Exploratory projects are means of organizing the fuzzy process of exploring emerging innovation fields in organizations, and their primary objective is knowledge creation. These projects are characterized by goals that are only broadly, if at all, defined at the beginning, and the necessary information and learning need to be created through iterative experimentation. Through a longitudinal approach based on 81 interviews and 7.5 hours of video data, this dissertation provides new information about the dynamic nature of managing exploratory projects. The findings suggest that in exploratory projects, the role of the project manager shifts from managing the efficient execution of the project towards facilitating the iterative development process by ensuring that the project team does not converge too early and is able to learn from experiments. Furthermore, to benefit from diverse point of views, practices supporting an open and trusting atmosphere and communication amongst the project team need to be purposefully established in the early phases of the project.
Managing for knowledge creation in exploratory projects

Satu Rekonen

A doctoral dissertation completed for the degree of Doctor of Science (Technology) to be defended, with the permission of the Aalto University School of Science, at a public examination held at the lecture hall AS1 of the school on 30 August 2019 at 12.

Aalto University
School of Science
Department of Industrial Engineering and Management
Abstract

During the last decade, there has been an increasing amount of research focusing on the management of exploratory projects in project management research. A characteristic of exploratory projects is that their goals are only broadly, if at all, defined at the beginning. This starting point is contrary to the traditional approach in project management in which a goal and plan for reaching the goal is clearly defined at the outset. Prior research has identified management principles and different strategies for handling exploratory projects, however, research on project managers’ approaches and the challenges that they encounter in this context is still limited.

Furthermore, the experiences of team members working on exploratory projects that require adopting an iterative (i.e. looping back in the process) development approach, in which developing knowledge through experimentation is a central activity, have also been hardly explored.

With the overall objective of improving the understanding of the management of exploratory projects, this dissertation addresses the following research questions: 1) How do project managers approach exploratory projects and what types of challenges do they encounter? 2) How should experimentation be supported by the project manager in exploratory projects? The current dissertation is a compilation of five individual articles, each providing a complementary perspective on the two broader research questions. A qualitative research approach utilizing case study and action research approaches is adopted. The empirical data that appears in this dissertation was collected through semi-structured interviews and video recordings. In total, 81 interviews were conducted with project managers and practitioners novice to exploratory projects and experimentation, and 7.5 hours of video data was gathered on experimentation efforts. A critical realist perspective to the phenomenon was adopted by following an abductive process of data analysis.

Through the longitudinal approach, the findings of the current dissertation provide new information about the dynamic nature of managing exploratory projects. Furthermore, by adopting a micro-level perspective in investigating how novice practitioners of the approach undertake experimentation, the findings of the current research offer valuable new insights into the management of experimentation, a key characteristic of exploratory projects. Finally, the findings suggest the central importance of process know-how in exploratory projects. The role of the project manager moves from managing the efficient execution of the project toward facilitating the iterative development process by ensuring that the project team does not converge (i.e. narrow the problem space by choosing the solution to develop further) too early and is able to extract learning from the experiments.
Viime vuosikymmenen aikana projekti johtamisen tutkimusalalla on lisääntynyt eksploratiivisten projektien (engl. exploratory project) johtamiseen keskityyvä tutkimus. Tunnusomaista eksploratiivisille projekteille on, että niiden tavoitteet asetetaan projektiin alkuvaiheessa vain löyvästi, jos lainkaan. Tämä lähtökohta on melko vastakkainen perinteiseen projekti johtamisen lähestymistavalle, missä projektiin tavoite ja suunnitelmasta tavoitteen saavuttamiselle määritellään selkeästi jo projektiin alusta alkaen. Aikaisempi tutkimus on tunnistanut projekti johtamisen periaatteita sekä erilaisia strategioita eksploratiivisten projektien johtamiselle. Eksploratiivisten projektien projektipäällikön lähestymistapoihin ja projektiissa kohdatuhiin haasteisiin liittyvä tutkimus on kuitenkin vielä melko vähäistä. Vielä vähemmän on tutkittu projektitiimien ja tiimin jäsenten kokemuksia projektiessa, joissa keskeistä on iteratiivinen (engl. iterative), eli toistuvan, menettelytavan omaksun (ja (tiedon) kehittäminen kokeilemalla.


Avainsanat eksploratiivinen projekt, projektipäällikkö, kokeilu, muotoilujatettu

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This is the end of an era and oh, girl, how good it feels!

Satu Rekonen
Helsinki, June 2019
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<tbody>
<tr>
<td>FEI</td>
<td>Front-end of Innovation</td>
</tr>
<tr>
<td>NDP</td>
<td>New Product Development</td>
</tr>
<tr>
<td>EDP</td>
<td>Early Development Phase</td>
</tr>
<tr>
<td>LDP</td>
<td>Late Development Phase</td>
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<td>R&amp;D</td>
<td>Research &amp; Development</td>
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Earlier findings have been published in a conference paper Rekonen, S. and Björklund T. (2014) Managerial activities and challenges in the front-end phase of innovation process. Proceedings of the PMI Research and Education Conference 2014, Portland, US.


Author’s Contribution

Article I: Adapting to the changing needs of managing innovative projects

Article I was co-authored with Dr. Tua A. Björklund, and the author of this dissertation is a first author of this article. This article is based on author’s research idea, and she was responsible for the research design and theoretical background of the article. The author conducted all of the interviews and played a primary role in analyzing the data. The author also played a primary role in writing the manuscript and acted as the corresponding author throughout the publication process.

Article II: Perceived managerial functions in the front-end of innovation

Article II was co-authored with Dr. Tua A. Björklund, and the author of this dissertation is a first author of this article. This article is based on author’s research idea, and she was responsible for the research design and theoretical background of the article. The author conducted all of the interviews and played a primary role in analyzing the data. The author also played a primary role in writing the manuscript and acted as the corresponding author throughout the publication process.

Article III: The struggle of sensemaking in exploratory projects

This article was co-authored with Miko Laakso, and the author of this dissertation is a first author of the article. The author played a primary role in collecting and analyzing the data and in the research design of the article. In the theoretical framing and writing of the manuscript, the authors contributed equally. The author is the corresponding author for the review process.

Article IV: Impediments for experimentation in novice design teams

This article was co-authored with Lotta Hassi, and the author of this dissertation is a first author of the article. The author played a primary role in the research design and collecting the data through interviews and action research. Data was collected while the author was working in the MIND research group, and fellow team members aided in collecting the data. The author acted as the project manager for the two-year research project, during which the data was collected. The author also played a primary role in analyzing the data, defining the theoretical background, and writing the manuscript. The author acted as the corresponding author throughout the publication process. Dr. Tua A. Björklund and Miko Laakso provided constructive comments on the empirical and theoretical parts of the article.
Article V: How individual characteristics promote experimentation in innovation

This article was co-authored with Lotta Hassi (first author), and the author of this dissertation participated in all stages of the research process: research design, data collection, data analysis, building the theoretical background, and writing the manuscript. The author played a primary role in collecting the data through interviews and action research. Data was collected while the author was working in the MIND research group, and fellow team members aided in collecting the data. The author acted as the project manager for the two-year research project, during which the data was collected. The author was involved in the early phases of the data analysis process and in the theoretical framing of the article (minor roles). In writing the manuscript, the author had a minor role.

Transcription services were procured from Tutkimustie Oy for all of the articles. The author reviewed the interview transcripts to ensure the quality of the transcripts and that the content of the interviews had not changed during the transcribing process.

The language of this dissertation has been checked by Scribbr Proofreading and Editing. The author subsequently reviewed the changes made by the professional editor, either accepting or rejecting them one by one.
1. Introduction

The competitive environment in which today’s organizations operate underlines the growing strategic roles of innovation and exploration. Projects play a fundamental role as vehicles for innovation in organizations (Davies, 2014), as innovation activities are nearly always organized as projects (Midler, Killen, Catherine, & Kock, 2016). Projects are used, for example, to create novel products, processes, and services; develop new technologies; implement strategies (Davies, 2014); or organize the fuzzy process of exploring new innovation fields (Lenfle, 2016). Even though innovation and projects are closely connected, stemming from their shared historical roots in studying large-scale defense projects in the 1940s and 1950s (Lenfle & Loch, 2010) and the common interest in studying projects in the context of innovation, they became divided into independent disciplines and largely ignored each other’s contributions for several decades (Davies, Manning, & Söderlund, 2018). While project management began to follow the optimizing model for managing highly uncertain and complex innovation projects, innovation management researchers preferred the adaptive model, based upon the two alternative models identified by Klein and Meckling (1958). The optimizing model relied on such actions as rationalistic planning, or formal processes and analytical techniques occurring at the beginning of the project to forecast future circumstances (Söderlund, 2011), whereas the adaptive model posited that the goal and the path to reaching the goal are essentially uncertain, as they rely on informal processes and learning gained from trial-and-error practice (Hirschmann, 1967).

Furthermore, the project management discipline came to emphasize the professionalization of the field, which led to the development of consistent frameworks, methods, and generic processes to be applied across industries (Davies et al., 2018), and values such as meeting tight deadlines, monitoring, coordinating a vast number of contributors, and controlling costs were deemed more important than accounting for the differences in the environments in which project management was applied (Söderlund & Lenfle, 2013). From this point of view, innovation was regarded as an execution challenge for project managers, and too much adaption and experimentation as counter-productive and risky (Davies et al., 2018). Indeed, previous research has demonstrated that to ensure project success, project changes should be minimized; hence, it is the duty of the project manager to isolate from all anticipated goal changes only those that are truly necessary to the successful implementation of the project.
(Dvir & Lechler, 2004). However, these project control processes have been noted to undermine the progress and support of learning and innovation (Keegan & Tuner, 2002; Lenfle & Loch, 2010). Processes work when the level of innovativeness is modest (O’Connor, 2012). When the goal is clear and unlikely to change and information is unambiguous, the traditional project management approach is highly relevant (Geraldi et al., 2008). However, it is clear that highly innovative initiatives do not fit the linear, phased approach that highlights control and planning (Keegan & Tuner, 2002; Lenfle & Loch, 2010). How innovation in and around the project is considered and managed has often been left undetermined in the project management discussion (Edkins, Geraldi, Morris, & Smith, 2013).

The mismatch of the dominant view of project management, which highlights control over flexibility, within the context of innovation has ignited a research stream on the management of exploratory projects (Lenfle, Midler, & Hälggren, 2018). Such projects are means of organizing the fuzzy process of exploring emerging innovation fields in organizations (Lenfle, 2008), and their primary objective is knowledge creation (Loch et al., 2006). Characteristic for exploratory projects is that both the goals and the means for reaching them are unknown at the outset (Lenfle, 2008), as the objective is to acquire understanding about an unfamiliar territory, and thus little knowledge exists at the beginning (McGrath, 2001). This starting point is quite contrary to the traditional approach in project management, which is largely based on an assumption that a stated, unchanging goal can be clearly defined at the outset of the project to optimize the resources for achieving it (BenMahmoud-Jouini, Midler, & Silberzahn, 2016). Where more traditional development projects organize around convergence toward a predefined goal, driven by milestones (Lenfle, 2008), exploratory projects begin by diverging and generating a variety of ideas to approach the challenge at hand (Gillier, Hooge, & Piat, 2015). The knowledge created during the project defines its next steps, which precludes proceeding according to a predefined plan (De Meyer, Loch, & Pich, 2002). In addition, highly innovative initiatives, such as exploratory projects where both the market and the technology must be explored, require iteration (i.e. looping back in the process) and knowledge creation through experimentation (Lenfle, 2008, 2016).

