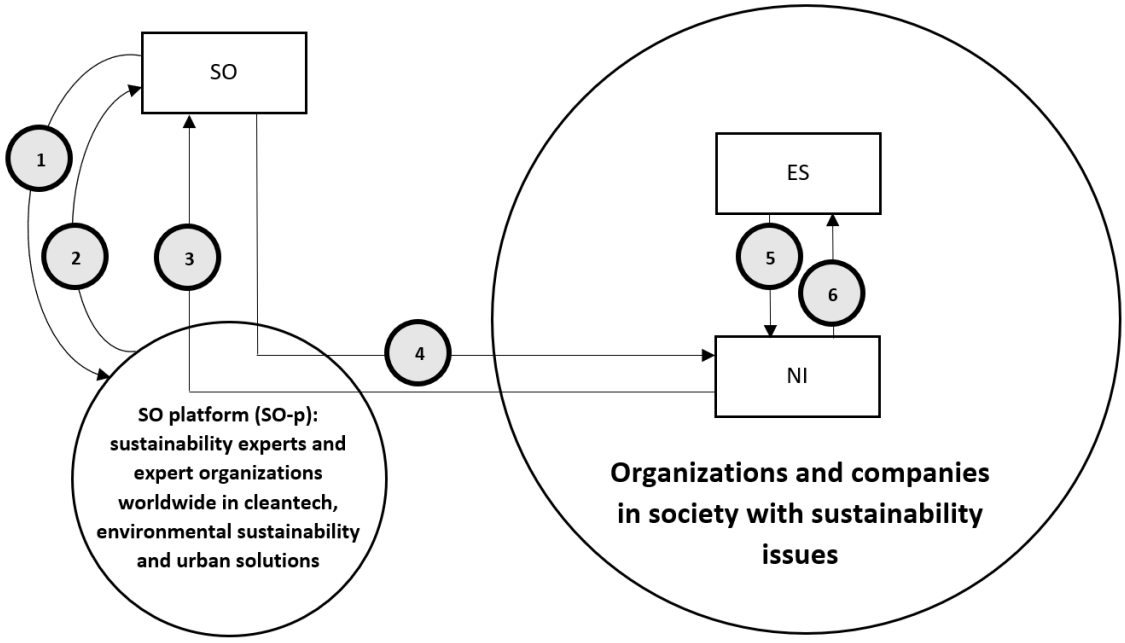
The case examined was a sustainability strategy project of "NI". NI with approximately ten employees was a subsidiary of "ES" – a European energy group with 1 700 employees. NI functioned as an innovation department within the group. Its role involved searching for new ideas and technologies among SMEs, startups, public institutions, and inventors, and developing them further in order to implement them within ES. NI formed an independent department within the group but had no external clients besides the units of ES group.

The area of sustainability was identified strategically central for ES in the future. NI wished to position itself as the key contact point in this topic within ES, and as the expert in developing sustainable business models. To lead the sustainability change within the ES group, it wanted to be better informed about the best practice examples regarding similar sustainability hubs and find models and examples on how such hubs interact with their corporations. In conclusion, the project task was to ***show the requirements for establishing a successful sustainability hub on the energy sector, and a rough concept for making one in ES***.

The project was facilitated by Solved ("SO"), a Finnish company operating an on-demand marketplace for sustainability-related knowledge work. SO offers a digital platform ("SO-p") for a community of experts and expert organizations spanning across numerous disciplines and specializations. For such experts and expert organizations, SO-p constitutes an opportunity of leveraging their expertise in various projects of SO's customers. Through SO-p, the customers get an easy access to globally distributed specialized knowledge, compiled in alternating combinations in accordance with the challenges they are facing.

The case team is here referred to as "SO-NI team". It had never worked together before. It consisted of the core team from SO's side, including three representatives from SO ("SO1", "SO2", "SO3") and two independent experts recruited from the SO-p ("SO4", "SO5"). The

core team from NI's side included five experts from NI staff ("NI1"–"NI5"). Nobody participated from ES directly, but one of the NI members was partly employed by ES. The team had ten members altogether, of whom 5–6 were involved in all project phases, hence building the core of the project. The representatives from SO's side and the ones from NI's side worked both separately and in tandem during the project. The members mostly worked in different parts of the world and met each other in varying configurations. The chat functionality of the SO-p and the cloud-based co-creation tools of Google (document sharing, meetings) were used as main communication channels. Only one face-to-face meeting was arranged. The sociotechnical context of the team is described in figure 6.



1: Manages expert community, develops digital tools for co-creation and communication. **2:** Searches for opportunities to sell/promote/develop expertise in global challenges. **3:** Searches for to the best experts from around the world to solve a specific problem. **4:** Helps to get started and recommends the best match for the needs of the organization/company. **5:** Is the mother company of. **6:** Functions as innovation department searching for new ideas to develop business.

Figure 6. Context diagram.

The study case was selected corresponding to the research questions. According to them, the purpose of the study was to find out how temporary, cross-boundary expert teams define the problems they solve, and which practices constitute their problem definition process. The study aims to bringing light into the role of problem definition when taking

stock of complex, ill-structured situations in teams. Hence, the case team not only had to be willing to open its daily work to an external observer, but it also had to fulfil the criteria of ***complexity, cross-boundary knowledge work, and temporariness***. Of these three, *temporariness* was a very salient feature in the SO-NI project which started in December, and excluding the Christmas holidays, lasted for 2,5 months. Many kinds of *boundaries* were presented in the team: the members represented diverse organizations or communities (NI, SO, SO-p), five nationalities, and diverse knowledge domains (energy industry, innovation, sustainability). *The complexity* of the project derived from several sources and was both internal (firm-specific) and external (coming from the environment of the firm) by nature.

First, the SO-NI project was launched in a turning point of the energy industry. In the wake of EU declaring its measures to attain climate-neutrality by 2050, the member countries were to align their politics to union-level goals. This meant pressure to come up with new solutions that would drive a comprehensive energy transformation – a transition to renewable-based energy systems. A significant number of societal actors, institutions, and political ambitions revolve around such transition, which tends to increase complexity. A report published only few weeks before the SO-NI project showed that annual investments in renewables should be more than doubled for the coming decade to meet the commitments set out in the Paris Agreement (IRENA 2019). However, the route to energy transformation was paved with multidimensional policy questions impossible to address without engaging a vast network of stakeholders – a feature associated with wicked problems (Daviter 2017).

Second, "sustainability" is a complex concept itself. It may be reached in terms of environmental, economic, or social responsibility. There was a spread in the ways how it was seen within NI. No clear consensus existed on what it meant to ES' business. As one in the team said: "there is ten employees in NI and ten different opinions". *Third*, the goal of the SO-NI project was all but clear in the beginning. The SO members of the team seemed to think they would create a sustainability strategy and a sustainability hub for the ES. Very soon it turned out however, that the project began at a moment when a larger strategy project was about to be launched within the ES group. No key players from ES participated the SO-

NI project. Thus, the goal turned out to be to create a sustainability "concept" or "strategy" (both terms were used) for NI alone. The project report would serve NI in the negotiations on group level strategy and help it to convince the other parties about its idea of putting together sustainability and innovation functions in one hub that would reside in NI and serve the whole ES group. The symptoms of ambiguity got their explanation towards the end of the project as it became evident that there existed confusion regarding the ownership of the sustainability issue within the group. Eventually, the SO-NI team could not lead alone the sustainability change of ES, but the limited access to information made it hard to outline alternative approaches as well:

> We [in NI] knew that the board [of ES] already voiced that there has to be a big focus on sustainability issues. That's what we knew but we didn't know in what detail and we didn't know where we want to focus on. And we hoped that during this strategy meeting, they [the ES board] are going to say something, but they didn't. So, we still don't know what they're planning. And since we're a daughter of ES, we're related to their goals. So, it's still waiting.
>
> *N2 in the final interview when the project had just finished*

Finally, the project differed from earlier SO projects in its utmost lean approach. The scarce resources regarding both time and money added the complexity, forcing the team to push it to the limit while seeking answers to complicated questions in only a few weeks of time.

4.3. Description of data

Qualitative case studies primarily use ***contextually rich data*** from bounded real-world settings to investigate a focused phenomenon (Barratt, Choi et Li 2011, 329) and to describe the essence of it in a systematic, concrete, and detailed manner (cf. Stake 1995, Yin 2009). Making ethnographic research entails data collection by participating and observing the everyday life of the actors in a situation and by interviewing them in order to analytically describe and understand a community or a group and the culture it belongs to (Metsämuuronen 2006, 94; Murchison 2010). To interpret the meaning or function of human behavior, non-structured data is favored instead of data coded in accordance with pre-determined analytic categories (cf. Metsämuuronen 2006, 95). Conducting a single-case process

study, on the other hand, entails diving deep and with systematicity to the sources of information to attain rich ***longitudinal data*** (cf. Ann Langley in Gehman et al. 2018, 6). All in all, case studies allow the use of a variety of data sources (Baxter et Jack 2008). With ample data, a reader with different orientation can fashion an interpretation different from the researcher's narrative (Donmoyer 2019; see also Gehman et al. 2018). For the same reason, the study should provide sufficiently low-inference descriptions of behavior and excerpts from transcribed interviews (Donmoyer 2019).

Bearing these guidelines in mind, the study on the SO-NI project was based on systematic triangulation and thick description of the data (data triangulation refers to use of multiple and diverse data to gain better understanding of researched process; cf. Yin 2009 and Peterson 2019, 154). The target was to gather as much evidence on the processes whereby actors construct meaning as possible. Data collection began with three preliminary interviews with Finnish open innovation experts in order to get an overview on how cross-boundary co-creation is exploited in Finnish corporate life at the moment, and to test the chosen research perspective. The actual research data was gathered thereafter through real-time observing of the SO-NI-team: its interaction in the meetings and chats, and on Solved platform (SO-p). In addition, my own fieldnotes and project documentation were collected and used as data. Five of the team members were interviewed in different phases during the process. These interviews were eight altogether.

The SO-NI team worked together for three months. Data collection was spread along the process flow. *The process map is presented in figures 7 and 8*. The first one represents the process as it was introduced to the team in the beginning of the project. The second one is an updated version made by me. It bases on the first with some changes made on the timeline to make it correspond the actual course of events, and some remarks concerning the data gathering for my own research (in light grey boxes). The project included three main phases which are presented on page 59 after figures 7 and 8. Each of them had a specific function and was targeted to produce a predefined input – memos, reports, spreadsheets, and slideshows – for the following phase.

Figure 7. The planned process of the SO-NI project. Process timeline presented as it was presented for the SO-NI team in the beginning of the project. Source: SO.

Group members

1. Core Group
SO1, SO2, NI1 and NI2

2. Strategy Group
core group + SO3, NI3, NI4 and NI5

3. Other Groups
• ES stakeholders (not participating in the end, however)
• Extended SO expert team: SO4, SO5

All the groups together are referred to as "SO-NI team" in this study. "SO core team" is used to refer to participants from SO side only, "NI core team" to participants from NI's side. SO5 participated in the role of the evaluator of project deliverables.