Research on exploratory projects bridges the project and innovation management literatures (Lenfle et al., 2018), between which cross-referencing has increased in recent years (Davies et al., 2018). The interest in this combination is apparent, particularly in special issues focusing on studies bridging project management and innovation (see e.g. International Journal of Project Management, vol. 26, 2008; Project Management Journal, vol. 47[2], 2016), and thereby illustrates the importance of conducting research in this area. Furthermore, adopting insights from design research to better understand the logic of exploratory projects has been called for (Lenfle et al., 2018). Recent research in project management has also proposed that problems in exploratory projects be compared to those for which design thinking is appropriate and that design approaches could assist project management in addressing challenges in
this context (BenMahmoud-Jouini et al., 2016). Design thinking in the management realm was opposed to linear and analytical problem-solving approaches dominating the majority of organizations (e.g. Martin, 2009) and has gathered wide attention and application. These linear approaches have been long acknowledged as unlikely to resolve “wicked” problems (e.g. Rittel & Webber, 1973), which are characterized by high uncertainty and ambiguity and do not have definitive formulations and solutions. Since design is a field where uncertainty and complexity are well accepted and embraced by focusing on undertaking wicked and ill-defined problems (Buchanan, 1992), design approaches are purported to facilitate innovation in fields beyond the context of professional design (Brown, 2008). Indeed, earlier research has noted that adopting some “designerly” (Johansson-Sköldberg, Woodilla & Cetinkaya, 2013) practices for addressing complex and open-ended challenges in more contemporary organizations might be useful, as design disciplines have developed elaborate professional practices for these type of challenges (Dorst, 2011). Design as an approach to tackling complex, wicked problems questions the validity of process-oriented, rational approaches to organizational improvement and emphasizes a human-centered approach that embraces leadership, informality, and ambiguity (Hobday, Boddington, & Grantham, 2011).

“Entering exploration entails a fundamental shift in project management” (Lenfle, 2008, p. 477), as project management is coming to increasingly address the creative, open-ended concerns in the early stages of projects (BenMahmoud-Jouini et al., 2016). This shift in the role of project management signifies that in many cases, project managers will be new to the process and methods useful in the context of exploratory projects. Therefore, investigating how novice project managers deal with exploratory projects and what types of challenges they encounter in managing them offers valuable insight. Furthermore, addressing wicked problems with incomplete and changing requirements necessitates transcending analytical problem-solving approaches and integrating experts from different fields (Edmondson, 2016). However, these experts are not necessarily skilled in applying design-thinking approaches and hence might stumble with the iterative approach, where learning must be created through experiments. Therefore, increasing our understanding of how teams working on exploratory projects should be supported provides valuable knowledge on how to manage such projects. To enrich our understanding of the management of exploratory projects, this dissertation explores the managerial approaches and challenges of novice project managers and how experimentation, a central element of exploratory projects, is approached by practitioners new to such an approach. In doing so, this dissertation adopts perspectives from the three identified research streams: project management, innovation management, and design research.
2. Research gaps and research questions

While in more traditional development projects, the end result is usually a product or service, exploratory projects aim at creating concepts and knowledge that can quickly be applied to the design of other applications (Lenfle, 2016). Hence, the primary objective of exploratory projects is knowledge creation (Loch et al., 2006; Lenfle, 2008). Due to the necessity of learning and knowledge creation in exploratory projects, the accumulated knowledge explored is as important dimension of project performance, as is the value of the “products” they create (Maniak, Christophe, Lenfle, & Le Pellec-Dairon, 2014). Indeed, the effectiveness of managing an exploratory project is equivalent to that of a knowledge-creation process, and this knowledge is created through iterative experimentation (Lenfle, 2008, 2016). However, it has been noted that the emphasis on control over flexibility in the project management discussion has neglected the knowledge-creation process of projects (Lenfle & Loch, 2010). Furthermore, these types of projects, which aim to tackle wicked problems, require integrating expertise from diverse functional areas (Edmondson, 2016), which may add another layer of complexity to the management of these projects.

Existing studies have identified management principles necessary for exploratory projects that differ from those applicable to more traditional development projects (see e.g. Loch et al., 2006; Lenfle, 2008; Davies, 2014). Although these studies suggest different strategies for coping with the learning required (Loch et al., 2006; Sommer, Loch, & Dong, 2009), discussions of the knowledge of project managers’ approaches and the challenges they encounter in exploratory projects are still largely absent from the current literature (Lenfle, 2016). The idea of creating early experiments, and through this small failures, is inconsistent with the mindset, infrastructure, and governance of traditional project management (Loch et al., 2006, p. 115). As Lenfle and Loch (2010) argue, experimentation and iterations occur outside the project management discipline, and these approaches are something which project management training does not provide the tools for.

In the first issue of the International Journal of Project Management, Blankevoort (1983) proposed that the tools and techniques used in project management had progressed from efficient and effective project planning to rational project management, which diminished the freedom to allow for creative behavior within projects. To date, only a small number of studies have examined the management of creative projects within the project management discipline (see e.g. Brocke & Lippe, 2012; Gillier, Hooge, & Piat, 2015; Simon,
2006). However, collective creativity and problem-solving are necessary in situations where goals are only broadly, if at all, defined (Simon, 2006), such as exploratory projects, and in this, project management moves toward an approach that is more open ended than optimizing (BenMahmoud-Jouini et al., 2016). Undeniably, managing the expansive nature of exploratory projects poses a significant challenge for project management (Gillier et al., 2015). However, existing knowledge of managerial practices and the difficulties project managers face in managing exploratory projects is still limited (Lenfle, 2016).

Against this background, I aim to explore the following research question:

*How do project managers approach exploratory projects, and what types of challenges do they encounter in managing them?*

A primary characteristic of exploratory projects is that the project team must explore and create new knowledge through experimentation (Lenfle, 2008). Prior to conducting an experiment, the team must know what it anticipates learning (Thomke, 2014). As they are working with problems that have been described as “ill-defined” (Simon, 1973) or “wicked” (Rittel & Webber, 1973), or problems that are essentially unique, have no definitive formulation to be discovered, and have few definitive measures for the “correctness” of the solution, the team must create understanding on the problem at hand through a messy process of synthesis and sensemaking (Kolko, 2010). This requires moving between divergent (i.e. widening the problem space by generating alternative solutions) and convergent (i.e. narrowing the problem space by choosing the solution to develop further) thinking (Laswson, 2006; Van de Ven, 1999) and between abstract and concrete realms (Liedtka & Ogilvie, 2011). Thus, experimenting is a process that requires different types of approaches and mindsets, and previous research has noted that moving between these might be challenging (Beckman & Barry, 2007). Furthermore, rather than aiming at the same interpretations or a unified view of a concept, participants must understand each person’s interpretations to stimulate learning about unfamiliar areas and to continue to “play with this ambiguity” inherent to these projects (Gillier et al., 2015). Although existing studies on the management of exploratory projects recognize the central role of sensemaking and learning through experimentation (Lenfle, 2008) and suggest different strategies for coping with the learning required (Loch et al., 2006; Sommer, Loch, & Dong, 2009), they provide limited understanding of the experiences of project teams aiming to develop the needed information through iterative experimentation or of how experimentation should be supported.

Against this background, I aim to explore the following, second, research question:

*How should experimentation be supported by the project manager in exploratory projects?*
My dissertation comprises a compilation of five individual articles, each providing a complementary perspective on these two broader research questions. The research questions are addressed in four internationally published, double-blind, peer-reviewed articles and one working paper (referred to as Articles I–V). Articles I and II address Research Question 1, and Articles III, IV, and V address Research Question 2. Table 1 provides a short overview of these studies, outlining their focuses and methodological approaches.

In the following chapter, I provide a theoretical background for my research, after which, in Chapter 4, I provide a general discussion of the methodological approaches I have utilized and the methodological choices I have made. In Chapter 5, I summarize the findings of the five individual articles. Then, in Chapter 6, I provide a synthesis and discuss the primary findings of my research. Finally, in Chapter 7, I provide a discussion on the theoretical contributions and managerial implications of my research.
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3. Theoretical background

This section aims to provide the theoretical background pertinent to this dissertation. I first review the characteristics of an exploratory project discussed in the project management literature. I then provide perspectives from design research that inform the management of exploratory projects. I follow this with examining the central role of experimentation in exploratory projects and how iterative testing of ideas is discussed in research on project management and innovation management. Finally, I review literature on creativity and innovation for leadership support in projects requiring innovative endeavors.

3.1 Characteristics of an exploratory project

Exploratory projects refer to the most innovative projects, in where problems are initially ill-defined and neither the goal, nor the means to reach the goal (nor technologies and customer requirements), are known at the outset (Lenfle, 2008). This is because there is little existing knowledge to begin with, as the objective is to acquire an understanding of an unfamiliar territory (Mcgrath, 2001). When compared to development projects, where the technical and market knowledge related to the project are well known at the outset of the project, exploratory projects refer to situations where both the market and the technology must be explored (Lenfle, 2008). This starting point is quite contrary to the traditional approach in project management, which is largely based on an assumption that the goal and a course of action can be clearly defined at the outset of the project and that the design and execution of a project plan is based upon these (De Meyer, Loch, & Pich, 2002; Lenfle, 2008; Loch et al., 2006). Conversely, in exploratory projects, the information necessary for deciding the course of action is determined only during the project, through experimentation (Loch et al., 2006, p. 113), and the knowledge created during the project defines the subsequent steps, which precludes proceeding according to a predefined plan (De Meyer et al., 2002). Obstfeld (2012) highlights the expanded role of choice in creative projects that require an ongoing series of decisions to guide the unfolding of actions. Furthermore, these types of projects are less repetitive by nature and involve high levels of novelty regarding the elements involved, such as people and ideas (ibid). Unlike traditional development projects, which organize a convergence to a predefined goal driven by milestones, exploratory projects begin by diverging and generating a variety
of ideas and alternatives for approaching the challenge at hand (Gillier et al., 2015). In addition to the lack of clear objectives, a lack of clearly outlined workunities, phases, and plans for risk management exists (Lenfle, 2016). As it is impossible to know what the learning process will illuminate during the project and thus impossible to identify risks, classical project risk management becomes irrelevant (Loch et al., 2006). Characteristic for exploratory projects is the iterative approach in which the necessary knowledge is created through experimentation (Lenfle, 2008, 2016).

Furthermore, exploratory projects also differ from development projects in terms of their “results”: where in traditional development projects, the end result is typically a product or service, exploratory projects aim to create knowledge that can quickly be applied to the design of other applications (Lenfle, 2016). Hence, the primary objective of exploratory projects is knowledge creation (Loch et al, 2006; Lenfle, 2008), which can exist, for example, in the form of concepts, prototypes, or new design models. Due to the necessity of learning and knowledge creation in exploratory projects, the accumulated knowledge explored is as critical a dimension of project performance as is the value of the “products” they create (Maniak et al., 2014). Prior research on the management of exploratory projects has recognized that those projects involving a high level of uncertainty and ambiguity cannot be controlled through the application of the same methods as in traditional development projects (De Meyer, Loch, & Pich, 2002; Loch, Solt, & Bailey, 2008; Lenfle, 2008), nor can they be evaluated according to the same criteria (Gillier et al., 2015; Midler, Lenfle, Pellec-, & ParisTech, 2013), as this would lead to the elimination of projects that do not quickly produce positive results (Keegan & Tuner, 2002). Indeed, it has been noted that the more the need for experimentation and learning exists in the project, the less efficient the progress toward goals become (Loch et al., 2006). The purpose of exploration lies in maximizing variation to increase opportunities for learning, rather than for immediate accomplishments (ibid).

Moreover, as exploratory projects follow a logic of the expansion of knowledge and concept spaces (Gillier et al., 2015), making sense of the knowledge created to adapt it into a potential concept is vital. Where in traditional development projects, project reviews aim to ensure convergence toward the objective, in exploratory projects, reviews serve as an instance of sensemaking (Loch et al., 2006) and reflection, in which the outcomes are jointly discussed and the course of action decided (Lenfle, 2016). Collaborating to complement various ideas and merge individual inputs into a whole is important to create the necessary learning (Loch et al., 2006). Moreover, rather than aiming at the same interpretations or a unified view of a concept, participants must understand each person’s interpretations to stimulate learning about unfamiliar areas (Gillier et al., 2015).

These ambiguous projects, which require the exploration of many alternatives, are referred to by various terms in the project management literature, including vanguard projects (Brady and Davies 2004; Frederiksen & Davies, 2008), soft projects (Atkinson, Crawford, & Ward, 2006), exploration projects (Lenfle,
2008), novel strategic projects (Lenfle & Loch, 2010), creative projects (Obstfeld, 2012; Gillier et al., 2015), or, recently, exploratory projects (Lenfle et al., 2018). Although these types of projects have been included in the discussion in project management research for some time, only recently has the literature on the management of exploratory projects been referred to as a distinct research stream (Lenfle, 2016; Lenfle et al., 2018). The research on exploratory projects is only in its infancy, and more research is necessary to understand how such projects should be managed.

3.2 Key features of design research that inform the management of exploratory projects

A primary difference between exploratory projects and more traditional development projects is that in exploratory projects, the process does not begin with problem-solving but with problem finding. Starting from problem-solving is impossible if the problem itself is not yet defined, which is true in exploratory projects (Loch et al., 2006; Lenfle, 2008). This means that the project team must begin by creating a better understanding of the current situation regarding the problem at hand (e.g. by observations, interviews), and through a reflective and messy process of synthesis, sensemaking, and reframing the problem (Kolko, 2010) in the abstract realm, the team moves toward the concrete, where experimentations play a crucial role (Beckman, 2007). As the traditional approach to project management is built upon the assumption that the project’s goals can be well defined at its onset (i.e. the problem is known), management approaches ensuring and supporting problem finding within a project team have received little attention, even within the research stream of the management of exploratory projects (BenMahmoud-Jouini et al., 2016). While design is generally accepted to be as much about identifying a problem as determining a solution – or, in other words, problem setting and problem-solving (Schön, 1983) – and design disciplines have developed elaborate professional practices in working with ill-defined and open-ended problems (Dorst, 2011) similar to those in exploratory projects, exploring design disciplines to learn from designers’ core practices offers a promising avenue for better understanding the logic of exploratory projects, and thereby their management.

Johansson-Sköldberg et al. (2013) distinguish between “designerly thinking” and “design thinking”; the former refers to the design research tradition of studying professional designers’ practices and theoretical work regarding how to understand the competence of designers, which is difficult to articulate, whereas the latter concerns the use of designers’ practices and competence outside of the scope and context of professional design (e.g. industrial design), with and for people without design expertise, and hence refers to the management discourse of design thinking (ibid). The primary message of the design-thinking discussion in the management literature is that it is possible to learn and receive inspiration from designers’ methods of working and thinking and apply them in innovation efforts in any discipline (Brown, 2008; Martin,
In this, design thinking is considered an organizational resource for innovation, organizational problems are approached as design problems (Kimbell, 2011), and the key methods – experimentation being one of them – are transferred to non-design environments. Therefore, in many cases, the people approaching these “design problems” possess no or very little experience on such approaches.

Problems designers address are commonly described as ill-defined and wicked (Buchanan, 1992; Rittel & Webber, 1973), where many possible solutions exist with no clearly defined rules on how to achieve them (Goldschmidt, 1997). These types of problems require transcending analytical problem-solving approaches (BenMahmoud-Jouini et al., 2016). Following Simon (1969), rather than regarding design as something tied to physical artifacts or solely as the right of trained professional designers, design can be considered a human action for solving problems. However, design practices have been noted to differ from conventional problem-solving (Dorst, 2011). The co-evolution of problems and solutions is “a defining and fundamental aspect of design activity” (Dorst & Cross, 2001). Indeed, the design approach does not comprise first defining a problem and then identifying a satisfactory solution for the fixed problem but rather a concurrent development and refinement of both the formulation of a problem and its potential solutions. This requires the continuous iteration of the processes of analysis, synthesis, and evaluation (Dorst, 2006) and the movement between abstract and concrete (Beckman & Barry, 2007; Liedtka & Ogilvie 2011). How the problem is formulated and interpreted is critical in the overall process of design (Björklund, 2013). At the beginning of the complex, open-ended problem-solving process of design, the end value to be achieved is often the only known factor (Dorst, 2011). The challenge is then to determine, in parallel, what (e.g. object, service, system) should be created and how this should occur. This concurrent creation of a “thing” and its manner of working is the core challenge in design reasoning (ibid). After all, according to Lawson and Dorst (2009), design essentially involves breaking problems apart, organizing problems or ideas in a novel way, and testing the new arrangement in practice.

Divergent and convergent thinking are central in the design process and require different cognitive processes and approaches in widening (divergent thinking) and narrowing (convergent thinking) the problem space, both from the team (Badke-Schaub, Goldschmidt, & Meijer, 2010; Beckman & Barry, 2007) and the leader (Buijs, 2007; Beckman and Barry, 2007). Divergence implies stimulating new thinking by diversifying and exploring or generating a variety of ideas, while utilizing various perspectives. This phase is described as learning by discovery and an expanding process of exploring new directions (Van de Ven, 1999). Convergence in design, on the other hand, concerns making sense of the typically overwhelming number of possibilities, narrowing the choices, refining and selecting the best options, and combining ideas in a coherent whole. This phase is characterized by learning through testing via trial and error (with chosen solution candidates) (Van de Ven, 1999). Both types of thinking and working occur on various levels throughout the process, while
addressing both the problem(s) and potential solutions. According to Leifer and Steinert (2014), in the generative divergent phase, the project team focuses on the problem (not the solution) and aims to understand such factors as who the user really is, how many alternative methods exist to solve the problem, and whether ways exist to rephrase (reframe) the challenge. The analytic convergent phase, on the other hand, focuses on answering the following question: given what is known, what are the next steps? As these two phases differ greatly by nature and require different types of thinking styles and mindsets, moving from divergence toward convergence is often a painful and difficult process for teams (Beckman & Barry 2007).

According to Beckman and Barry (2007), the first movement from concrete to abstract occurs after the team has generated understanding and data regarding the context through observations and interviews, and the team ought to make sense of all collected data. This involves processing a large amount of information (ibid) as well as identifying and questioning the assumptions that the project team may possess related to its expected output (Hey, Joyce & Beckman, 1998). Moreover, the difficulty of dealing with wicked problems often involves making sense of the problem and identifying promising directions to pursue to solve the problem at hand. Indeed, design is often described as essentially about making sense of things (e.g. Krippendorff, 2005). This is echoed by Weick (2001, p.62) in his statement that “Design is clearly a process of sensemaking that makes do with whatever materials are at hand.” Recent research has explored the influence of the material practices of design in individual- and group-level sensemaking (Stigliani and Ravasi, 2012). Stigliani and Ravasi (2012) found the physicality of material artifacts to extend the capacity of individuals and groups to process mental content and, hence, to support the cognitive work of sensemaking (ibid).

According to Weick (1993, p. 635), “the fundamental idea of sensemaking is that reality emerges from the ongoing efforts to establish order and make retrospective sense of what occurs.” In design, sensemaking involves seeking relationships or themes in the gathered data and understanding and attempting to uncover hidden meanings relevant to the design task (Kolko, 2010). Kolko (2010) uses the term sensemaking to refer to an internal, personal process, while he positions synthesis as a collaborative, external process where designers aim to “organize, manipulate, prune, and filter gathered data into a cohesive structure for information building” (ibid. p. 15). However, sensemaking can also be a collaborative activity in which teams work together to create a shared sense of the information they possess (Kirschner, Buckingham Shum, & Carr, 2003).

Sensemaking allows for common understanding, which enables decision-making on the directions to pursue. These directions can be divergent or convergent in nature, for example, gathering further data, producing more ideas, or proceeding with experimenting on promising ideas. The analysis of existing information through sensemaking should ultimately lead to formation of mental representations or “frames.” Problem framing, or the process of structuring and formulating the problem along with creating a standpoint from which a problem can be successfully tackled, is central to design expertise.
(Cross, 2004; Dorst, 2011). Dorst (2011) argues that framing in response to paradoxes in the problem situation is a central and distinctive feature of designers’ problem-solving practices and is at the “core of design thinking.” Reframing the problem – that is, creating a new way of understanding the problem – will guide the team to identify new solutions (Beckman and Barry, 2007).

Reflection has been acknowledged as an important part of design (Schön, 1983). According to Schön (1983), design is a process of reflection-in-action, where the design problem is gradually restructured and developed. Reflection on the problem at hand occurs in problem setting, where certain features of the problem space are chosen to be attended to and certain areas of the solution space are identified to be explored. Time for reflection on the outcomes of learning is essential for transforming tacit experience into explicit knowledge (Schön ibid.). In exploratory projects, this reflection-in-action is fundamental, as the goals are defined during the project. It has been suggested that, while in more routine execution projects, project reviews aim to ensure convergence toward the objective, in exploratory projects, reviews serve as a place for sensemaking (Loch et al., 2006) and reflection, during which the outcomes are jointly considered and the course of action decided (Lenfle, 2016).

The characteristics of designers’ work and practice have been discussed for over four decades within the research stream on design expertise (Johansson-sköldberg & Woodilla, 2013). In this stream, experienced and exceptional designers have been investigated, and the processes of novice and expert designers have been compared regarding how they undertake design problems (Cross, 2004). According to Lawson and Dorst (2009), design capability can be considered to consist of different levels of design expertise (Lawson & Dorst, 2009; based on Dreyfus, 2004). In this grouping, the first level, novice, is described as the following: “A novice will consider the objective features of a situation, as they are given by the experts, and will follow strict rules to deal with the problem” (Kokotovich & Dorst, 2016) and “a novice gets to know design as a series of activities that are organized in a formal process” (Dorst, 2015, p. 57). The development of expertise has been said to pass through different phases, in which training and education are required for one to develop as an expert. Thus, the manner in which novice and expert designers deal with the continuous iteration between the “problem space” and the “solution space” varies.

### 3.3 The central role of experimentation in exploratory projects

Experimentation is a primary principle regarding exploratory projects (Lenfle, 2008, 2016; Loch et al., 2006). This aligns with innovation management, as the following note from Thomke (2014, p. 125) highlights: “At the heart of every company’s ability to innovate lies a process of experimentation that enables the organization to create and refine its products and services.” He argues that the systematic testing of ideas is the key for companies to create and refine their products (Thomke, 2001). Experimentation in the innovation management literature refers to creating accumulated learning through tangible trial-and-
error-cycles (Thomke, Hippel, & Franke, 1998). In project management research, experimentation is typically discussed in relation to risk management and identifying unforeseeable uncertainties (events that cannot possibly be predicted at the outset) in highly uncertain projects (De Meyer et al., 2002; Sommer, Loch, & Dong, 2009; Sommer & Loch, 2004). These studies refer to “trial-and-error learning,” where the original plan must be flexible to a fundamental refinement or even a complete abandonment (Sommer et al., 2009). However, drafting a plan for action must be regarded as a temporary framework that allows the learning process to begin (Lenfle, 2008). In monitoring this process, the project manager must track the experimentation cycles by paying attention to such things as what is being learned, whether the initial problem can be redefined, and what must be solved next (Loch et al., 2008). Loch et al. (2006) distinguish between trial-and-error experimentation and exploratory experimentation, where the latter aims at maximizing the chance of learning rather than efficiency and immediate progress. In trial-and-error experimentation, on the other hand, the organization develops and implements the plan while simultaneously monitoring the situation to continually evaluate whether the plan must be revised, and if so, how. When it comes to exploratory projects, where the aim is to create learning in an unknown territory, exploratory experimentation is required.

Experimentation is generally described as an iterative cycle consisting of different stages (see e.g. Loch et al., 2006; Davenport, 2009; Thomke, 2014). Although the names of the various stages differ, that the experimentation must be planned and designed (Loch et al., 2006; Thomke et al., 1998) and that it must have clear objectives (Thomke, 2014) are common throughout. As noted by Thomke (2001), well-designed experiments must have clear objectives, such as what one expects to learn, and hypotheses, such as what one presumes to occur. This usually involves reviewing existing data, observations, and potentially prior experiments to use learning to design new experiments (Thomke, 2014). Another key aspect of successful experimentation is analyzing and interpreting their findings (Loch et al., 2006; Thomke, 2001; Thomke, 1998). In this, the experimenter compares the results against the anticipated outcome and adapts her learning to the problem under investigation (Thomke, 2014). This forms the basis for experiments in the next iteration, as lessons learned are implemented (Loch et al., 2006; Thomke, 2014).