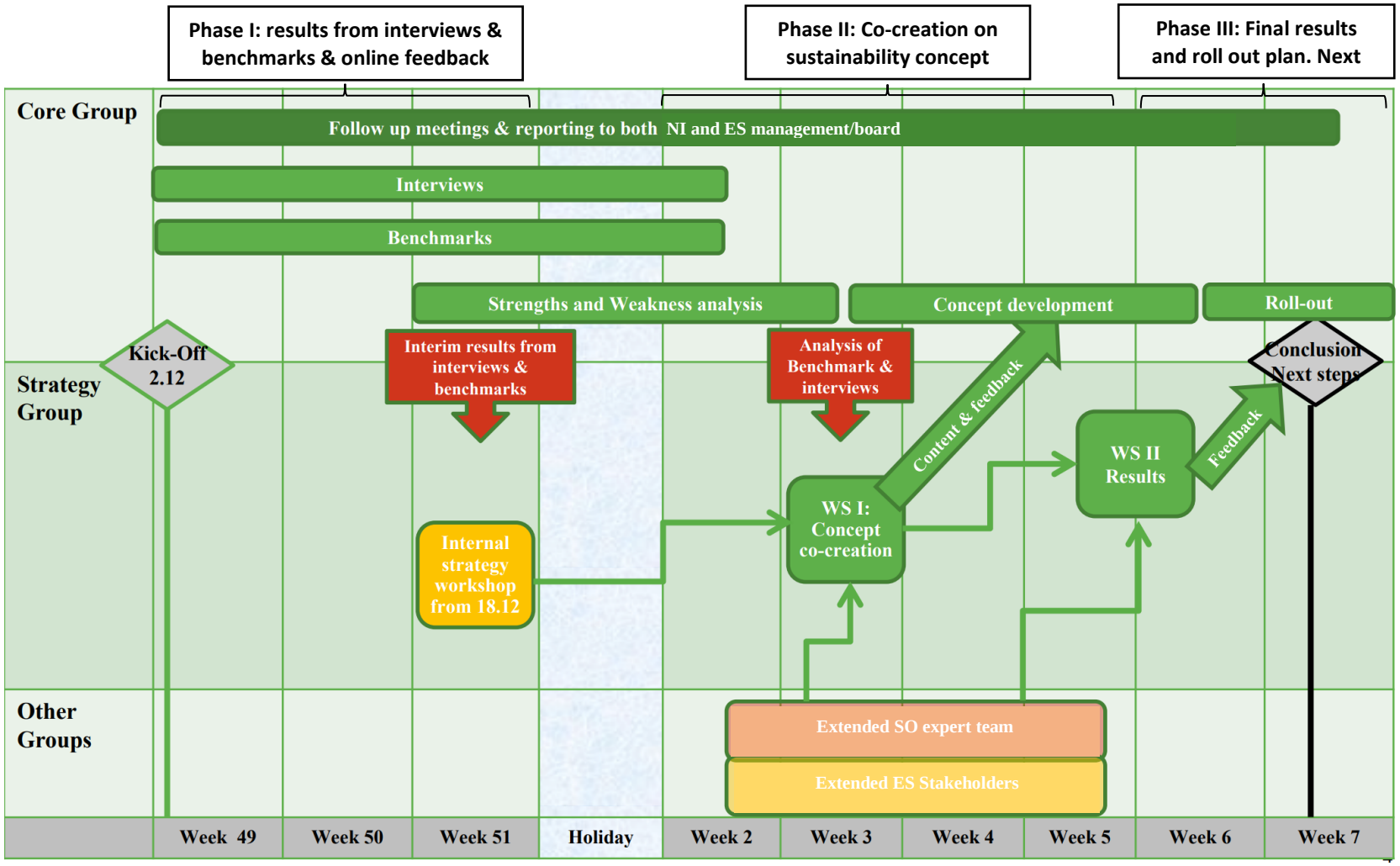
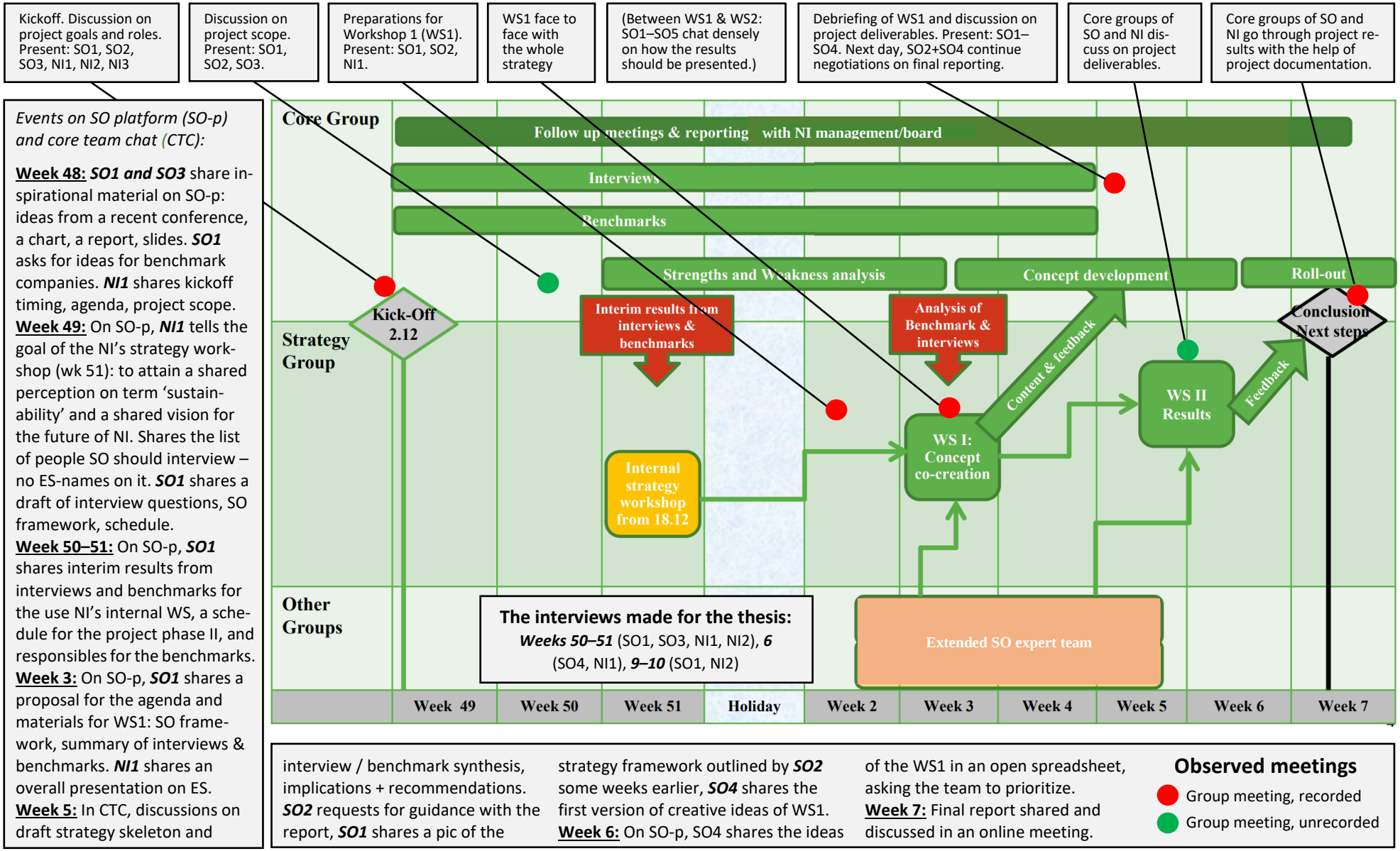


Figure 8. The actualized process of the SO-NI project with author's remarks on events belonging to the research of this thesis (light grey boxes).



1) A benchmark study was conducted by SO core team as a part of the SO-NI project and consisted of eight interviews and eight desk research. The study package was conducted in order to clarify how other companies or hubs on the energy sector and other fields as well deal with sustainability issues – how do they organize their sustainability functions, and what are their business models related to the Sustainable Development Goals (SDGs). These findings directed the team towards reflecting the strengths and weaknesses of NI in the area of sustainability, and to analyze its current innovation models, products, and processes, and potential for implementing models, products, or processes on this field. The question was: what does it take to get NI to the lead sustainability change within ES – what would be the tasks, competences, knowhow, or tools required?

These reflections were overlapping with the second phase: **2) the co-creation** that was planned to produce the sustainability concept for NI: strategy, framework, focus, commitments, targets, action plan, and operational model. The last phase included presenting **3) the final results and roll out plan**, discussions around them, and specifying of **next steps**.

Every phase had as a core one face-to-face workshop or hybrid conference together with the teams of both NI and SO. The project started with a kickoff organized as a hybrid meeting, NI members participating from their office abroad, SO members from Finland. In the second phase, the shared interaction with the whole team took place in face-to-face workshop. The feedback session in the end of the third phase was again a hybrid meeting. Outside these three events, the interaction took place in varying team compositions in teleconference meetings and phone calls, chats, or mails, and even in face-to-face between those who worked at the same office. The team also used the online platform of SO (SO-p) designed for cross-boundary co-creation in sustainability-related projects.

The data consisted of 23 documents including recordings of *meetings*, core team *chats, project documents* created by the SO-NI team, and my own *research interviews and fieldnotes* (table 5).

Table 5. Data sources.

Method	Description	Documentation	Research objective
Interviews	3x semi-structured pilot interviews with Finnish creative teamwork / open innovation experts (à 30 min)	Transcript of audio records of 2 phone calls and 1 F2F-meeting	Preliminary introduction to the theme, testing research idea before choosing SO-NI project as the research case
	7x semi-structured interviews with SO1, SO3, NI1, NI2 in different points of the project (à 30 min)	Transcript of audio records of 7 phone calls	Reflecting process phases from the perspective of different individuals; adding contextual understanding; obtaining both retrospective and real-time accounts by those people experiencing the phenomenon of theoretical interest
	1x face-to-face conversation / interview with SO1 after the project (90 min)	Transcript of an audio record of F2F meeting	
Observation	Kickoff meeting, online (60 min)	Transcript of an audio record	Illuminating tensions and patterns of change in the interaction of team members, adding contextual understanding, keeping up the project schedules
	Workshop 1 (WS1) preparations online with SO1, SO2, NI1 (60 min)		
	WS1 (one day) face to face	Transcript of an audio record (partial)	
	SO's internal meeting after the workshop unraveling the first impressions, online (60 min)	Transcript of an audio record	
	Project feedback conversation, online (90 min)		
Chats and messages on SO-p	Interaction of the whole team on SO-p; sporadic, short message threads / single messages	Screenshots of some of the message threads	Keeping up the project schedules and timeline; evaluating the role of technology in the project
	Interaction of the SO core team on SO-p via chat functionality including tens of messages	A copy-paste text document of a long message thread	Observing the preparation of project deliverables
Fieldnotes	A chronological diary steadily replenished with new notes	A text document with 19 sides of time-stamped impressions, notes, and screenshots of researcher	Reflecting process phases; outlining preliminary conclusions; describing / classifying phenomena, seeing how the concepts interconnect; cross-checking the transcribed interviews whether any details were missed
Project documents	Core project documentation (project report/report draft, list of creative ideas, strategy framework)	Text documents & spreadsheets edited online, slideshows, drawings	Reflecting the issues on sociomateriality

The recordings were transcribed as long as it was technically possible. Fieldnotes were accomplished in a form of a diary, where events, documents etc. ran in chronological order, but notes or annotations regarding them could be added even afterwards when there was better ground for conclusions. This ensured the steady linking of data and memos without missing the clear process view of the whole.