Indeed, iterations in experimentation are necessary for learning (Thomke, 2014), and experiments should not be thought as one-off activities, but as continuous (Loch et al., 2006). This requires utilizing the analyzed results from previous experiments for planning another experiment and repeating the activities in the experimentation cycle (ibid). The learning of the experiment comprises those features of the outcome that could not be known, foreseen, or predicted in advance (Thomke et al., 1998). The learning leads to revising and refining the objective of the development undertakings, and progress is made iteratively toward an acceptable outcome (ibid). Thomke (2014) argues that iteration time is critical to effective learning and that the key lies in keeping the
experimentation cycle small and fast to gain learning early and often (Thomke, 2001).

The design of experiments that will prove or disprove the initial hypotheses play a crucial role in the management of exploratory projects (Lenfle, 2008). The effectiveness of managing an exploratory project has even been said to be comparable to the effectiveness of a knowledge-creation process, in which the knowledge is created through iterative experimentations (Lenfle, 2008, 2016). Loch et al. (2006) argue that experimentation should occur early in the process, as information gained is most valuable if it is received early, due to the lower costs and higher opportunities for learning. The role of project managers in exploratory projects is to continuously verify the original project idea and push for quick experiments to collect feedback and ensure learning (De Meyer et al., 2002).

Iteration, as well as accumulated learning through multiple experiments, is also a key element in design thinking (Carlgren, Rauth, & Elmquist, 2016; Liedtka, 2014). According to Liedtka (2014), in the context of uncertainty and ambiguity, learning through experimentation is superior to an analytical approach in decision-making, and continuous learning and the iteration of hypotheses will decrease risk and advance success in the innovation process. Experimentation is defined as a bias toward iterative testing, trying things, and moving between divergent and convergent thinking (Carlgren et al., 2016). Although prototyping has long been a key feature in fields such as product development and architecture, in design thinking the purpose of prototyping is somewhat different. In the context of design thinking, prototypes are means to conduct field experiments to test the fundamental and value-generating assumptions of a hypotheses (Liedtka, 2014). Hence, experimentation focuses on creating accumulated learning through iterative cycles, where prototypes may be used to, for example, deliver a given functionality. Experimentation begins by defining what must be learned, which then guides what sort of prototype is needed.

Much of the research related to experimentation in both the project management and innovation management literatures focuses on such things as describing a process to be followed (see e.g. Loch et al., 2006; Davenport, 2009; Thomke, 2014), different modes (e.g. computer simulation vs. rapid prototyping) for experimentation (Thomke, 1998), or factors (e.g. fidelity of experiments, iteration time etc.) affecting learning by experimentation (Thomke, 2014). How project teams really manage to handle the different stages of the experimentation cycle, or what might inhibit the learning in experimentation, has received less attention in these discussions.

3.4 Leading innovative endeavors in exploratory projects

In the context of exploratory projects, the role and purpose of project management shifts from operative toward creative, as project management increasingly comes to address creative issues upstream of projects (BenMahmoud-Jouini et al., 2016). Collective creativity is necessary in
situations where goals are only broadly, if at all, defined (as in exploratory projects), and in these circumstances, the project manager must know how to foster, channel, and manage the innovative efforts of the project team (Simon, 2006). The role of project manager in the context of innovation is crucial, as they are closest to the project and are intimate with the project team and the progress of the project (Tatikonda & Rosenthal, 2000). Furthermore, the responsibility for managing both the innovation process and the people in the project team is usually in the hands of the project manager (Elkins & Keller, 2003). Hence, the role of the project manager appears crucial in the context of innovation, in leading the professionals and managing the process (Valle & Avella, 2003).

Exploratory projects have been argued to fall in between research and development (Lenfle, 2008), and the success of research and development efforts, on the other hand, has been noted to depend on creativity (i.e. the generation of new and useful ideas) and innovation (i.e. the translation of viable new ideas into new products or services) (Mumford and Gustafson, 2007). Although the terms “creativity” and “innovation” are sometimes used interchangeably in the management literature, they label fundamentally different features of R&D activities (Gilson and Shalley, 2004). This motivates the review of both the creativity and innovation literatures for leadership support in projects requiring innovative endeavors, such as exploratory projects.

First, previous research has noted that project managers must cope with multiple conflicting and changing contingencies while attempting to foster innovation and efficiency in innovative projects (Lewis, Welsh, Dehler, & Green, 2002). Lewis et al. (2002) revisited previous studies surrounding the management of product development projects and categorized each exhibited project management technique as either an emergent or planned style of project management. Emergent styles of project management refer to such things as the facilitation of the creativity, flexibility, and improvisation of team members, while planned styles of project management involve providing managerial discipline and direction. The authors conclude that the successful management of innovative projects, such as product development projects, necessitates the capacity to manage tensions, meaning that different combinations of managerial actions must be applied at different times during the project. Indeed, earlier studies have recognized the need for project managers to balance between “firmness and flexibility” in the context of innovation (Lewis et al., 2002; Tatikonda & Rosenthal, 2000).

Moreover, creative problems are inherently ill-defined and poorly structured, and the progress of solving these types of problems has been noted to depend on the construction of an appropriate structure, as noted by Mumford and Mulhern (2018). Because problems in exploratory projects present novel and ill-defined tasks with no inherent direction, project managers must provide structure and direction to tasks (Amabile, 1997; Buijs, 2007; Mumford, Scott, Gaddis, & Strange, 2002). Mumford and Mulhern (2018) have suggested that successful leaders of innovative work include the need for leading the work of
creative efforts, the people doing the work, and the firm. As project managers are responsible for both managing the activities and guiding the project team through the process (Elkins & Keller, 2003), the first two – leading the work and leading the people – are necessary. The former refers to concerns aiming to integrate activities and ensure timely production, whereas the latter involves stimulating and supporting creative efforts. Also, Amabile, Schatzel, Moneta, and Kramer (2004) have noted that leader behaviors supporting creative efforts require both task- (or instrumental) and people- (or relationship) oriented actions. In this, relationship-oriented leader behaviors comprise practices such as demonstrating consideration for employees’ feelings, acting friendly and personally supportive, and being concerned for their welfare, whereas task-oriented behaviors refer to such practices as planning projects, clarifying roles and responsibilities, monitoring work, and managing time and resources (ibid.).

In regards to task-oriented approaches, earlier research has highlighted the need to develop and remind the project team of a vision and strategic goals to cope with uncertainty and improve focus (Keller, 1992; McDonough III & Barczak, 1991). Mumford and Mulhearn (2018) note that leaders must establish a shared understanding, or shared mental models, of the project at hand. In their study, Mumford et al. (2001) found that such things as the leader’s communication of the nature and importance of the project, of the key technical challenges of the project, and of the key constraints and critical ambiguities in the project all support the team’s formation of a shared mental model, which, on the other hand, is a key factor of a team’s ability to produce creative problem solutions.

Another central activity in fostering innovative endeavors is encouraging the exploration of new ideas, needs, and opportunities (Amabile & Khaire, 2008; Kim, Min, & Cha, 1999; Waldman & Bass, 1991), for example, by explicitly requesting creative and innovative solutions (Waldman and Bass, 1991; Amabile & Khaire, 2008), stimulating team members to consider and conceptualize problems in new ways (Waldman & Bass, 1991), offering complex and demanding tasks (Shalley & Gilson, 2004), and acting as a role model (Amabile & Khaire, 2008; Amabile et al., 2004). Indeed, team member creativity has been noted to be a social process that builds on and integrates individual knowledge and skills at the project level (Kratzer et al., 2010). Intellectual exchange in teams can be promoted by the leader, for example, through encouraging all team members to participate in discussions, focusing discussion on key challenges, questioning proposed approaches, and asking team members to analyze and evaluate alternative approaches when other team members are encountering difficulties (Atwater & Carmeli, 2009).

Furthermore, autonomy in the process and day-to-day conduct of the work (Amabile, 1998; Amabile, Conti, Coon, Lazenby, & Herron, 1996), as well as providing sufficient resources for pursuing the generation and implementation of different solutions (Mumford et al., 2002), has also been highlighted. For example, prior research has shown individuals to be more creative if they feel that they can choose how to accomplish the tasks they are given (Amabile, 1998). In particular, time has been noted as a crucial resource, as creative work
has been found to require time to explore different perspectives and play with ideas (Amabile, Hadley, & Kramer, 2002). Indeed, as noted by Loch et al. (2006), the more exploratory learning is required in the project, the less effective the progress toward goals becomes.

Finally, regarding task-oriented managerial approaches, earlier research has emphasized the necessity of technical expertise in the domain of the project manager in innovative projects (Barczak & Wilemon, 1989; Clark & Wheelwright, 1992; Kim et al., 1999). For example, it has been proposed that leaders need to contribute toward generating and recognizing feasible ideas, finding and defining significant problems, and providing technical stimulation to gather various ideas and solutions into a framework that can be used as a basis for further development (Howell and Higgins 1990; Kim, et al., 1999). However, domain expertise may entice the project manager to extend too deeply into the role of technical expert at the expense of more fundamental leadership behaviors (Valle & Avella, 2003). Therefore, possessing technical expertise may be a double-edged sword for project managers. Nevertheless, as noted by Turner and Cochrane (1993), as innovative projects aim to tackle complex and ill-defined problems, the project covers several disciplines, and hence, the project manager cannot be a technical expert in all areas. This emphasizes coordinating the work of others and utilizing the diverse skills of the project team.

Among people-oriented approaches, on the other hand, previous research on creativity and innovation has emphasized fostering an open and safe team climate that supports sharing ideas and differing views, as well as taking initiative and risks (Amabile et al., 1996; Baer & Frese, 2003; Edmondson, 1999; Kim et al., 1999). Furthermore, the project manager has been noted to play a key role in establishing a climate that supports innovative pursuits (e.g. Fisher, 2011; Lee-Kelley & Leong, Loong, 2003). Developing a climate for psychological safety is vital in innovative work, where team members must be able to share their ideas, openly propose new ways of working, and create alternative problem-solving approaches (Baer & Frese, 2003; Edmondson, 1999). A climate for psychological safety describes a work environment where employees feel safe speaking up without negative judgment (Edmondson, 1999). According to West (1990), in a non-threatening and supportive climate, people are more courageous in taking risks and proposing new ideas, as well as taking initiative. However, as noted by Baer and Frese (2003), developing a climate where people feel safe taking interpersonal risks, are encouraged to propose new ideas, and can openly discuss problems, is easily neglected. According to Edmondson (1999), coaching done by the leader is likely to have a remarkable influence on team psychological safety. Furthermore, she suggests that if the leader is supportive, coaching-oriented, and non-defensive toward questions and challenges, employees are likely to perceive the team’s environment as safe. Moreover, psychological safety has been noted to reduce the fear of failure, as it helps to overcome the psychological reactions that most people have toward failure (Cannon & Edmondson, 2005), and this may promote experimentation behavior in organizations (Lee, Edmondson, Thomke, & Worline, 2004). Accepting unsuccessful trials as a necessity to innovation and an unavoidable
outcome of experimenting is a precondition for achieving an experimentation-driven approach (Lee et al., 2004). Hence, leaders should encourage intelligent risk-taking and experimentation, as well as identify and analyze failures (Farson & Keyes, 2002; Lee et al., 2004). Signaling the importance of spending time on problem identification, knowledge sharing, and reflective reviews is key in encouraging learning from failures (Garvin, Edmondson, & Gino, 2008).

Moreover, given that creative work is associated with risk (of e.g. failure or demonstrating one’s ignorance in front of others) and challenges regarding the ill-defined nature of the problems, recognizing the value of individual contributions (Mumford et al., 2002) and providing constructive feedback is necessary (Amabile, 1997). Gibson and Mumford (2013) found that creative problem-solving should be facilitated by a limited number of deep criticisms, which, on the other hand, requires that the leader possess domain expertise to appraise the creative work of the project team. Earlier research has proposed that feedback may promote creativity and may provide creativity standards for employees; this is particularly critical for individuals who lack experience in producing creative outputs (Zhou, 2008).
4. Research methodology

This section explains the methodological choices of the dissertation and how the five studies that form its empirical portion were conducted. This dissertation adopts a qualitative research approach, utilizing both action-research and case-study approaches. I first discuss the philosophical considerations characterizing the current research before outlining in more detail the action-research and case-study approaches. Then, I describe the research settings of the studies, after which I explain the data collection procedures. Finally, I review the data analysis process used in this research.

4.1 Methodological choices

“The way we think the world is (ontology) influences what we think can be known about it (epistemology) and how we think it can be investigated (methodology)” (Fleetwood, 2005, p. 197). As epistemological and ontological assumptions guide research design and the research process (Zalan and Lewis, 2004), the researcher must be aware of the philosophical positions adopted in terms of the nature of both reality (ontology) and knowledge (epistemology). This dissertation adopts a critical realist position, which entails certain epistemological and ontological positions and views, discussed next.

Critical realism offers a manner of combining a modified naturalism while recognizing the necessity of an interpretive understanding of meaning in social life (Sayer, 2000). First, unlike anti-realists, who argue that entities described by theory do not exist independently but are dependent on the cognitive activities and capacities of the researcher (Devitt, 2008), critical realists agree with positivism, that an observable world independent of human consciousness exists. This means that an entity can exist independently without someone observing, knowing, and constructing it (Fleetwood, 2005). However, although critical realists accept realism, unlike positivists, they question researchers’ abilities to derive general laws to explain empirical observations (Bhaskar, 1998).

The focus of investigation in critical realism is on the events or effects, referring to the external and visible behaviors of people, systems, and things as they occur, or as they happened (Easton, 2010; Sayer, 2000). Furthermore, critical realism distinguishes between the real, the actual, and the empirical (Bhaskar, 1978). The real refers to whatever exists, natural or social, be it an empirical object for us or not (Sayer, 2000). While the empirical domain is
where observations are conducted and experienced by the observer, the events explored occur in the actual domain and may not be observed, or they may be understood quite differently by observers (Easton, 2010; Sayer, 2000). Although the actual domain may not be directly observable, it is connected to levels of events and observations (Easton, 2010). As such, a process of interpretation exists between these domains. This does not suggest that the real or the actual cannot be observed but instead that it may not always be capable of being observed.

However, while acknowledging an observable world independent of human consciousness, critical realism simultaneously proposes that knowledge about the world is socially constructed and that social phenomena are shaped by interpretation (Sayer, 1992; 2000). This highlights that critical realism is only partly naturalistic, while acknowledging that social phenomena are intrinsically meaningful and that meaning must be understood, rather than measured or counted (Sayer, 2000).

Although (critical) realism agrees with interpretivism that social phenomena must be understood and are concept dependent, unlike in interpretivism, in critical realism, this does not rule out causal explanation; this is one of its critical features (Sayer, 2000). However, it is crucial to differentiate between conventional causation “understood on the model of regular successions of events” and causal mechanisms (Sayer, 2000, p. 14). The latter refers to identifying causal mechanisms, recognizing how they work, and learning the conditions under which they have been activated (Sayer, 2000). According to Sayer (1992, p. 104), causation in critical realism aims to answer the question of “what makes it happen.” In critical realism, we can only understand what occurs in the social world if we understand the social structures that have given rise to the phenomena that we are attempting to understand (Bhaskar, 1989). This dissertation aims to enrich our understanding of the management of exploratory projects. In addition to describing how novice project managers approach exploratory projects, or how experimentation is undertaken by practitioners new to such an approach, the analysis aims to describe why these “events” occurred (e.g. what impeded experimentation, or why certain phases were challenging for project managers).

4.2 Action-research approach

The research setting in Articles IV and V provided an opportunity for real-time study through an action-research approach. Action research is a generic term that refers to many forms of action-oriented research (Reason and Bradbury, 2001). Due to this lack of a precise definition, it should be viewed as an approach or orientation toward research, rather than as a particular methodology (Reason and McArdle, 2004). As the term “action research” suggests, the nature of knowing, as purported by the methods used within this research approach, is based on the experience of doing (Ladkin, 2004). An underlying assumption of action research is the intentionality of the researcher regarding the “outcome” of the project, which refers to the practical consequences of the improvement
and the achievement of a deeper understanding of a situation (ibid). As noted by Coughlan and Coghlan (2002), action research adopts a scientific approach to study the resolution of important organizational concerns, together with those who experience them directly.

“Knowing” in action research is the outcome of an extended epistemology that involves multiple manners of knowing, in addition to propositional knowing based on theories, such as experiential and practical knowledge (Heron, 1992). Arguments exist over whether action research is viewed akin to positivist research (Stringer and Banister, 1979) or to a post-positivist, social constructivist paradigm (Lincoln, 2001). For example, Kurt Lewin, often considered the pioneer of these approaches, realized that the idea of action research does involve conducting experiments, although in the field rather than the laboratory (Gustavsen, 2001). However, action research has also been compared with positivistic research, the primary argument being that while the aim of positivistic science is the creation of universal knowledge and covering law, action research, on the other hand, is particular, situational, and springs from praxis (Susman and Evered, 1978). Nevertheless, Susman and Evered (1978) noted that action research need not be justified in relation to alternative epistemologies and research approaches, but rather it can be justified within its own terms.

Action research concerns research in action rather than about action (Coughlan & Coghlan, 2002), and research with people rather than on people (Reason, 1994), and it more strongly emphasizes what practitioners do than what they say that they do (Avison, Lau, Myers, & Nielsen, 1999). This research approach has been noted to be appropriate in cases where the research question aims to describe a series of actions unfolding over time in a given group or organization, understanding as members of a group how and why their actions can change or improve the working of some aspects of a system, and understanding the process of change or improvement to learn from it (Coghlan & Brannick, 2001). Furthermore, action research has been suggested as a suitable research strategy for researchers to engage in critical dialogue with practitioners who reflect and interpret their own experiences (Cicmil, Williams, Thomas, & Hodgson, 2006). In adopting an action-research approach, Articles IV and V aim to understand how experimentation as a method for development is undertaken among practitioners new to such an approach. This required the researchers to follow how the teams proceeded with the activities of the experimentation cycle and why some tasks were more difficult.

In action research, the intention of the researcher, coupled with a commitment to rigorous reflection and experimentation with a new understanding of behaviors, is the hallmark of this approach (Ladkin, 2004). According to Reason and Bradbury (2001), the primary purpose of action research is to produce practical knowledge that is useful to people in the course of their everyday lives. Gummesson (2000) notes that action research always involves two goals that solve a practical problem and contribute to science. One challenge in conducting action research is for researchers to engage in both making the action happen and stepping back to reflect upon it as it occurs, to
contribute to the theory and the body of knowledge (Coughlan & Coghlan, 2002).

Action research is described as an iterative process that involves both researchers and practitioners, who act collectively on a particular cycle of activities, and that includes problem diagnosis, action intervention, and reflective learning (Avison et al., 1999). Action research has been noted as an emergent process that cannot be designed nor planned in detail in advance (Coughlan & Coghlan, 2002). According to Coghlan and Brannick (2001), action research is an iterative cycle of the following phases: identifying the empirical problem, planning how to proceed, acting to induce change, and evaluating the outcome. Central in action research are the cycles of action and reflection (Ladkin, 2004; Coughlan and Coghlan, 2002; Avison et al., 1999). While some theorists argue for systematic self-reflection, others suggest that reflection is best undertaken collaboratively by co-participants in the research process (Kemmis & McTaggart, 2005). In particular, participatory action research – in which the studied participants are involved in the research process and are regarded as co-researchers, as the action researcher is working with the participants on their issue so that the issue may be resolved or improved for their system and a contribution be made to the body of knowledge – is noted as a social process (Kemmis & McTaggart, 2005; Reason, 1999). In this, “the aim is to create an environment in which participants give and get valid information, are able to make free and informed choices, and generate internal commitment to the results of their inquiry” (Argyris & Schön, 1989, p. 613).

The role of the researcher in action research is that of an external helper who facilitates action and reflection within an organization under study (Coughlan & Coghlan, 2002). Schein’s (1999) typology of inquiry is a useful framework for the action researcher (Coughlan & Coghlan, 2002). He distinguishes between three types of inquiry: pure, exploratory diagnostic, and confrontive. Pure inquiry refers to understanding the story of what is occurring and listening carefully and neutrally (e.g. “What is going on?” or “Tell me what happened?”). In exploratory diagnostic inquiry, on the other hand, the action researcher aims to manage the process of how the content is analyzed by the other and explores such factors as emotional processes, reasoning, and actions (e.g. “Why do you think this happened?” or “How do you feel about it?”). Lastly, in confrontive inquiry, the researcher, through sharing her own ideas, challenges others to think from a new perspective, for example, regarding the existing processes (e.g. “Have you thought about doing this?”). All three inquiry types were utilized in Articles IV and V, as tutoring sessions (explained more in detail below) often began by reviewing what had occurred and understanding why it had occurred. The tutors, or researchers, then shared their ideas so as to challenge the participants to think from another perspective. The researchers in Articles IV and V served as tutors for the teams, adapted the facilitation of experimentation during the experimentation sprints, and provided the needed support and guidance.
4.3 Case-study approach

A case-study approach was utilized in this dissertation. Given the limited empirical understanding of the experience of project managers and project teams working in exploratory projects and of the adoption of experimentation in established organizations, the case-study approach was chosen due to its strength in providing an in-depth understanding of exploring, describing, and explaining complex phenomena in their natural contexts (Eisenhardt, 1989). According to Stake (2005), case-study research is a choice of what is to be studied rather than a methodological choice. It has been noted that with unfamiliar situations, or ones for which little theoretical background exists, the case-study approach may be the only available means of investigating a problem (Yin, 1994). Furthermore, in the three studies (Articles I, III, and IV), the context and the experiences of the actors are critical, which justifies selecting a case-study approach (Benbasat, Goldstein, & Mead, 1987; Bonoma, 1985). Yin (2003) has suggested that case studies are particularly suitable when the boundaries between the phenomenon and context are unclear. As Article IV investigates experimentation in organizations not accustomed to such development approaches, the context has a remarkable role in the phenomenon investigated. Furthermore, the selection of research setting and corresponding cases is crucial in allowing the variables of interest to be directly examined (Eisenhardt, 1989). In this regard, the research setting in Articles I and III allowed for following the project teams in real time throughout an exploratory project.

While Yin (e.g. Yin, 1989) and Eisenhardt (e.g. Eisenhardt & Graebner, 2007) represent the positivistic-oriented case-study approach, which aims at generalizing the case to a population, Stake (2005), for example, proposes that the purpose of a case study is increasing the understanding of a specific case by providing experiential knowledge regarding the case in question. This study has adopted the latter, more interpretive approach to case studies and did not aim at formulating propositions to be tested or build theories from multiple cases. Academics adopting a replication logic to case studies argue, for example, that evidence from multiple cases can be considered more compelling (Yin, 2009), and that multiple-case studies provide theory that is better grounded, more accurate, and also more generalizable (Eisenhardt & Graebner, 2007). On the other hand, the positivistic approach favoring replication logic has been criticized in its focus on the constructs developed and their measurability at the expense of understanding the context, the rich background of each case, and the deep structures underlying them (Dyer & Wilkins, 1991). As Gummesson (2007) states, “is it not better to understand a phenomenon in depth than to know how often the not understood phenomenon occurs?” (p. 230).

According to Yin (1989), three types of case studies exist: exploratory, explanatory, and descriptive. The first refers to case studies that seek to define research questions and hypothesis, while explanatory case studies aim to investigate causality (i.e. link an event and its effects). The latter, descriptive case studies, adopted in this dissertation, on the other hand, aim to explain specific events in their specific contexts. (ibid).
Although the positivistic approach to case studies is described as linear, and the process to consist of clearly identifiable steps, “from getting started” to “reaching closure” (Eisenhardt, 1989, p. 538), both Eisenhardt (1989) and Yin (2012) refer to data analysis and data collection as overlapping steps. Dubois and Gadde (2002, 2014) present systematic combining as a non-linear and non-positivistic approach to case studies. In the research process of systematic combining, “matching” is a cornerstone that refers to a process of going back and forth between the theoretical framework, data sources, and analysis. The data analysis process of this research draws from the systematic combining approach and is discussed in more detail in Section 4.6.