4.4. Data analysis

Ethnographic perspective generally follows the logic of induction. Where positivist social researcher aims at applying hypothetico-deductive model or determining the truth or falsity of propositions derived from a certain theory, qualitative ethnographic investigator may enter the field of study with as few preconceptions as possible and rely on an accumulation of impressions during the research process (cf. Reichertz 2014; Gioia et al. 2013). Inductive reasoning moves from specific observations or measures to detecting *patterns and regularities*, and finally ends up to developing general conclusions or theories.

The data analysis of this study consisted of several phases. First, the project events were observed in real time, making fieldnotes along the way. Second, the course of actions was recapped by reading the transcripts of the event recordings, and the documents the team had elaborated so far. Finally, all the transcripts and data files were gathered into qualitative data analysis software NVivo 12.0. They were renamed in accordance with the actual dates of events. This allowed to see at a glance the timeline of the project and the actual moment when each document, interview, or discussion was accomplished. The data was read several times in NVivo, at the same time labeling fragments of it. The labels indicated either to repetitive themes or otherwise interesting or potentially relevant issues.

The primary subject of research was text: the transcripts of interviews, meetings, and workshops together with project documents. In qualitative case research, ***themes generation and coding of texts*** is the most recognized and used analysis method for empirical material (Rashid, Rashid, Warraich, Sabir, et Waseem 2019, 7). The initial phases of material

interpretation and analysis are typically referred to as naming of sub-concepts, main concepts, and categories (ibid., 9–10).

As stated by Gioia et al. (2013, 20), myriad of informant terms, codes, and categories emerge already early in the research. Since this study followed Gioia methodology in particular, labelling data fragments in the data of SO-NI project resulted in articulating a variety of ***first-order codes*** emerging in it. As the research progressed, I started seeking similarities and differences among those codes and reduced their number, and after that labelled the remaining ones with phrasal descriptors. The remaining first-order codes were drawn together under more abstract ***second-order themes***. Of these two, the first-order codes represent the informant terms – what actually happened during the project. The second-order themes, on the other hand, operate at the theoretical level, building a larger narrative on the basis of the data. The analyses went on towards investigating whether it was possible to distill the emergent themes further into overarching ***aggregate dimensions***, and, finally, towards building a data structure grounded in the collected data. (Cf. Gioia et al. 2013, 20.)

To give an impression of the analysis phase, tables 7 and 8 show later how the evidence picked up from the data supported the selected themes. Data structure emerging from the open coding of the data is presented in table 6.

4.5. Research reliability and validity

Reliability refers to how consistently a method measures something. If another researcher would reach the same results using the same methods under the same circumstances, the measurement is considered reliable. Validity, on the other hand, tells how accurately a method measures what it is intended to measure. A valid research is believed to produce results that correspond to real properties in the physical or social world. The interpretivist research philosophy behind ethnography and Gioia method, however, highlights the experiences and analysis of a *certain researcher* and the models or theories (s)he values insightful (cf. Murchison 2010, 218; Rashid et al. 2013). Another researcher might produce a very different study about a similar topic. For this, interpretivist must answer the questions

associated with ***credibility, conformability, transferability, and dependability***, instead of the usual positivist criteria of reliability and generalizability (cf. Denzin & Lincoln, 1998; Lincoln and Guba 1985). As Peterson puts it, the hallmark of high-quality qualitative research is *trustworthiness*, which is typically viewed as the counterpart to rigor, validity, and credibility in conventional quantitative research (Peterson 2019, 148). The trustworthiness in Gioia methodology is built by applying "systematic conceptual and analytical discipline that leads to credible interpretations of data and also helps to convince readers that the conclusions are plausible and defensible" (Gioia et al. 2012). This might as well be called as *authenticity* or *internal validity* (cf. Rashid et al. 2013, 8) of the research. The narrative on findings of the research must make sense for any educated reader.

In this study, credibility and conformability are pursued through systematic and minute application of Gioia method which offers a step-by-step framework for presenting the data with rigor. In it, indeed, "the presentation of evidence matters" (Gehman et al. 2018, 10).

Furthermore, the question of transferability is assessed by giving a detailed, rich description of both the setting and the process studied so that readers can judge the applicability of findings to other settings which they know or evaluate the reliability of the study more in general (cf. Lincoln et Guba 1985; Syrjäläinen 1991). To add reliability and dependability, both data and methodological triangulation are used. This entails using multiple sources of data in order to reach richer descriptions of the phenomenon (data triangulation) and applying a combination of observation and interviews (methodological triangulation) (cf. Denzin 1978). Interpretations and preliminary findings of the researcher were discussed with informants in the interviews.

A central point of criticism towards ethnography concerns ***the ethics*** of research. Ethnography aims at describing the reality and the experiences – the culture – of the others. This is seen to call for first-hand participation and a deep reliance on intensive work with the informants drawn from research setting. It is well justified to ask whether it is possible to describe or understand in a neutral way what *others* feel or how *they* interpret the reality

(cf. Rantala 2006, 234). On the other hand, the more complete the participation, the grater the danger that the researcher "goes native" or completely adopts the values and goals of the group (s)he is studying, or even becomes a full member of it (Pratt et Kim 2012). The interpretations of a lone researcher are in a risk of being ***biased***.

In this study, choosing a non-participant observer role instead of a participant observer partly resolved the ethical considerations. Distancing myself from experiences of the fieldwork and writing things up dispassionately was also a very natural position for my personality. I would have felt uncomfortable if immersing very deeply or personally to everyday activities of the team. In addition, co-creation sprints in a multinational expert team was new to me, and I had no prior experience of working with the energy sector, nor did I know the SO-NI team members in advance. For all these reasons there is good reason to believe that the observer bias was not the primary concern in this study.

One more criticism relevant in case research specifically concerns the problematics of ***anonymity***. The researched subjects should not be recognizable in that depiction (Syrjäläinen 1991). In this research, the identity of the participants of the project was concealed. To ensure the full transparency of the research the participants were also informed about the research process at the beginning of the research project.

In this thesis, ethnography was performed by a single ethnographer, who through in-depth immersion in a single community came to produce a subjective and situated account, translating her own experience of being. The results are not presented as generalizable or as objective description of the reality. Through the measures described in this section the reliability and validity of the research is, however, taken care with the means generally offered in the literature covering the quality of the ethnography.

5. FINDINGS

The study was conducted for the purpose of finding and analyzing empirical evidence on the problem definition process in temporary expert teams. The objective was to add understanding on the role of problem definition for the team's ability to effectively solve complex problems and adapt to change.

Qualitative, longitudinal data was gathered in a single case setting through non-participant observation of team discussions, chats, and messaging taking place in online conferences, workshops, and on the online platform the team used as a communication tool. Interviews with team members and project documentation formed another part of the research data. The data was approached from ethnographic perspective and analyzed using NVivo 12 and Gioia methodology.

This chapter presents the core findings of the study derived from the methods applied to gather and analyze information. Due to process study approach, the research findings are frequently reflected to the chronological course of events (see process map introduced earlier in section 4.3).

5.1. The structure emerging in the raw data

The data structure is a graphic representation of how the research gradually progressed from raw data to the analytical terms and themes. Parsing together a full set of first-order terms and second-order themes together with aggregate dimensions formed the basis for the data structure grounded in the data.

Table 6 introduces the data structure in the way it emerged from the open coding of the data. In the table, first-order concepts represent practical, informant-centric notions rising directly from the data. Second-order themes bring those concepts to a more general and analytical level, mixing them with insights drawn from the literature review as well.

The literature review discussed system, design, and solution approaches to problem solving. When reading the empirical data closely, the same theoretical lenses seemed to function fairly well as summarizing aggregate dimensions of the second order themes.

Table 6. Data structure emerging from the open coding of the data.

1st Order Concepts	2nd Order Themes	Aggregate Dimensions
• Creating awareness on what others are doing "out there" • Making benchmark studies and interviews • Investing lots of time in defining a mess of problems present at the field of interest	Making sense of the external complexity	Expanding complexity –> System focus
• Creating engagement and shared understanding through discussion and explaining ideas • Reflecting own situation to a wider system view • Showing strong personal devotion to sustainability issues	Building shared understanding of the scope & goal	
• Listing a wide range of potential measures or ideas that might be helpful in running the change within NI/ES • Deciding on priorities • Defining the problem through creating multiple solutions and choosing the ones that give quick wins and concretize the change needed	Partitioning the complexity for bigger impact	Reducing complexity –> Design focus
• Utilizing specialized expert knowledge to screen and evaluate potential measures and ideas • Seeking for relevance and "perfect fit"	"Perfect fit" with the help of experts	
• Preparing project deliverables • Utilizing models, frameworks, schedules, agendas, templates, and other material objects	Sociomateriality of knowledge creation	Giving physical appearance to knowledge –> Solution focus
• Creative engagement and learning around material objects • Visualizing shared synthesis through the documents	Using artifacts as vehicles of interaction	

When assessing complex situation, the team switched between all three approaches picked up as aggregate dimensions. The switch was mediated by diverse social practices: mutual sense-making of the external complexity, building shared understanding of the team scope, balancing between many aspects of the complexity in order to expose the best fit for NI, and using artifacts like project documents as vehicles of activities and interactions.

Six themes peaked out in the empirical observation. Table 7 opens the fragments of team discussions and interviews supporting them and offers evidence for the chosen concepts.

Table 7. Concept-evidence table.