4.4 Research setting

This dissertation includes distinct sets of data collected from three different research settings. The empirical studies of Articles I–III are situated in the context of two year-long graduate level courses in which student teams were given a unique, industry-provided design brief, through which they solved real, ill-defined design and product development challenges brought forth by industry sponsors. Thus, the students worked for a real customer throughout the project and in both courses, the project teams had a budget of approximately 10,000 euro reserved for the concept and product development. In the empirical context of dataset I (Article I and II), the course was taught by a Finnish University whereas in the empirical context of dataset II (Article III), the course was taught by a US University, where the Finnish University is one of the collaboration partners. In both cases, the lectures of the courses were held once a week during the first months of the project, and in addition, the project teams held checkpoint meetings with the teaching team. Otherwise, the project teams worked independently to solve the challenges provided. Student project teams needed to complete the design process from defining design requirements to constructing functional prototypes that are ready for consumer testing and technical evaluation. The project work began with re-defining the problem provided by industry sponsors and was followed by user studies. Divergent-convergent ideation guided the creation of design choices. Through iterative prototyping and testing of ideas, the project teams needed to come up with a functional prototype as a final result. Furthermore, the students could rank the project briefs according to their interest; however, this did not guarantee that everyone would be assigned to their first-choice project. Both courses ended with an exhibition day, which was open to the public and where the project teams presented their end products and possessed the functional prototype to test in their fair booth.

The student teams were interdisciplinary and international. In the empirical context of the dataset I, the project teams had off-site members from partner universities in various universities abroad, while in the empirical context of the dataset II, half of both project teams under study was located at the Finnish University and the other half at the US University. The sizes of the interdisciplinary student teams in the empirical context of the dataset I varied
between eight and 13 members, all comprising the majority of team members from the Finnish University. Each team also had an assigned project manager, who needed to separately apply for the position; hence, all interviewees were willing to adopt the duty of managing the project. In the empirical context of the dataset II, on the other hand, both teams had three members from the Finnish University and three members from the US University with no project managers.

The third dataset (Articles IV–V) was gathered from a Finnish financial institution of 500 employees, operating in both Finland and the Baltic countries, in 2013 and 2014. In the organization studied, top management was interested in introducing experimentation as an additional approach to its innovation activities, which would require a change in how problems are approached. To study how experimentation is adopted among practitioners new to such an approach (Article IV), and how individual characteristics promote experimentation behavior (Article V), the researchers launched six-week long experimentation sprints. During these sprints, the teams were required to follow a cycle of experimentation, which formed the framework for the teams’ actions. Drawing from the existing literature (see e.g. Thomke, 2014; Davenport, 2009), the experimentation cycle consisted of the following five stages: identifying uncertainties, designing the experimentation setup, building a prototype, running the experiment, and finally, reflecting on the feedback and iteration (see Figure 1).

![Figure 1 Stages of the experimentation cycle](image)

The objective of the experimentation sprints was provided by the leadership of the organization and was defined as “how might our organization become the world’s best place to work?” The sprints were established for two interlinked purposes: to allow real-time research of experimentation in action by the researchers and to introduce the experimentation-driven approach toward development to the organization. The researchers, together with the organization’s management, defined the focus and initial scope of the sprints, ensuring room for exploration.

These sprints began with two half-day workshops aimed to provide the necessary methods and tools for participants and introducing experimentation as a development approach. The first workshop focused on helping the
development teams move from a general objective (e.g. “How might our organization become the world’s best place to work?”) toward more specific problems to be solved (e.g. for Team A: Meetings in our organization are inefficient and frustrating; see Figure 2). In the same workshop, the teams also developed a variety of ideas for how to solve the identified problem.

![Figure 2 Structure of experimentation sprints](image)

In the second workshop, teams first selected one from among all of the ideas developed in the previous workshop. The remaining ideas remained as a reserve in case the chosen idea proved unsuccessful. The second workshop resulted in an experimentation plan for conducting the first experiment to learn more about the initial idea. These workshops were followed by three (Spring 2013 sprint) or two (Spring 2014 sprint) tutoring sessions, where researchers worked with teams to reflect on their work and together decide on the next steps. Between the tutoring sessions, teams were meant to design and conduct their experiments, gather feedback, and analyze their results.

### 4.5 Data collection

For Article I, data was collected through 18 face-to-face interviews, which were conducted by the author. All interviews were held in Finnish, the mother tongue of the interviewees. The six project managers were interviewed thrice during the project lifespan. The first interviews occurred in the front-end phase (FEI), when the projects had been occurring for approximately six weeks, the second in the early development phase (EDP), at four months, and the final in late development phase (LDP), at seven months, approximately three weeks before the end of the project (see Figure 4). As it was assumed that differences (e.g. regarding the nature of work) would arise between the beginning of the EDP, when teams had just begun working on physical prototypes, and the end of the LDP, when teams were to finalize the functional prototype, interviews were conducted in two phases during the development phase. The structure of the course provided a setting where one could approximately predict the timing of the various phases of the development process, which provided an opportunity to simultaneously explore several projects of the population with similar external environments and constraints (Eisenhardt, 1989). For Article II, all 15
project managers in the course were interviewed (face-to-face) while in the midst of the FEI. By this time, the project teams were engaged in the following activities: redefining the project brief, conducting market studies, ideating various alternatives for an initial concept, and choosing concepts for further development. Interviews were held in either Finnish or English, depending on the nationality of the interviewee. In Article III, all 12 members of the two design teams, six on each team, were interviewed thrice during the project: in the beginning, when the projects had been running approximately six weeks (FEI), in the middle, at four months (EDP), and at the end, at seven months, approximately three weeks before end of the project (LDP). Each team comprised of three students from the Finnish University and three students from the US University. In total, 36 interviews were conducted. In all Articles (I–III), in addition to the interviews, the projects were followed throughout the courses in events such as mid-term presentations or prototyping sessions, along with spontaneous interactions with the project members located in Finland, at the same physical location with the researchers. Furthermore, in Article III, project teams were observed over a period of one week preceding the final event of the course at the US University.

For Articles IV and V, data was collected through video-recorded tutoring sessions and qualitative interviews. In Article IV, four teams were followed throughout the sprint, and data was collected through 12 video-recorded tutoring sessions and interviews with all 15 participants. In Article V, on the other hand, data was collected through 17 video-recorded tutoring sessions and individual interviews with all 18 participants. In addition, researchers made observations of four workshops, the tutoring sessions, and the closing sessions, which resulted in field notes and documented reflections of researchers (see Figure 4). After each tutoring session, the authors reflected on the process of the teams and discussed the difficulties to adapt the tutoring. These conversations were documented in notes describing the progress and practical actions taken by the team, as well as reflections on the general feelings of the team members.
The researchers acted as tutors for the teams, facilitating the experimentation during the project based on the needs of the teams and providing the necessary structural support.

4.5.1 Participants

In Articles I–III, all participants were in their mid-twenties and possessed educational backgrounds in either business, industrial design, product development, or work psychology. The majority had several years of working experience in their fields, accrued in various summer and part-time jobs. In project management, all of the project managers (Articles I–II) could be considered novices or advanced beginners in the terminology of Dreyfus and Dreyfus (2005) and were facing a given problem and a given situation for the first time or possessed very little real-life experience. Cicmil (2006) has noted that novice and advanced beginner levels of knowledge in project management are primarily based on textbooks, prescriptive methods, and procedures that do not consider context-dependent factors. Advancing to higher levels of project management knowledge can only occur through personal experience in the domain (Cicmil, 2006). Thus, the course can be perceived as a first step of the students in attaining higher levels of project management competence. For Article I, out of the 15 projects in the course, six were chosen based on maximizing the heterogeneity of the projects, in terms of project briefs, sponsors, team composition, and managerial background. This occurred to improve the validity and reliability of the obtained findings. In Article II, on the other hand, all 15 project managers in the course were interviewed. In Article III, the cases selected for the study were the two projects in collaboration with the Finnish University. This enabled access to follow the projects more intimately, as the researchers were physically located in the same location. Moreover, the participants of the study consisted of members who were not experienced professional designers but rather were novice or, at best, advanced beginner, following the levels of design expertise proposed by Lawson and Dorst (2009). In Article I, all interviewees were Finnish, unlike in Articles II and III,
in which part of interviewees were from the collaborating universities of the Finnish University and possessed different nationalities.

In Articles IV and V, the participants were in their thirties and forties and possessed several years of experience working in expert and managerial positions within organizations. The participants came from five different departments and formed the cross-functional teams during the experimentation sprints. While in Article IV, the unit of analysis was the team, Article V explored each participating practitioner individually. The participants were selected based on their similarities in terms of relation to experimentation: all participants were unfamiliar with experimentation as a development approach. However, as the participants came from different departments and worked in experimentation sprints focusing on different topics, variation in terms of the context in which experimentation was adopted as a manner of development occurred.

### 4.5.2 Qualitative interviews

In all five Articles, thematic, semi-structured interviews were conducted face to face. In a semi-structured interview, an interview guide with specific open-ended questions, organized by topics, is used, but the order in which the questions are presented may vary between interviews (Bailey, 2007). The interview format was selected due to its appropriateness for exploring complex phenomena and the potential to deepen and clarify issues emerging during the interviews, which allows comprehensive and in-depth discussion about the topic (Hirsijärvi and Hurme, 2001). The interactive nature of the semi-structured interview format allows the researcher to react to knowledge gained during the interview and request additional information (Silverman, 2006). In the present study, the core questions were the same for all interviewees, but their order varied depending on the interview flow, and additional prompting questions were posed to encourage further clarification. The semi-structured format enabled the researcher to remain sufficiently focused but still allowed sufficient flexibility in the interview questions for new ideas and issues to emerge. In Articles I–III, the interview questions were first discussed with two experienced researchers to improve the interview form before the first interviews. In all studies, the interview questions were revisited after having conducted a few interviews to modify the questions to better serve the situation and the phenomena investigated. All interviews for the five articles were also audio recorded with the permission of participants and transcribed for analysis. The interviews ended with the query of whether the interviewees had anything further to add or any questions regarding the interview or study. In addition, in all studies, comprehensive notes were taken in each interview, which were transcribed into a memo immediately after the interview.

In addition, all interviews utilized a participant-selected critical-incident approach (Cope & Watts, 2006), which enables interviewees to better recall self-selected, meaningful moments and events in more detail (Chell, 2004). Participants were asked to reflect on the moments of success and failure during the management of the projects (Articles I–II), the development of the concept
(Article III), or inspiring and exhausting moments while further developing their ideas through experimentation (Articles IV–V). All interviews began with introductory background questions to make participants feel comfortable and at ease in the interview situation (Rubin & Rubin, 2011).

In Articles I and II, interview questions were formed based on central themes identified in the existing literature on managing innovative projects; in Article III, on the other hand, in the literature on innovative teamwork. Interviewees were asked to reflect on their activities and primary roles and the challenges faced during the project. Open-ended questions were formed based on these themes, which asked for significant, successful, or problematic experiences. For example, role reflections were prompted by questions such as “How would you describe your current role as the project manager?” The objective was to create a holistic understanding of the lived experiences of project managers (i.e. what they had done in practice and why, and what types of challenges they had encountered in managing the projects).

For Articles I (six project managers) and III (two project teams), the interviews were conducted approximately three months apart by the author, who was not involved with course teaching and grading. The first interviews began with personal background questions and reflections on why the interviewees were motivated to apply for the project manager position in the course. At the beginning of the second and third interviews, participants were asked to recall what had occurred in the project since the previous interview. Participants in Articles I–III were informed that the interviews were handled anonymously and would not affect course grading in any way.