Theme	Representative Quotations
Making sense of the external complexity ***– Awareness***	"This **benchmarking**, if you take them in the wrong way, like SO2 was describing, then it doesn't work, but it's definitely part of **creating awareness** that what the others are doing and really seeing the whole." "I think what we really would like to learn is what others do. How they do it and **what can we learn** from it to make it easier for us to find an approach that works for us." "How can we contribute to the **life of the community**?" "**Interviews and benchmarks** have been eye-opening. We've seen the range of different ideas when talking to the different leaders and one of my personal conclusions is that there's no one way to make it as a sustainable company. There are **different ways of building your focus** to be what you want." "We need some kind of feeling how are companies… ***how is the world dealing with this*** stuff, actually."
Building shared understanding of the project scope ***– Relevancy***	"We can only be successful **if we manage to share the view of what is important to us** and what is sustainability to us, and I think we need to define that first." "We need to define what are **the important and relevant topics that are likely to affect** your business with a high risk or high opportunity." "(…) how can we do it [the project] so it **fits** us, it **fits** our team, it **fits** the things we are doing and how we would like to do it. So, we would need to define our own **goals**." "The biggest project risk, of course, is that in the end, we did all the tasks, we did the workshops, we did the interviews and everything. And then we have too general outcome." / "The final outcome (…) has to be (…) **relevant** for both NI and as a secondary target for ES." "(…) The strategic intend for NI needs to be **clarified** even more, because it seems it wants to do plenty of things at the same time with its limited resources. The discussion needs to head towards a **focus** for NI for its two targets."
Partitioning the complexity for bigger impact ***– Quick Wins***	"I think you were listening most of the time on Wednesday… there was quite a lot of sort of signals that they cannot present something like a real concept (…); they have to sort of **feed the content step by step** to the bigger organization and get some **quick wins** (…)." "There are a lot of solutions, creative ideas, in this document, but I think that for the purpose of time we should look and **pick up those that have an implementation time which is shorter**." I suggest we need not attach ourselves to the categories of implications and recommendations strictly. What I'm looking at is whether there is **value in the list of points** in the document **for NI**.

	"What we can do is make our own goals for ourselves as a department, and try to give input, and make projects in this field. (…) It's not possible to think in such a big scale, **so let's concentrate on that stuff you can really influence.** (…) I can influence my department, my colleagues, and the projects I'm doing."
"Perfect fit" with the help of experts ***– Expertise***	"We'd like to be the team that when you think of sustainability and ES (…) everyone is just thinking of us. That we are on top of mind, that **we are the experts** within the company." "For us it is also to get as much knowledge about this issue as possible because **we have to argue** in the strategy meetings in our company (=ES)" / "We want to show them that we have a clue, that we have a plan how we are dealing with this (…)" / "(…) **we can show them**, look, we have… we made some benchmarks, we looked at other companies, we have some knowledge about this issue now, and we want to have the lead." "There is really a lot of knowledge [on SO-p]. It sounds very appealing to me that you can **reach out to those experts all the time and you have access to knowledge** that otherwise you wouldn't have that easily." "I hope the **output** is really, it has a high quality then." (…) "Something **practical**. (…) A really common understanding about our role, and about our tasks in the future (…)." / "One of the ways to do that persuasion for the bigger company is to let them know we do not only know what we're talking about, but **we** also **have an idea how we're going to run this thing**." "My personal concern (is) to get this information to a point where I can… **I'm able to provide** some **solutions** to what they need." "I know that all this is but a starting paper for NI to enter a conversation in the strategy making of ES. ***The real delivery is our help*** in the implementing activities."

Not all the themes were presentable in form of quotations, however. Table 8 offers examples of repetitive team activities illuminating the sociomateriality and the use of artifacts in the team.

Table 8. Concept-evidence table, sociomateriality and material artifacts.

Theme	Representative Manifestations in the Data
Sociomateriality of knowledge creation	• Team members frequently expressing their expectations on concrete, objective outcomes • A magnitude of models, templates, and documents utilized or prepared during the process: the ABC method visualization, the SO framework, the interview templates, pre-summary and later summary of the interviews and benchmarks, list of creative ideas collected in the workshop, project report draft, the actual project report etc. "We want to go out of this workshop with some **concrete actions** we have to do, or a **concrete strategy** for the next months."

	Agenda of an online conference of the core team: 1.) **Synthesis report** summary & recommendations based on interviews & benchmarks; 2.) Preliminary Solution options to drive Sustainability **agenda**; 3.) Discuss: **material and format** for NN for Feb 5th strategy meeting; 4.) Outline of the **strategy report** (draft); 5.) Next meeting
Using artifacts as vehicles of interaction	• Discussions largely arranged around specific documents • Example 1: strategy group elaborates & guides the documentation process in the meetings, core team discussions circle around preparation of specific deliverables • Example 2: in the kickoff one of the slides illustrates ABCD method ○ *ABCD method utilized as a model for the whole SO-NI project* ○ *Team spends a lot of time discussing the visualization* ○ *Discussions build the shared understanding of the upcoming project phases* • Example 3: in the workshop the team collects creative ideas for future actions ○ *The ideas first collected in small groups, and then divided by the whole team under categories given by the facilitator: 1.) Strategy & Vision, 2.) Business, 3.) Operations* ○ *The given categories originally rise from the SO framework with parallel headings: 1.) Mission with Purpose, 2.) New Business, and 3.) Sustainable Operations* ○ *After the workshop, the facilitator puts the ideas in a spreadsheet and asks the team to prioritize the suggested actions by giving each of them a number on a scale from 1 to 5* "…but it's definitely part of creating awareness on what the others are doing and really seeing the whole scale of the… yeah. So, it's part of this A." (SO member using ABCD method to arrange his/her thinking of his/her daily work)

As seen in table 7, the second-order themes derived from the team discussions could be summed up with only one key word when needed (Awareness, Relevancy, Quick Wins, and Expertise). The following sections of the study offer little longer summaries of the main themes in the data structure.

5.1.1. Making sense of the external complexity

As seen earlier in figure 8, the team spent weeks after weeks on making ***background studies***: preparing and conducting interviews and benchmarks or reporting and discussing them. Considerable effort was put on finding former examples of innovation-sustainability hubs in analogous firms and learning from ***the best practice examples*** in the field. This was one of the leading themes throughout the project – specifically during the first half of it.

The fragments from the data reflect the scope of the background studies and the attitudes and enthusiasm shown in the team during the investigations in the field:

"And on the C part in terms of creative solutions, *what's out there unlimited and un-bounded* that we can come up with, and out of these we decide on the priorities…" ***(SO2 explaining the ABCD method for the rest of the team)***

"Interview with X completed. (…) [The interviewee] has been in X for 15+ years and looked knowledgeable and conversant with the issues. (…) Great things X is doing, punching above its weight. Surprisingly, the diagram I sent you (SO1) earlier in the day is what she used as illustration too, on sustainability and innovation. She liked the interview, esp. the questions asked from our list. She said they were specific and to the point." / "Interview with SVP of Y completed this morning. (…) Again, another good discussion. (…) It's eye-opening to see the stance of top companies, their big-thinking attitude, and at the end of the day these sessions become inspiring too." ***(SO2 chatting on the interviews for the rest of the team)***

While looking "unlimited and unbounded" on what is out there and trying to understand the whole, the team seemed to move towards ***expanding the complexity*** it faced rather than restricting it. This meant deep engagement of the core team especially in creating shared understanding around the findings of the background studies and in explaining the ideas rising from them.

5.1.2. Building shared understanding of the project scope

Alongside the dense background studies the team gradually tried to move ***towards a more restricted view*** on the purposes of ES and NI specifically. Time and effort was invested to ***reflecting the situation in NI and ES to a wider system view*** opened in the background studies.

The building of a shared view on what the project was up to brought the team members closer to each other. Words **"we", "us", and "our"** were heavily used in team gatherings while going through this process. The first research interviews for the thesis were made at the same time during the first phase of the project. In them the members highlighted their personal devotion for sustainability. These two – the very intense concentration on finding the scope that best fits for "us" and the confessions of devotion and enthusiasm of different people in one-to-one interviews – gave the impression of a homogeneous and idealistic group of people with not many contradicting values.

The data included examples of SO1 coaxing the team to detail their understandings of what should be the target of ES/NI in the future when thinking of sustainability. While asking, he simultaneously came to propose some alternative interpretations of the situation:

> "(…) just getting a little bit understanding in sort of how do you see [the meaning of sustainability for ES/NI], what does it mean for – as in terms of goals, in terms of do you want to be the most sustainable energy company in the world? Do you want to be more like a carbon neutral, or just give a positive handprint to the world? Or how do you see the kind of sustainability from the target setting point of view?" ***(SO1 to NI1 in phase 1)***

Defining the project scope constituted a shared reflection between diversity of thoughts, perspectives, or solutions, and selection between them to find purpose in the pursuits of NI in particular. This way, the complexity and the confusion around the topic was narrowed. The elaboration of the shared understanding did not evolve into drawing together of differing strands of opinion, however. The eventual scope of the project remained unspecified. This was shown in the feedback session where SO core team presented the final report of the project. The report included lists of recommendations regarding vision, operations, stakeholders, future opportunities, trends, and risks, and current reality checks related to sustainability for both NI and ES. The actual sustainability concept included several ideas for a new strategy map for ES, powered by NI. Six strategic focus areas were identified with many concrete actions in each of them. Three tactical focus areas included tens of activities prioritized "primary" and "secondary", and ideas "worth considering". Two options of how to create a sustainability hub within ES were visioned, as well as two potential organizational structures for such a hub. The annex included roadmap templates for both services and operations. SO core team referred to the challenges in getting the information needed from ES which had made it hard to build a precise solution and directed the work towards a theoretical solution instead.

5.1.3. Partitioning the complexity for bigger impact

The internal complexity of the project was tangible in messy power relations, bureaucracy, and restricted access to information which all complicated the possibilities of NI to position

itself within ES. It was seen in the diversity of views within the firm on what sustainability means to its business. External complexity was underscored in the wickedness of global climate change: in many alternative ways of fighting it, and in the societal dimensions of it, as well as in the multitude of external stakeholders involved in the efforts of solving it. Technically, the strategy of the team in navigating these conditions of poor visibility was to systematically generate concrete steps that would bring about change despite the challenging starting position. The team assessed the problem space by ***listing a range of*** potential, concrete, and "doable", ***easy-to-implement measures and ideas*** – like cut bits of potential solution. The ideas were targeted at starting the sustainability change within the project organizations NI and ES. The next step would be the ***deciding on priorities***.

This way, the team ***purposefully designed the potential future*** of the organization and planned the steps to be taken. What came out of the process was the articulation of a wide range of potential actions. By doing this, the team not only added flesh on the bones of the original project drafts, but also avoided seeing problems as intractable masses of complexity that lack the basis of being broken down into manageable parts. The bearing idea in responding the complexity was ***to innovate freely and simultaneously sieve out those ideas in particular that would give quick wins***. Such ideas, when implemented, would immediately start concretizing the change on its way. This would make it possible to limit the variety of problem-solving activities in the future and thus ruled out at least some parts of the complexity revolving around the project.

5.1.4. Finding "Perfect fit" with the help of experts

In the beginning, the referrals to this theme were classified under three codes: ***seeking purpose and relevancy, partitioning team task*, and *longing for "perfect fit"***. Fundamentally the fragments collected under the codes referred to adding understanding on which measures to take in the context of ES specifically. The balancing at the boarder of varying levels of complexity continued to be the undertone in these discussions. There existed a certain back and forth movement between expanding and narrowing the problem space throughout the project.

A prominent feature clearly observable in the first half of the project in particular was ***the trust in expert knowledge*** in generating this movement: both in showing what to look at the outside of the organization, and in ideating and choosing the elements of solution where to focus. The team seemed to take ***the integration of specialized knowledge as a guarantee of well-fitting final solution***. The NI team imagined itself reaching the new role as sustainability experts with the help of external experts and seemed to expect a great part of the complexity to be solved through combining expertise available on SO-p and through exploiting the findings of benchmarks and interviews. Especially in the beginning of the project, knowledge was viewed as an object that would be easily transferred from outside into NI and from NI into other departments of ES. Towards the end of the project, the trust in external expertise taken from SO-p matured towards a richer and more detailed self-image of the expertise within NI. The NI members identified their potential role as the initiators of strategic change through redesigning their current work (see section 5.3).

5.1.5. Sociomateriality of knowledge creation

Sociomateriality was a lasting theme throughout the project. Referring to project documents was particularly frequent during the last phases of the project. The documents were many: the interview templates, pre-summary and summary & synthesis report of the interviews and benchmarks, list of creative ideas (collected in WS1), project report draft, and, in the end, the actual report. Even the meetings and online conferences were largely arranged around specific documents which gave the framework for the discussions.

5.1.6. Using artifacts as vehicles of interaction

The communication in the SO core team in particular revolved a lot around the drafting, elaborating, or commenting project documents. The discussion in core team chat particularly was all about preparing project deliverables for NI. The models and the templates served as tools for keeping the team acting and contributing and to organize teamwork. In the kickoff meeting, for example, one of the slides illustrated the so called ABCD method (www.naturalstep.ca/abcd). SO core team used it as a model for the project. The project

could well have followed the method in any case, but it was seen important to visualize it and to use considerable amount of time to come to terms with it together. It seemed to help the participants to organize their thinking.

Similarly, the team used templates or models as tools to organize teamwork. This added efficacy but could also replace a more free-form and open discussion, like when collecting creative ideas on how to push forward the sustainability agenda within the ES group. The ideas were collected in the workshop and divided there under three categories: Strategy & Vision, Business, and Operations. These categories originally came from the SO framework in which parallel headings were Mission with Purpose, New Business, and Sustainable Operations. The framework (fig. 9). The framework had proved functional in earlier SO projects and was chosen as the core principle for building a solution this time as well.

Figure 9. SO framework for sustainable business.

After the workshop, the facilitator (SO4) put the suggested actions in a spreadsheet and asked the team to prioritize them by giving them numbers on a scale from 1 to 5. Hence, the team used a simple enquiry based on an old project model and a spreadsheet to handle

a complex issue fast instead of much more complicated joint discussions on priorities – still guaranteeing at least a minimum level of interaction around the possible alternatives.

5.2. Teaming and building team relationships

The process of the SO-NI team was minutely planned. The meetings were facilitated by SO1, and in some parts also by SO2 or SO4. The facilitators kept asking questions, seeking feedback, and reflecting results of the background study with the rest of the team. The facilitation pushed the team forward. There was very little if any time for unofficial chatting during the online conferences or other observed team activities.

Still, the relationships and the cooperation between the members seemed conspicuous and smooth to the extent that it was hard to believe that, expect some of the members from SO's side, the members of the team did not know each other before this project. It felt natural to link the observed spontaneity and easiness to the very low team hierarchy and homogeneity of members with respect to attractions and interests. This was especially apparent in the fragments taken from the research interviews made for this study:

The topic is of great importance to me as a very big personal interest that we are doing something that is really making an impact. So, I thought that this might be the reason [why I was asked to join this team] but I don't know why but I haven't asked.

From my personal point of view the project is very inspiring (…) I think that this project is once again so interesting that we are probably linking even volunteers who will join for the love of the game.

For me personally, it's a very important project. Because of the topic, sustainability, which is, personally, very essential in my life. (…) I think most of the people in this project are very idealistic people who want to change something. Who have the energy and the motivation to do new stuff, and have the feeling that sustainability is the biggest issue in our century.

This is my impression from our talks online that there is a good connection and a good liaison, a good link between the core team.

NI2, SO4, and NI1 in research interview in the project phases 1 (the first two) and 2

Professional and personal commitment to sustainability gave a strong motivation to engage with one another's knowledge on the subject and to absorb knowledge emerging through the background research and discussions. Furthermore, since no relevant stakeholder groups were involved in the process from the ES side, there were very few sticking points in the team process that could somehow have compromised the team relationships. The fundamental questions on the meaning of sustainability for the whole ES group and on how to arrange its sustainability functions in the future remained largely intact. Technically, all these features might have deepened the project engagement and helped reaching a level where learning emerges. What compromised such outcomes according to research interviews, was the haunting hurry, the limitedness of shared space for discussion, the technical troubles, and the superficiality of relationships formed across the organizational borders:

It's a very stressful time of the year for me and I find it very hard being in a team that's only online. (…) I need people being physically around me to remind me that I have to do something. (…) There are so many projects that we have to finish before the end of next week because then it's a two weeks break when no one's there. (…) So, there is not a lot of space actually for these discussions. (…) I think everyone is just very tired. ***(NI2, phase 1)***

My problem with this platform is the usability (…) I see things are going on and sometimes I can even read what someone posted and I know they are waiting on an answer but I can't answer it [because the platform being not available in mobile]. ***(NI2, phase 1)***

The platform is not always the most convenient way to work. So in many ... I'm not, if I have a small project with a startup, I think it's not necessary to invite them to SO-p and everything. It's quite enough if you talk all two weeks via video conference, or have one or two mails per week. That's ok. It's not always necessary to use the platform. ***(NI1, phase 2)***

I have so many stuff to do there all day. It's more or less often to find really the time to give more feedback. More reliable feedback. That's difficult. But the channels are there. (…) We cannot find the time to answer the questions and give more feedback, because we're not that much in the office and everybody's doing his project. ***(NI1, phase 2)***

With respect to learning from people, this I call experience sharing, and I didn't got this to this point yet. I just was keen to get the amount of information which was already available that I'm at the level similar to what the other team members are already (…). So I didn't got the chance to really get some experience and to get some knowledge from the people. ***(SO4, phase 2, joining the project a couple of weeks after the others)***

5.3. Characteristics of system, design, or solution focus in the teamwork

System focus – building awareness and seeking for relevancy. The work of the SO-NI team was grounded in efforts of understanding the larger system view of what sustainability means for organizations. The systems level approach was understandable given the nature of climate change which redefines energy supply and forces the whole energy sector to a historic transition from fossil fuels to renewables. Upheaval around the transition forms a dynamic mess of problems which challenges the analytical solution approach. Hence, the team could not ring-fence itself into optimization and growth of NI or ES alone. It had to confront and somehow take stance to a huge cultural variation in what should be included under the concept of sustainability. As noted by one of the SO members, in Nordic countries even the number of women in the board of directors may be considered when evaluating sustainability. Similarly, attitude towards gas as an energy source varies from country to country. The background studies – the benchmarks and interviews covering several global companies and their sustainability strategies –, were a tool to approach the systemic nature of the topic. The team seemed to invest a lot of time in defining a dynamic mess of problems present at the field, learning through observing it, and focusing on what is relevant in it for NI an ES. Less was done to formulate the exact problem of NI or ES. When thinking of problem definition, adding awareness of the solutions other firms had created and learning from them was a way to identify problems or things that ought to be changed within NI or ES.

Design focus – partitioning the complexity and finding "perfect fit" with experts. The concept creation of the team followed a process best described with terms of design thinking. The final report advised NI and ES "to respond to uncertainty, complexity, and diversity with new business models and new ways of working". The first step towards envisioned change was to "to get commitment from ES management for a bold sustainability vision and a mandate for NI to either drive or strongly contribute to the sustainability agenda". The agenda itself – the second step – included *a multitude of creative ideas on climate positive solutions*. The activities (33 altogether) the team already designed for this step

were prioritized under the headlines “Primary”, “Secondary”, and “Worth considering”. The report suggested to continue further with flagship projects, agile piloting, and rapid experiments. The third and fourth steps of the solution included the ideas of *orchestrating and scaling up an ecosystem*. These steps included same kind of activities NI already ran on the field of innovation but now extended to the field of sustainability. (Fig. 9.)

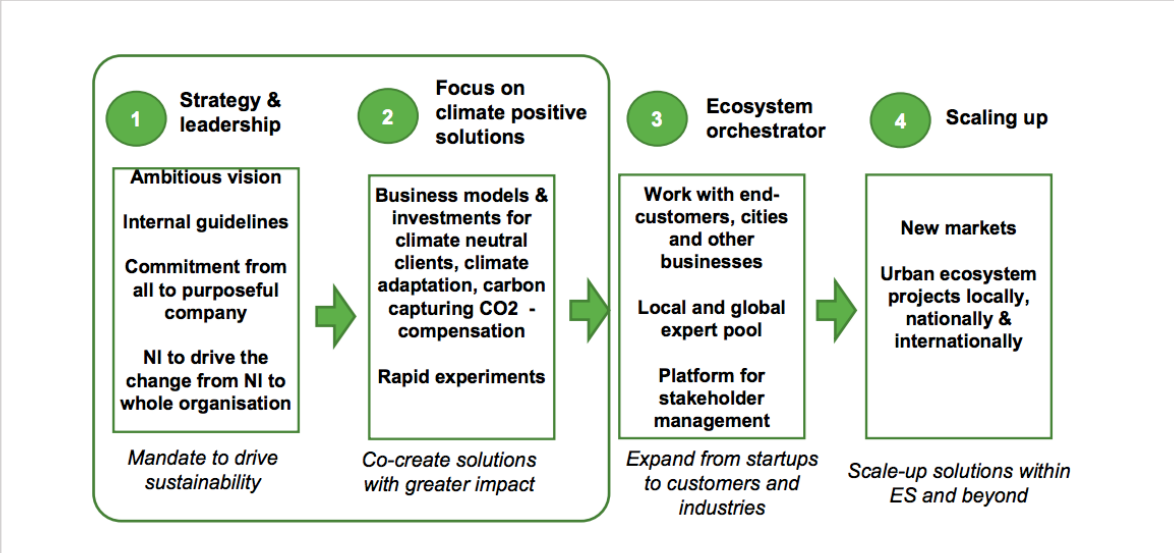


Figure 10. Sustainability concept for NI created by the SO-NI team.