In Articles IV and V, at the beginning of the retrospective interviews, participants were asked to briefly summarize their journeys during the experimentation sprint: what they had done and how they had proceeded. At this point, the participants of Sprint 2 were given a trigger exercise in which they drew an “emotional rollercoaster” illustrating their experiences during the experimentation sprint. Participants of Sprint 1 had already drawn these rollercoasters in the tutoring sessions during the sprint, and in these cases, the interviewees brought their drawings to the interview. This emotional rollercoaster also worked as a manner to reflect upon the critical-incident moments that the participants had experienced during the sprint. Participants were then asked to reflect on the sprint and recall their experiences with critical-incident inspired themes (Cope & Watts, 2000), such as challenging and exhausting moments and turning points, with the aim of gaining an improved understanding about their experiences of the experimentation sprint and understanding what enabled or impeded the team to move forward with the experimentation cycle. All interviews were conducted in Finnish, the mother tongue of the interviewees. Finally, after finishing the interviews, the authors conducted retrospective reflections discussing the progress and challenges met by all of the teams. These retrospective reflections were again recorded (130 min.) and listened to write notes for the data analyses.
4.6 Data analysis

Qualitative data has been described as an “attractive nuisance,” referring to the attractiveness of its richness but also the difficulty of identifying analytic paths through that richness (Miles, 1979). As Patton (2002) has noted, no clear-cut formula exists for transforming qualitative data into findings, and data analysis can be challenging, as the amount of data in qualitative studies is typically large. The five articles in this dissertation consist of rich data, including video and audio recordings, transcriptions of interviews, and field notes. To make sense of this rich data, the analysis relied on thematic analysis that primarily follows the process proposed by Braun and Clarke (2006). Thematic analysis has been noted to be suitable for critical realism and acknowledges “the ways individuals make meaning of their experience, and, in turn, the ways the broader social context impinges those meanings, while retaining focus on the material and other limits of ‘reality’” (ibid, p. 81). According to Braun and Clarke (2006) thematic analysis refers to identifying, analyzing, and reporting themes within data and minimally organizes and describes the dataset in rich detail.

As the author had been collecting the data (with the exception of few interviews) through interactive means (interviews and action research), she possessed some prior knowledge of the data as well as some initial analytic interests. As noted by Patton (2002), the first steps of analysis occur in the field, where emerging analytical insights are recorded in field notes. This was the case with all five articles included in this dissertation: field notes were written after each interview (all articles) or tutoring session (Articles IV–V). In addition, reflective discussions with other researchers occurred systematically after each interview round (three in total) in Articles I–III and after each tutoring session (12 to 17) in Articles IV and V. Furthermore, after data collection, the authors reflected on the entire data collection process and recorded this discussion to provide more depth to the analyses in Articles IV and V. However, immersing oneself in the data to the extent that the researcher is familiar with the depth and breadth of the content is necessary (Braun & Clarke, 2006). Hence, the studies began with familiarization with the data (i.e. reading and rereading the interview transcriptions and noting initial ideas that arose during the readings).

After familiarization with the data, keeping in mind the interesting features of the data related to the study (e.g. project managers’ perceptions and descriptions of their managerial approaches in Article II, or interactions and situations impeding the team from experimentation in Article IV), initial coding began. Codes refer to “the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon” (Boyatzis, 1998, p. 63). Coding occurred through using the “comment” command in Word and writing notes on interview transcripts using highlighters and colored pens. The typical length of a code was one or a few sentences, as the following demonstrates: “They provide very little feedback. If I am present, everyone is acting very correctly. It would of course be nice to know if there is something on their mind as now I am living in the illusion that everything is just fine.” The process of coding is an important part of data analysis (Miles and
Hubermann, 1994), and one data extract can be coded one or more times (Braun & Clarke, 2006), as was the case in this dissertation’s studies.

The initial coding resulted in a set of data extracts that were then grouped into potential themes based on similarity of content. “Theme” refers to something that captures an important aspect of the data in relation to the research question and characterizes some level of patterned response or meaning within the data (Braun & Clarke, 2006). Themes form the units of analysis and are the place for interpretive data analysis in relation to which arguments are made about the phenomenon being investigated (Boyatzis, 1998). Visual representation was utilized in this phase to facilitate the sorting of various codes into themes. For example, in Articles I and II, interview transcripts were cut according to the codes, and these “pieces of papers” were rearranged using Post-its describing their content to organize them into initial themes. Finally, a type of “thematic map” (Braun & Clarke, 2006, p. 89) was created, which illustrated the relationship between the codes and the themes, as well as between the primary and sub-themes. Preliminary definitions of the initial themes were also written at this point.

As noted by Braun and Clarke (2006), no one right way exists to proceed with reading for thematic analysis. While some argue that early reading can narrow one’s analytic field of vision and lead to a focus on some aspects at the expense of others, Tuckett (2005), for example, argues that engagement with the literature enhances one’s analysis by sensitizing the reader to more indirect features in the data. However, it has been noted that entering the field with some background “technical literature,” as Strauss and Corbin (1998) put it, is critical, acknowledging, however, that all of the literature need not be reviewed beforehand. Miles and Huberman (1994) differentiate between two types of frameworks: one tight and classified, the other loose and emergent, with the former referring to the deductive approach and the latter to the inductive approach, in the spirit of grounded theory by Glaser and Strauss (1967). According to Miles and Huberman (1994), each has its pros and cons; too much prior structuring of the study might “blind the researcher to important features in the case or cause misreading of local informants’ perceptions” (p. 16), while, on the other hand, a framework that is too loose might lead to “indiscriminate data collection and data overload” (ibid., p. 17). Dubois and Gadde (2002, 2014) suggest a systematic combining approach that relies on the “tight and emerging” framework. They propose that prior concepts should be used as reference and function as a guideline and that systematic combining is closer to an inductive approach than a deductive one. The primary idea of a systematic combining (Dubois & Gadde, 2002, 2014) is continuous movement between an empirical world and a model world.

While the data analysis in all studies was data-driven and based on the “bottom up” approach – where themes identified from the data are strongly linked to the data itself (Patton, 1990), and the researcher approaches the data without trying to fit it into a pre-existing coding frame or her analytic preconceptions – an interplay between the existing theory and theoretical observations occurred during the research process, as suggested in the
abductive approach (Dubois & Gadde, 2002). While the researchers possessed an initial understanding of the existing literature – based more on broad themes on, for example, the management of innovative projects – after collating the codes into first potential themes, the existing literature was reviewed more carefully. The preliminary empirical findings then guided the selection of the literature. After reviewing the literature based on preliminary findings, the themes were reviewed to refine them. Patton’s (1990) dual criteria for judging themes based on internal homogeneity and external heterogeneity was considered to ensure that data within the themes forms a coherent unit and, on the other hand, that recognizable and clear distinctions exist between themes. This phase resulted in forming new themes (e.g. in Article I) or removing existing ones (e.g. in Article V). The final definitions and names of the primary and sub-themes were created at this point, although the process of defining and naming had begun earlier through utilizing working titles along the way.

In Articles I and II, the researcher had a more detailed research question (i.e. how project managers adapt to the changing needs of managing innovative projects) in mind when beginning to code, whereas in Articles III–IV, in the beginning of the data analysis process, only a broad research question existed (i.e. how experimentation is approached among practitioners new to such an approach), and the more specific research questions (e.g. what impediments appear for experimentation among practitioners new to such an approach, or what kinds of challenges project teams face during an exploratory project) evolved during the coding process. It has been suggested that, especially in case studies, more precise questions might arise during the research process.

Articles I and II also included quantified qualitative analysis (Chi, 1997) aiming to increase the transparency of the process. However, the analysis in these articles relied on qualitative data and analysis. Although ideally, a number of occurrences of the theme will exist across the dataset, this does not necessarily imply that the theme is itself more crucial. As Braun and Clarke (2006) note, the “keyness” of a theme depends more on whether it captures something important in relation to the overall research question than on quantifiable measures of occurrences, and frequent occurrence can simply reflect greater willingness to discuss the topic at length (Sheilds & Twycross, 2008).

In Articles I, III, and IV, the data was analyzed using within- and cross-case analyses. As noted by Eisenhardt (1989), the overall idea of within-case analysis is to become intimately familiar with each case as a standalone entity, whereas cross-case analysis forces the researcher to look beyond and view evidence through multiple lenses. Data was analyzed iteratively with a literature review, and the existing literature e.g. on managing innovative projects, design thinking or design expertise affected, to some extent, data analysis and theme development. In Article III within-case analyses began with reading the field notes from the tutoring sessions and the closing session of experimentation sprints and watching the videotaped material, while simultaneously making notes on what was observed, with a focus on recognizing interactions or situations that impeded the team’s moving forward with experimentation. To
create a solid picture of the cases under study, the recorded retrospective reflections on them created by the authors were listened to at this point, after which the transcribed interviews, as well as the interview notes, were read for each case. This resulted in a draft of the preliminary case reports, and the preliminary themes regarding impediments for experimentation in novice teams were recognized.

Keeping the preliminary themes in mind, the video material and interview transcripts were again reviewed to discover additional empirical evidence for the emergent themes. The interview transcripts were then systematically coded based on the preliminary themes, and descriptions of meaningful moments and incidents from the videotaped tutoring sessions that supported a particular theme were systematically written down and transcribed. At this point, there were five themes altogether, and all themes were critically discussed and reflected upon by the researchers. To identify the critical elements in the data, all themes were revisited at this point. After revisiting the themes and reviewing the exemplary quotations and notions from tutoring sessions, the final themes were formed.

4.6.1 Data analysis of video material

Articles IV and V included video material from the tutoring sessions of experimentation sprints, altogether 7.5 hours of video data related to the experience of experimentation. Video-based methods have been noted to enrich understanding of organization studies by allowing an understanding of the socio-material and embodied forms of behavior (Gylfe, Franck, Lebaron & Mantere, 2016). As noted by Gylfe et al. (2016, p. 135) “In comparison to field notes and interview transcripts, video data allows the researcher to go back and revisit ‘the field’ through repeated viewings of the video.” Suplementing the interview material, video recordings of Articles IV and V provided access to the activities in the tutoring sessions as they occurred. From video, it is possible to identify how team members engage moment to moment in mutual interaction by talking and using nonverbal communication (e.g. gaze direction, facial expressions, tone of voice, gestures, and changes in body position). Video recordings provide a “microscope” to capture both sequentially organized talk as well as nonverbal details and nuances in social interaction (Knoblauch et al, 2015). Video recordings capture, for example, how participants discuss their projects, how they formulate messages (e.g. enthusiastically, approvingly, disapprovingly), how they relate to one another and interpret what others say, and what types of agreements and disagreements occur.

As is the case with other forms of qualitative data, the analysis of video data is also iterative and emerges gradually through the detailed examination of the data and the selective transcription of particular fragments (Heath and Luff, 2018). In the cases of Articles IV and V, the authors began the data analysis by watching all of the video material to identify critical occurrences influencing how participants were proceeding with experimentation activities. During the first round of review, notes were made on occurrences that appeared meaningful regarding experimentation. After watching the video material, the
researchers shared their thoughts on the observations made, which was followed by a second round of watching all of the video material. From these reviews, the researchers then identified instances of particular actions and sequences of action that seemed to either promote or hinder the participants in moving forward with experimenting. The preliminary review and analysis were supplemented with field notes from the tutoring sessions and the researchers’ recorded reflections, in which they discussed thoroughly how the participating teams, as well as individuals, were able to proceed through the experimentation cycle. After recognizing the particular fragments for analysis from the video data, the researchers transcribed the discussion and the visible aspects of these fragments by writing down what was observed, who was saying or doing what, and how the others reacted to it. These notes included quotations and a description of the visible behavior of participants, for example, “Somehow we feel that we could just implement this [idea] already. – So we did not think alternative ways to experiment our idea.” This notion of one team member is accompanied by a laugh from other team members. They quickly look at each other before becoming quiet. One team member makes no eye contact with the tutors and is turned toward the other two team members. The team remains quiet, and the tutors take over the discussion. This fragment was initially coded under the theme of “resistance to iteration” (Article IV).