The central idea in the concept was to intentionally ***conceptualize and plan the artificial*** through listing many models, patterns, products, operations, services, technologies, or systems that would be helpful in running the change. The intractable mass of complexity was thus broken into manageable parts which could be later combined to solutions highly relevant for NI and ES. In addition, towards the end of the project, the NI members of the team also recognized the possibilities in their current role within ES. Step by step they could even lead the change through ***redesigning their current work***, hence attaining “quick wins”:

“(…) in the beginning (…) I had the feeling that we have more influence on the group [regarding sustainability actions]. (…) now I see it a little bit more realistic. (…) We cannot have the lead of the whole issue, of the whole topic [within ES]. (…) What we can do is make our own goals for ourselves as a department, and try to give input, and make projects in this field. (…) It’s not possible to think in such a big scale, so let’s concentrate on that stuff you

can really influence. (…) I can influence my department, my colleagues, and the projects I'm doing. That's what I can personally influence, and I should concentrate on that." ***(NI1 in the interview, phase 3)***

"I just like the idea of challenging corporate, the mother company, and I just think that we can challenge them through the project we're actually bringing in. You know, we're suggesting startups and projects through an e-innovation day (…). I think it really could change a lot if we only bring in startups and ideas that fit the sustainability criteria, so that could also challenge them without going for the big thing." ***(NI2 in the feedback session, phase 3)***

This transformation of *expectations regarding the project outcomes* empowered NI to act even before the official mandate. This increased the relevancy of the project for NI, whereas the haziness around the scope of it decreased, which again alleviated the sense of complexity. Another part of the whole were the ***strong expectations*** of the NI members ***regarding the expertise*** available on SO-p and the transferability of the knowledge to other contexts. The perfect aligning of the measures to be taken in ES was believed to reside within the heads of the external experts. Towards the end of the project, however, the NI members in particular woke up to the process nature of knowing:

What I learned through this project is that the more I'm able to participate, the more I'm able to discuss things with others, the more I'm able to voice my questions, the more I get out of it. It's not like any other project where you give a task and say this is your timeline and we see each other again in two months and you just present me your results. […] I need to be prepared to spend more time on the SO-p being involved. […] After this project I know that this topic of sustainability and what we want to do and what we're thinking of doing is way bigger than of what I thought of in the beginning. ***(NI2 in the last interview)***

Solution focus – sociomateriality of knowledge creation. Finally, the results orientation of the SO-NI team was firmly present in schedules, agendas, documents, and other physical objects it elaborated and commented in the project. This way, the data strongly demonstrated the sociomaterial nature of the teamwork, but also the strong affiliation between the physical objects and "getting things done" – achieving concrete solutions in restricted time. The urge to create the desired solutions in due time was fueled by templates and

frameworks. The following and filling in such physical objects partly kept the team going and communicating, and partly pushed it towards finding workable solutions efficiently.

5.4. Narrative summary: Problem definition process of the team

The SO-NI team did not seem to pay a lot of attention to which *problems* in particular it would be solving. Rather, the team seemed to answer the complexity it faced with action. Even if no distinct problem definition phase could be identified, there were incidents in the data where single team members were asked, or voiced out spontaneously, their conviction of what is the problem (or the "challenge") of the company:

"Like NI2 said, [the challenge is] to tell a story why we are a sustainable company. You know, not only to have the green flag on your house and your office, let's say it like that, but really to get a step further. That's the big challenge for us." ***(NI3, phase 1)***

"There's no department, no organization responsible for sustainability issues. We think it's important that we have it in the future and that's the reason why we are working on this project now; how we can position ourselves in this role in the group." ***(NI2, phase 1)***

"The current mission is a green marketing campaign, unfortunately." ***(SO2, phase 1)***

"To convince the whole company, the whole group about the importance of this issue. And to convince them, actually, that we are the experts in this field and that we want to have the lead in the future for this issue." ***(NI1 in phase 2)***

"No clear commitment. Advisory board represents people who are not the best sustainability drivers. (…) Conservative ideas, too little focus, not enough power." / "Problem here is: Company is not having a clear vision with purpose." ***(SO1 in phase 2)***

"(…) they [in the NI] were quite unsure if ES will really share the same vision they want to have right now for 2020 and beyond. So that was for me their challenge. How to explain and how to attract ES on their side." ***(SO4 in phase 3)***

By revealing assumptions about the problem, the team members came closer to understanding each other's perspectives. This way, the problem definition of the team proved a collective activity. It translated the initial web of problem symptoms into a set of problem definitions which partly formed the basis of generating solutions. The discussions did not lead into definite problem formulations, but different kinds of formulations were said aloud

randomly and functioned as inputs for further discussions. The problems were not openly articulated in the project documentation either, which merely consisted of current state analysis or ideas and recommendations for the future.

The research data told a story of a small subsidiary willing to drive the sustainability change within a big firm without knowing how. The solving of the problem required facing both internal and external complexity. In these conditions of poor visibility, diverse perspectives to problem solving were needed. Figure 11 summarizes the problem definition process of the team. ***Practices covering the efforts of making sense of the external complexity*** are presented in the upper right cell. The target in them was to create awareness on what is going on in the field of sustainability, and to reflect it to the context of NI. This served strategic goal setting: building common understanding of the position in which NI visions itself in the future, but also building a shared understanding of the scope of the project. Going through benchmarks and interviews served teaming and augmentation of shared knowledge on the complex topic. The middle cell on the right offers examples of ***practices targeted to narrowing external complexity and designing new, local solutions*** based on it. First, the problem space was systematically *extended*. Now the appetite for external stimulus and new ideas was replaced with efforts of *reducing* it through partitioning the mass of complexity and prioritizing and fitting the suitable parts of the solution into NI context. To gain the support of the whole group, NI needed quick wins to demonstrate where it is heading. It could immediately pick up solutions fast to implement by redesigning its current working methods. Specialized expert knowledge was used to sieve out the actions with greatest impact.

In the last cell are examples of ***sociomaterial practices***. They made visible the solution focus of the project which appeared in the active availing of documents and solution models to sustain the interaction around the problem and the solution in progress. This served the efficient project execution. Templates or models functioned as scaffolds for building the solution and gave shape to shared synthesis. The final report formed the basis for taming *internal complexity* by providing guidelines to selecting activities among many alternatives.

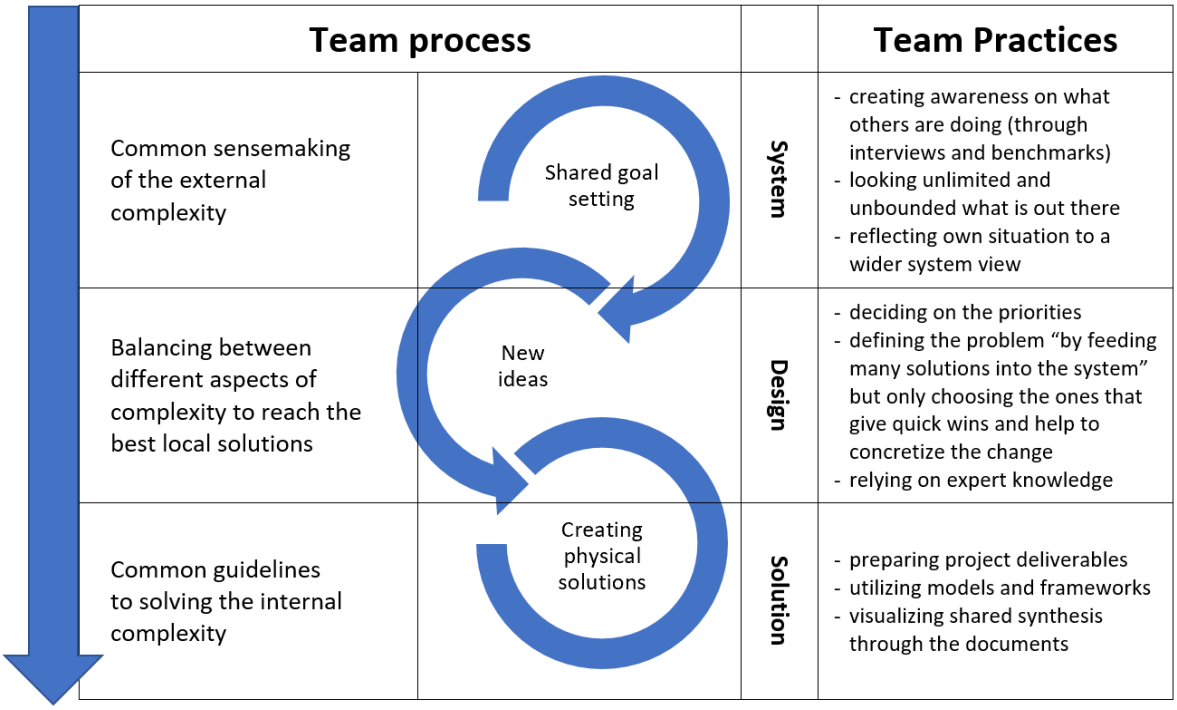


Figure 11. Problem definition process of the SO-NI team.

The process model here is theoretically rather than chronologically arranged. There was movement back and forth between the project phases. The solutions of the team, for example, were crystallized in the material objects which were elaborated throughout the project and served as snapshots of the solutions in progress. There was also back and forth movement between expanding and narrowing the problem space throughout the project.

One way to define the problem the team solved is to look at the solutions it produced. The SO-NI team jumped fast to generating solutions – as soon as after the kickoff. In the conditions of poor visibility it centered the efforts to expanding understanding of the topic, and then to partitioning the mass of complexity and generating many potential solutions and prioritizing them. The actualized solution made on the basis of the whole will only emerge later, during the implementation. This kind of solution seemed to resolve the need for long-term adaptation to fundamental change of the industry. The key elements in it were the alignment of an ambitious vision and the new internal guidelines for reaching it, and fast experimenting with solutions identified to have the greatest impact.

6. DISCUSSION

Over the past few decades, we have witnessed a change in how organizational knowledge creation, learning, and innovation are framed in the academic community. If they once were understood as prevalently internal, firm-specific, and controlled processes, transition is on its way towards understanding them as more fluid, dynamic, and open processes, where technology plays a significant role. For many theorists, boundaries no longer represent an essential element of organizations (Schreyögg et Sydow 2010). Traces of this transformation are seen e.g. in Tucci et al. (2016) who write on Open Innovation (OI), as well as in Yoo et al. (2012) who point out the role of digital technology in changing product and service innovation. These processes have their roots in digitalization and globalization (Wageman et al. 2012, 301), fast changes in customer preferences and technology, and pace-rewarding competition (Enberg et al. 2006), but, more generally, they seem to relate to the shift from production to knowledge-intensive work. In the era of high specialization and complicated innovations, organizations are to quickly access and harness knowledge wherever it might be located. Temporary expert teams are believed to rapidly create valuable knowledge and innovative responses to the unexpected.

From the point of view of knowledge management, the discussion on temporary, interorganizational teams twirls around generating capabilities or understanding mechanisms of *combining diverse, decentralized knowledge as response to complexity and uncertainty*. This process is sustained by encouraging specific organizational designs. One strategy is to decompose organizational units into smaller ones like sub-units, thus increasing specialization and economizing the transmission of information and knowledge (Becker 2001, 1043). This is increasingly taken further by enhancing interactions with various *external parties* and using project-based forms of organizing (Lundin et Söderholm 1995, Söderlund 2008, Ahern et al. 2014b, Sydow et Brown 2018). Despite knowing all this, we still know only little about how the teams that temporarily combine experts of many domains or industries establish their knowledge creation process, and what is the role of problem definition in it. Knowing more about this could help launching complex projects in the future. The last chapter sums

up the key findings of the thesis in order to open a clearer view to knowledge work in temporary teams transforming complex, ill-structured situations into solvable problems.

6.1. Answers to research questions

The thesis examined how temporary expert teams define complex problems, and what does their problem definition process look like. Ultimately, this process is believed to tell us something about the ability of the team to transform complex situations into solvable problems despite the lack of many critical resources like time. This section reiterates the research questions and summarizes the major findings of the thesis under each of them.

Q1. In the organizational research, what are the main logics in discussing problem definition?

The question was assessed from several complementary perspectives derived from complex problem-solving literature. The ***solution approach*** highlights the role of managerial efficiency, optimization, and growth in decision-making and production – and problem solving. ***Systems view*** stresses the broad contexts with highly interrelated and interacting qualities which produce together messes of complex problems (cf. Ackoff 1994; Senge 1990). ***Design thinker*** looks at problems inductively in their natural environment, trying to intentionally connect and integrate useful knowledge from the different knowledge domains – arts and science, theory and practice alike – to suit the problems and purposes of today (cf. Buchanan 1992). Finally, ***practice approach*** is here understood to be a cross-cutting approach with respect to three other perspectives, since it is possible to adopt practice position under any of the approaches just mentioned.

The division of approaches suggested is not the only one, nor the best possible. The importance and relevance of the analysis is in seeing the richness and diversity of premises when discussing the role of problem definition for knowledge creation. While one highlights the efficacy in the pursuit of a certain outcome which is often known in advance (solution approach), the other stresses the meaning of the mere journey towards the many

possible outcomes (systems approach). The latter probably sees the ventilation around the spectrum of worldviews and learning from them more important than the accomplishing of a certain, exact end state. Where some call for optimization in order to make the "right" decisions (solution approach), the others keep the door open for many solutions (systems and design approach). Some may call the best experts on the field to ideate the whole new product X to replace the old Y, of which production is way too slow to be competitive (design approach). Others want to know what is the problem with the production line of Y – should it not be fixed first in order to add productivity (solution approach)? In other words, the problem definition process is likely to vary in accordance with the type of the task the team is confronting, but also in accordance with what is expected from the outcome and the process: extreme novelty or improving the old, exploiting of centralized knowledge within the firm, or exploring the distributed knowledge "out there".

Q2. In the framework of practice-based team research, what kind of practices are associated to the work in temporary expert teams?

The knowledge diversity in temporary expert teams seems to be molded into performance benefits through *shared action and participation*. These two enable the transforming of specialized knowledge possessed by individuals into an integrative cogenerated solution (cf. Majchrzak et al. 2012, Carlile 2004). The practice-based research on projects and teams suggests that goals, tasks, and eventual problem formulations of the team are product of a dialectical process grounded in the social interaction of the team (cf. Lundin et Söderholm 1995; Engwall 2002; Majchrzak et al. 2012; Berggren et al. 2008). The goals and the problems can be redefined, reinterpreted, or demarcated throughout the process if needed. Elaborating further the findings of Majchrzak et al. (2012), the team practices around complex problems can be divided to those that target at **1) controlling the complexity** or relate to **2) teaming and handling team relationships** or to **3) materiality of teamwork**.

The first category includes practices that refer to restructuring the problem space by drawing on cross-domain knowledge of the team: decomposing the problem into more manageable subproblems that are easier to address (Simon 1973; Foss et al. 2016), partitioning or

narrowing the team task, synthetizing, integrating, and making the situation to appear real, tangible, and less ambiguous through rhetoric (Lundin et Söderholm 1995), or lagomizing the expectations towards the project (Berggren et al. 2008). *The second one* refers to building good team experience and psychological safety: avoiding conflict, encouraging creative engagement, fostering personal responsibility for translating one's own knowledge into collective knowledge, asking questions, seeking feedback, experimenting, reflecting on results, discussing errors (Majchrzak et al. 2012; Edmondson 1999; Carmeli et Gittell, 2009). Through these, individuals come to declare their values, interests, ideas, and knowing (cf. Engwall 2002; Schippers, Edmondson, West 2014). *Lastly,* working with sociomateriality implies the using of artifacts as vehicles of human activities and mediated interactions which contribute to creation, accumulation, transfer, sharing, or reproduction of knowledge (Mariano and Awazu 2017). Materiality of knowing is reflected in using stories and metaphors or objects such as presentations, diagrams, drawings, prototypes, or models to support or scaffold the teamwork, or to move knowledge across boundaries (Edmondson et al. 2018, 353; Okhuysen et Bechky 2009; Carlile 2004; Orlikowski 2006). Addressing the linkage of artifacts and problem definition reminds of the paper of Ahern et al. (2014b) who argue that the dichotomy between experimental, dynamic, "knowing" knowledge (know-how etc.), and explicit, static, "known" knowledge (designs, design practices, plans, etc.), are in dialectical interplay during the problem solving.

Q3. What is the role of problem definition in the temporary expert teams' process of taking stock of complex, ill-structured situations?

Since problem definition is a little researched topic in the team literature, assessing P3 stipulates turning to the results of the case inquiry. The main contribution of the case team ("SO-NI team") was to concept a new sustainability hub within an energy company. The team recognized the opportunity of *amalgamating sustainability and former innovation functions* in one unit in order to better confront the future challenges. The insight to redesigning the former ways to respond to the customer needs was gained gradually towards the project end. During this process, the revealing of each one's assumptions about the problem fed many discussions around the topic. This way, ***the problem definition*** of the

team proved a collective activity. It ***functioned as one of the drivers in an on-going micro-level practice of reflection between multiple thoughts, perspectives, or solutions on the one hand, and selection between them to find relevance and purpose in the context of the team on the other hand***. No distinct problem definition phase could be identified, however. No problem formulations were expressed in the project documents either. Rather, the team jumped fast to the ideation of solutions. It seemed to answer the complexity it faced with action. Despite this, the project offered solutions to the complex situation the case organization was facing.

The analysis of the research data supports many of the ideas discussed in the literature on teams and complex problems. The team members integrated their knowledge with others' knowledge by revealing implicit assumptions about the problem and by working to understand each other's perspective through probing in a way similar to that described by Hargadon and Bechky (2006). This seemingly worked for uncovering each team member's priorities and helped to shape shared solution paths as suggested by Edmondson et Harvey (2018) and fed back-and-forth forms of dialog enabling the engagement needed to facilitate the combination, expansion, and reframing of knowledge (cf. Boland et Tenkasi 1995, Tsoukas 2009).

The observations on the case team contest, however, the problem-centric view typical of systems thinking – the ethos of proper problem identification as a precondition of action. The analysis supports the idea that temporary expert teams do not invest a lot of time to literally defining their problems. Rather, ***the problems come forth in team discussions during the project execution***. Rittel's (1972) notion of problem solvers understanding the problem only after first solving it hits the spot when analyzing this case project.

The results suggest, instead, a relatively strong applicability of design thinking methodology in the context of temporary expert teams. In design thinking, problems become defined during the team process, in team interaction, and in relation to the ideas for their solutions (cf. Cross 2006). The study demonstrates ***a correlation between the "designerly" ways of***

responding to the uncertainty and complexity (cf. ibid.), ***and the focus on action and tasks typical of temporary teams*** (Bakker, 2010; Lundin et Söderholm 1995). The case team responded to uncertainty and complexity by designing new business models and new ways of working and encouraged to continue with agile piloting and rapid experiments in the future. Running such a development agenda certainly leads to better understanding of the problems of the energy company over the time, and to learning through experiment.

Q4. How do temporary expert teams define the problem(s) they will solve – which practices constitute the problem definition process?

The problem definition in the SO-NI case matured gradually as an interplay between diverse dimensions of problem-solving: focus on system, design, and solutions. These dimensions seemed to be linked to each other and develop in continuous interaction. At the level of team practice, they served varying purposes, like scanning the external complexity, narrowing it, and designing local solutions on the basis of it, or giving physical form to final solutions.

The first focus of the team was in ***making sense of the systemicity behind its topic***. By going through benchmarks and interviews and other background information produced for the use of the project, the team worked for building awareness on what is going on at the field of sustainability. What was learned was immediately compared to the team's own context. This extended the knowledge around the topic and served the strategic goal setting. At the same time, the team strived for ***narrowing this external complexity and designing new, locally fitting solutions***. Specialized expert knowledge was seen to help the selection among many alternatives. The clear division of project phases with respective project documents underscored *the* ***sociomaterial nature of the teamwork***. The ***physical objects*** urged the creation of desired solutions in time and ***made tangible the strong solution focus of the team***.

The teaming and team relationships developed during the interaction and shared reflection around benchmarks, interviews, and physical documents in progress. This served knowledge integration and team-based learning by keeping the team members talking and contributing.

The data also revealed some countercurrents in the team process. They ran between ***external complexity*** (the complexity of the sustainability theme with its correlations to climate change, globalization, etc.) ***and internal complexity*** (the complexity of power relations and hierarchies within organizations involved and the diversity in what is understood with the word "sustainability"). Aspiration for ***team creativity*** (sensing the need for change and new ideas) ***versus team effectiveness*** (needing to get the ideation done in 2,5 months) were both present in the process. Furthermore, the team strived for ***workable "local" solutions*** while simultaneously going deep in learning how the ***system functions*** through background studies. This entailed continuous balancing between the ***multiplicity of possibilities*** and finding ***relevancy and purpose*** for NI, its customers, and the community. The team balanced between these kinds of extremes and utilized as a tool an approach to creative ideas that mostly resembled design thinking.

The result of the process was not an unequivocal problem definition, but several creative ideas or solutions. Their gradual prioritizing and reduction will, over time, reveal the actual problems they solve.

The SO-NI team kept organizing and integrating knowledge throughout the project – a recurring idea in reflections of both Ahern et al. (2014b) and Engwall (2002). At the end of the project end, new knowledge existed (Engwall 2002). The results indicate that the sharp confrontation between "traditional" project research with its positivist lens and, on the other hand, seeing complex projects as problem solving and knowledge formation based on organizing and learning (cf. Ahern et al. 2014b) can be replaced with one holistic view. The team practices build on many problem-solving approaches reaching from managerial decision-making to e.g. systems thinking. Seeing knowledge as an object in the form of explicit "known" knowledge like designs does not exclude the higher forms of knowledge creation in the same project. Project documentation and process plans functioned as social augmentations which both gave structure to teamwork and helped to carry out the task and solve the problem (cf. Orlikowski 2006, Wood et al. 1976). They served as containers of the knowledge in progress, as the team step by step built its solution.

6.2. Conclusions

Chapter one presented an illustration of the sphere of influence of problem definition practices in temporary expert teams (fig. 2). According to the preliminary literature review, problem definition seemed to be linked to shared understanding of the task, to ideal team composition, and to quality of solutions. When the picture is complemented with the main categories of team practices observed in the case project, three dimensions of teamwork emerge (fig. 16).

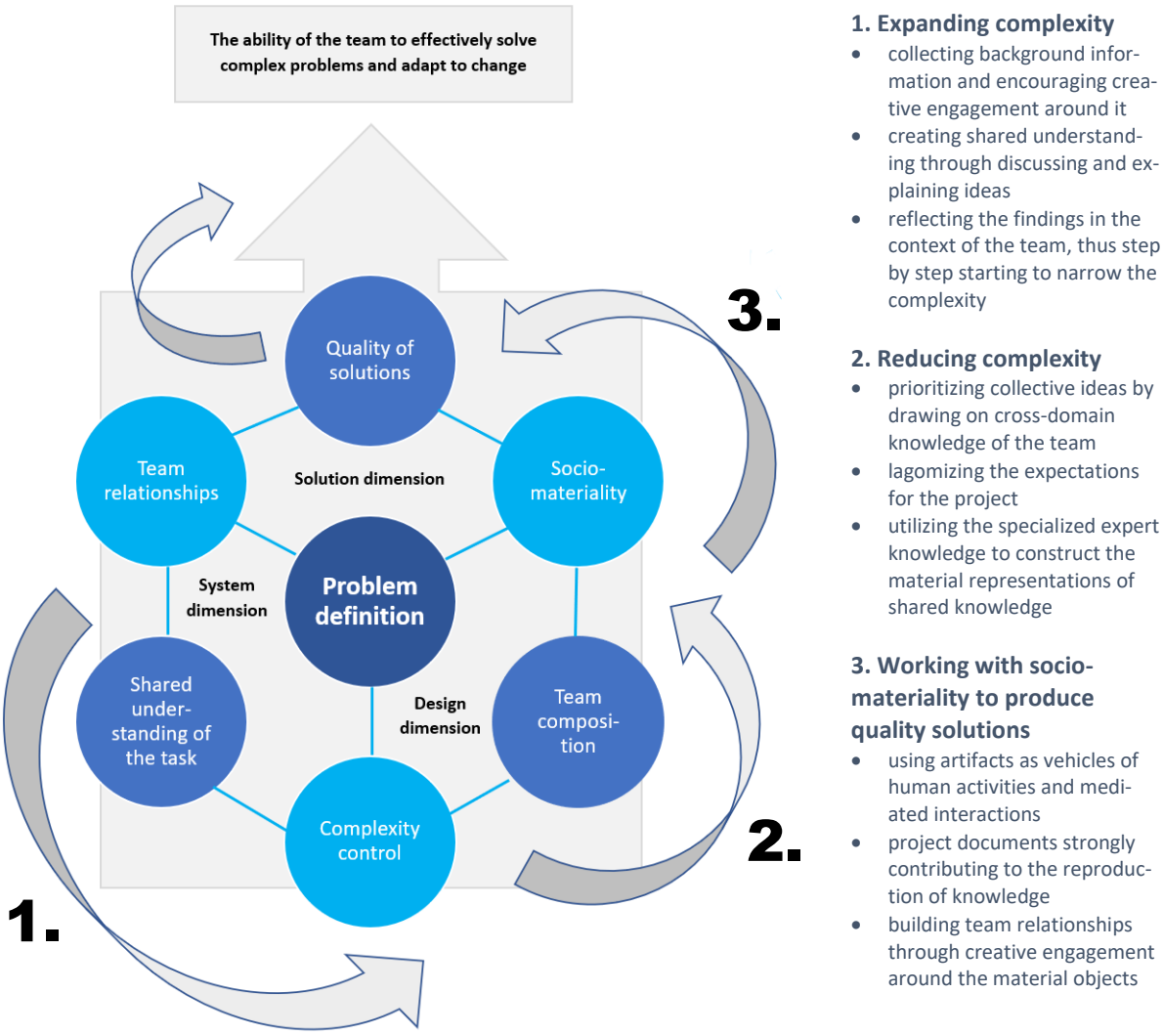


Figure 12. The integrative framework of complex problem definition in temporary expert teams.

System dimension (1.) covers the efforts of the team to tame the external complexity surrounding it. The efforts focus on building common understanding of the reality and finding purpose in it for the team and the organizations it represents. The real-life examples of other companies and organizations motivate discussions on team goals, processes, or outcomes of the project and focus collective attention of the team towards enacting ideas. Through this, the problem space is systematically extended. Going through benchmarks and other background research also serves teaming and augmentation of the shared knowledge on the complex topic. Reflecting the findings to the context of the team directs attention towards gradually narrowing the scope to add relevancy for the team.

Design dimension (2.) refers to balancing between expanding and narrowing the amount of information and possible solutions. This entails intentionally conceptualizing and planning the artificial by listing and then prioritizing potential models, patterns, products, operations, services, technologies, or systems which could be helpful in running the change. Using specialized, domain-specific expert knowledge is required to structure the end solution on the basis of many competing ideas.

Solution dimension (3.) refers to focus of the team on producing material objects such as presentations and deliverables which first function as scaffolds for building the final solution and, in the end, as a means of visualizing the solution. They form the backbone of the efficient team performance and flesh out the quality of the solution, making it possible for anyone to judge the results and utilize them. Creative engagement around material objects supports teaming. For example, a template for evaluating and prioritizing ideas awakens members to voice their personal views of the topic.

Assessing the problem definition of temporary expert teams seems to require abandoning the idea of a coherent sub-process dissociable from the rest of the team process. Instead, defining the problem is an organic part of the teamwork. It is not primarily about giving a specific utterance for the pursuit of the team, but rather an on-going micro-level practice which is all about *selecting between inclusion or exclusion of specific parts of the complexity*

into the final solution. Seeing problem formulation as a continuous activity and integral part of teamwork rather than an independent "utterance" or "formulation" the team makes during its existence brings some of the prior literature into new light.

The value of the solutions of the team may not depend on the quantity of problem formulations (cf. Lundmark et al. 2016), comprehensiveness of problem formulation process (cf. Baer et al. 2013) or making "wrong" or hasty assumptions about the problem in the beginning (cf. Lyles 2014). Rather, the success factors in defining the problem reside in flexible changing between system, design, and solution lenses during the team process: not sticking to only one of them, but holistically applying many. This triangulation gradually peels off the mess the team confronted in the first place, revealing the contextually relevant "kernel" of the whole. At best, the process is self-correcting. Wrong assumptions about the problems are shot down during the team process, and the problem comprehensiveness increases progressively, hand in hand with the deepening knowledge about what is relevant in this particular context.

6.3. Limitations

The primary limitation to the generalization or transferability of the results is the sample size; only one project was studied. This was, however, a deliberate choice in line with the research approach explained in section 4.1.

The study investigated thinking processes which progress individually depending on the work or other experience of the person in question. The experiences of the participants will vary a lot from project to project. In the small sample of this particular study case, the informants were experienced innovation and sustainability experts. Even the organization which in this case was in role of the customer (NI) was an established innovation developer with a vast project portfolio in R&D, product development, and idea management. It had years of experience in networking with universities, industries, and startups both nationally and worldwide. The part of the team in consultative role (SO) had been building its

community of global sustainability experts for years and had led numerous high-level sustainability projects with numerous teams.

Furthermore, the results must be interpreted with caution vis-à-vis the actual level of complexity the team really faced. Global warming or social injustice are objectively wicked problems, but the final judgement of the actual complexity in individual real-life situations of the organizations is always subjective. The discussions in the SO-NI team can be seen as a dry run of potentially very complex organizational renewal project taking place later. However, no real coordination of diverse opinions or objectives within the ES group were needed yet, nor did the team go through the eventual negotiations on the future role of NI as a part of its mother company. All this was likely to reduce the complexity of the project. The case project proved to be less complex than anticipated also because the team consisted of very like-minded experts. Hence, the applicability of the results to dissolving highly interrelated wicked problems in society remains a distant goal.

One more limitation concerns the balance between the focus on informants' interpretations of the lived life as opposed to factual observations. In Gioia method, the first ones should be in the spotlight. In this study, the emphasis was at least partly the opposite. As stated earlier when analyzing the reliability and validity of the study, ethnographic researcher has an active role in building her study and in interpretating the studied phenomenon. Some other researcher might have stressed more in-depth-interviews, which typically form the pillars of grounded theory studies. In this study, the interviews were rather short and not very many in number. Due to these limitations, the study may not represent the voices of the informants to the extent that probably would be good for a qualified GT or Gioia method inquiry.

Finally, this research setting did not consider the value of the solutions of the case team. This would have required a project evaluation and preferably comparative examination of several projects. Because of this, far-reaching generalizations concerning the goodness or business benefits of the team arrangements chosen in the case project should be avoided.

In the meetings as well as in the final interviews, however, NI members of the team expressed very clearly their satisfaction with the project outcomes. From this point of view, the project can be evaluated successful.

6.4. Implications for practice and future research

This thesis implies that in complex projects, reasonable success can be reached even if the team does not go through an externally observable problem definition phase. This is not to say that the team would not define problems. Rather, the definition is an intrinsic part of the project activities. This process builds on a holistic approach which considers the external complexity surrounding the project and constantly compares it to the team context. The final problem definition forms as a result of a process that might be best described as following the ideas in design thinking: through active exclusion and inclusion of solution components and utilizing artifacts as vehicles in creating, accumulating, transferring, sharing, or reproducing knowledge.

In view of results of this study, future studies could further explore how the ideas in design thinking in particular resonate with different kinds of project settings. Applying design thinking methods to research of temporary expert teams will probably offer good practical applicability since the whole field of study is largely dedicated to the rapid development of products, prototypes, services, processes, or organizations.

Further research may also benefit from tighter joint review of sociomateriality and design in individual projects. Both research lines enable addressing complex problems without strong affiliation to plain problem formulation activity. This might suit better for temporary organizations where action orientation is a strong contraindication with lengthy lingering amidst diverse problem speculations. There is also a risk of wasting resources if the problems become nailed down too early, and the chosen paths prove to be mistaken.

Finally, the results showed the strong aspiration of the case team to search for wider, cross-sectional, and comparative foundation for the choices it made. This was seen in

considerable amount of background studies. These aspirations were here interpreted as signs of systems thinking. The definition of “purpose” was seen to be in connection to this theme in particular. This was not only due to the large scope of the background investigations and the claims on finding the “good fit” or “relevancy” from the point of view of stakeholders represented in the team. Rather, there might be room for a new, purpose-oriented view on complex problem definition in teams. Very few if any future team can generate even a single product or a service in a vacuum, without considering the sense of purpose in the lives of customers and other groups in the community. A research line worth further inspections could be addressing teamwork as purpose-driven activity. In this discussion, the question of problem definition becomes even more complicated. A purpose-driven team has to gain knowledge about the preferences and sources of meaningfulness of a variety of groups in order to create value for stakeholders and the community in general.

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