After transcribing the vocal and visible aspects of the particular fragments of video data, the researchers conducted a preliminary coding of these fragments to be able to form larger groups of themes describing either impediments for experimentation (Article IV) or individual characteristics promoting experimentation (Article V). The formation of the final themes was iterative and required revisiting the fragments several times, re-watching the video material, and adding new fragments to the analysis.
<table>
<thead>
<tr>
<th>Research question</th>
<th>Year</th>
<th>Data collection</th>
<th>Data</th>
<th>Methodological approach</th>
<th>Unit of analysis</th>
<th>Participants</th>
<th>Article</th>
</tr>
</thead>
<tbody>
<tr>
<td>RQ 1: How do project managers approach exploratory projects, and what types of challenges do they encounter in managing them?</td>
<td>2010–2011</td>
<td>Qualitative interviews of six project managers conducted at the beginning, in the middle, and at the end of an exploratory project</td>
<td>18 semi-structured qualitative interviews, average length 44 minutes</td>
<td>Longitudinal, case-study approach</td>
<td>Novice project managers</td>
<td>Master's level students</td>
<td>Article I</td>
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<td></td>
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<td></td>
<td>ca. 13 hours of recorded data related to the experiences of project managers in the context of exploratory project</td>
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<td>RQ 2: How should experimentation be supported by the project manager in exploratory projects?</td>
<td>2010–2011</td>
<td>Qualitative interviews of 15 project managers conducted in the beginning of an exploratory project</td>
<td>15 semi-structured qualitative interviews, average length 40 minutes</td>
<td>Qualitative interview study</td>
<td>Novice project managers</td>
<td>Master's level students</td>
<td>Article II</td>
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<td>ca. 11.5 hours of recorded data related to the experiences of project managers in the context of exploratory project</td>
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<tr>
<td>RQ 2: How should experimentation be supported by the project manager in exploratory projects?</td>
<td>2010–2011</td>
<td>Qualitative interviews of 12 project team members conducted at the beginning, in the middle, and at the end of an exploratory project</td>
<td>36 semi-structured qualitative interviews, average length 49 minutes</td>
<td>Longitudinal, case-study approach</td>
<td>Novice design teams</td>
<td>Master's level students</td>
<td>Article III</td>
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<td></td>
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<td>ca. 28 hours of recorded data related to the experiences of project team members in the context of exploratory project</td>
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<tr>
<td>RQ 2: How should experimentation be supported by the project manager in exploratory projects?</td>
<td>2013–2014</td>
<td>Qualitative interviews of 15 participants novice to experimentation as a development approach Video recordings of altogether 12 tutoring sessions of four novice design teams (altogether 15 participants)</td>
<td>15 semi-structured qualitative interviews, average length 73 minutes 12 video-recorded tutoring sessions altogether ca. 14 hours of recorded interview data and 5.5 hours of video data related to the experience of experimentation</td>
<td>Action-research approach, qualitative interviews</td>
<td>Novice design teams</td>
<td>Practitioners of the organization</td>
<td>Article IV</td>
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<tr>
<td>2013–2014</td>
<td>Qualitative interviews of 18 participants novice to experimentation as a development approach Video recordings of altogether 17 tutoring sessions of 18 participants</td>
<td>18 semi-structured qualitative interviews, average length 76 minutes 17 video-recorded tutoring sessions altogether ca. 20 hours of recorded interview data and 7.5 hours of video data related to the experience of experimentation</td>
<td>Action-research approach, qualitative interviews</td>
<td>Novice designers</td>
<td>Practitioners of the organization</td>
<td>Article V</td>
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5. Summaries and primary findings of the five articles

The empirical research of this dissertation consists of four original articles published in peer-reviewed journals and one working paper. These articles investigate the managerial approaches of project managers and the challenges they encounter in managing exploratory projects (Articles I–II) and, on the other hand, the experiences of project teams working in exploratory projects and the challenges they face during in doing so (Articles III–V). While Articles I–III follow novice project managers or project teams during an exploratory project, Articles IV and V focus specifically on experimentation and follow project teams that are new to such an approach at different phases of an experimentation cycle.

5.1 Article I. Adapting to the changing needs of managing innovative projects

Through a longitudinal investigation of six project managers, this article explores changes in the approaches of novice project managers during an exploratory project and hence responds to the first research question: How do novice project managers approach exploratory projects, and what type of challenges they do they encounter in managing them?

The innovation process is typically described as including three general phases: the FEI, the new product development (NPD) phase, and the commercialization phase; the first two concentrate on the development of the idea itself (Koen et al., 2001). The FEI is considered the first stage of the innovation process, and it can be roughly described as the period from idea generation and concept development to either approval for development or termination (Murphy and Kumar, 1997). The NPD, on the other hand, is roughly a series of stages through which an idea is processed and evaluated (Koen et al., 2001). The nature of work in these two phases is also inherently different. Where the FEI is marked by “fuzziness,” uncertainty, and unpredictability, the development phase is more structured, linear, and goal oriented, and speed and timing issues play key roles (Koen et al., 2001; Zhang and Doll, 2001; Zien and Buckler, 1997). Due to these inherent differences in the nature of the innovation process phases, different managerial approaches are clearly required within innovative projects (see e.g. Buijs, 2007; Kim et al., 1999; McDonough III & Barczak, 1991). However, even though many of the management approaches
applicable early in the FEI might not be applicable in later development phases, and vice versa, management studies rarely differentiate between the phases of innovative projects in their prescription of appropriate approaches, lumping them together as the general pursuit of innovativeness. The responsibility for managing both the innovation process and the team members is generally ascribed to the project manager (Elkins and Keller, 2003). The role of the project manager appears crucial in the context of innovation, in leading the professionals, guiding the development team through the iterative and chaotic front-end phase, and managing the process during the development phase (Valle and Avella, 2003). It has been noted that managing an innovative project requires that the project manager balance a variety of managerial roles and functions and cope with multiple, fluctuating, and often conflicting contingencies (Lewis et al., 2002).

Against this background, this study investigates novice project managers’ approaches during the front and development phases in innovation projects in real time. All six project managers were interviewed thrice during the project lifespan: in the FEI, approximately six weeks after the start of the project; in the EDP, at four months; and in the LDP, at approximately seven months (i.e. three weeks before the end of the project). Data was collected by the author from a graduate-level product development course taking place at a Finnish University during the semester of 2010–2011. The structure of the course provided a setting where one could approximately predict the timing of different phases of innovation, providing an opportunity to simultaneously explore several projects of the population with similar external environments and constraints (Eisenhardt, 1989).

The study recognized five total classes of managerial activities and challenges during the innovative project, which were grouped according to task-oriented managerial approaches: general project management, responsibility and ownership, providing a suitable context for development work, and people-oriented managerial approaches, including the establishment of a climate of trust and the provision of support within the team. The importance of accounting for phase differences was further supported by the concerns brought up by project managers not remaining static but varying between different phases. The managerial approaches of novice project managers moved toward the more traditional, such as highlighting the allocation and scheduling of resources, as the project proceeded. All in all, task- rather than people-oriented approaches were dominant throughout the projects. During the FEI phase, creating a shared sense of direction for the project and role expectations were emphasized. Although in the FEI, all managers were engaged in hands-on participation, in the EDP, clear differences in participation emerged. Furthermore, while in the earlier phase, project managers emphasized dispersed decision-making, but in the EDP, project managers took a stronger role in decision-making (e.g. in making final decisions in situations where no clear decisions could be made with the team). In the LDP, project managers focused on pushing all team members to contribute their best for the remainder
of the project, and little was done at this phase related to ongoing challenges, due to time pressure.

Based on the empirical findings, this article presents three propositions for each phase of the innovation process investigated: FEI, EDP, and LDP.

Front-end phase:

Proposition 1a. Task-oriented activities related to developing a shared sense of direction and role expectations are emphasized in the FEI, which ensuring that team skills are fully utilized.

Proposition 1b. Establishing behavioral norms is a key task in the FEI, which sets the tone for the remainder of the project.

Early development phase:

Proposition 2a. Transitioning to EDP requires managers to rethink their roles. For example, while all managers engaged in hands-on participation during the FEI, transitioning to EDP necessitated changes in the degree of involvement.

Proposition 2b. Managerial approaches become less democratic as ambiguity is reduced during the EDP.

Proposition 2c. Challenges increase during the EDP, due to both changing managerial roles and difficulties in addressing accumulating problems.

Late development phase:

Proposition 3a. Managerial approaches shift from exploration to execution in the LDP by focusing on making do with existing resources to ensure timely production.

Proposition 3b. Activities related to ongoing challenges decrease as time pressure increases, with managers ceasing further attempts to influence accumulated problems, such as involving team members.

Proposition 3c. Due to a lack of time and attention, problems accumulate quickly, particularly with managers involved in hands-on activities.

The longitudinal research design enabled examining the implications and transitioning of project managers between different phases of the innovation process within the same projects in real time. A primary contribution of the study is that project manager approaches did not remain static between the different phases of innovation projects but instead varied. For example, managerial approaches toward boosting innovative work were primarily
highlighted during the front-end phase, whereas the allocation and scheduling of resources were emphasized during the latter development phases. Thus, the analysis demonstrates that project managers must be able to adapt and respond to variation between periods of stability and clarity and of creativity and ambiguity and that transitions between the phases are somewhat problematic. The EDP emerged as a transitional phase between the ambiguous FEI and more structured development phases. This change in nature appeared to require project managers to rethink their managerial roles and adjust their management approaches. Furthermore, this transition phase also posed challenges for most of the project managers, as they were required to shift from fostering creation to fostering an execution-type approach.

A second contribution of the study is that the findings reveal that project managers without domain expertise of the project experience (and must tolerate) more uncertainty than those with domain expertise regarding the project. This is due to project managers without domain expertise being unable to predict or help to solve technical problems, or even estimate how long it would require to fix the situation. A marked difference in the transition phase emerged in the changing degree of managers’ hands-on participation in the project. While all project managers participated in ideation activities in the FEI to encourage exploration, project managers with domain expertise also began to participate in the actual design activities in the latter phases, whereas those lacking domain expertise distanced themselves from hands-on work. However, delving deeper into actual prototype building often occurred at the expense of other managerial duties during the LDP – a risk previously discussed by Valle and Avella (2003). Thus, project managers who are unable to contribute to technical execution may possess more capacity for people-oriented managerial approaches.

In several cases, the project managers, for example, noted that they had not received any response from their teams to their repeated attempts to foster a more open atmosphere, and they thus eventually abandoned these attempts. It seemed that once a certain threshold was surpassed, the managers reshaped their roles to emphasize activities that bore the most fruit and abandon (rather than continue to reformulate) those that were unsuccessful. This leads to the third contribution of the article, that the front-end phase is the most fruitful time for establishing a solid base for efficient teamwork. If the novice project managers did not attempt to create team methods for working or fostering a sense of togetherness during the FEI, it became more likely that these issues would not be considered important in the later phases either. Establishing practices supporting open and constructive communication is highlighted in multidisciplinary teamwork, where the project manager must be able to utilize the diverse skills of the team in a rapidly changing project environment. Project managers were struggling to impel team members to share their unique points of view during different phases of the project. As innovative projects usually require multidisciplinary teamwork, practices supporting open communication among team members must be purposefully established in the project’s early
phases for them to become natural, well-rooted methods of working within the team.
Table 3 Summary of the Article I

<table>
<thead>
<tr>
<th>Article</th>
<th>Research question</th>
<th>Key concepts</th>
<th>Research methods and data collection</th>
<th>Primary findings</th>
<th>Primary practical implications</th>
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<tbody>
<tr>
<td>I. Adapting to the changing needs of managing innovative projects</td>
<td>How project managers adapt to the changing requirements of innovative projects and what their managerial approaches at different phases of innovation process are</td>
<td>Front-end and development phases of innovation process, novice project managers</td>
<td>Qualitative research Longitudinal study and case-study approach Semi-structured qualitative interviews</td>
<td>Offers a rare example of a longitudinal research design investigating managerial approaches, their implications, and transitions between different phases of the innovation process in real time. Identities altogether five classes describing managerial approaches and concerns in managing innovative projects. Presents nine propositions of project managers’ managerial approaches and adaptions to the different phases of the innovation process. Argues that the early development phase emerges as a transition phase, which requires project managers to rethink and transform their roles. Argues that the front-end phase is crucial for establishing behavioral norms and a solid base for efficient teamwork, which serves throughout the project.</td>
<td>As the nature of work changes when moving from the front-end phase to the development phase, the project manager must explicitly consider the changes needed in their role as well as update the norms for working to ensure the team continuously works efficiently as a whole. To build a base for a united team, the project manager must put effort into arranging common working sessions and informal gatherings at the beginning of the project. Activities related to creating and maintaining a desired atmosphere and ways of working in the team seem to be buried under concerns more concretely ensuring the progress of the project. To fully utilize the heightened ability of a multidisciplinary team to solve complex tasks, the project manager should have one-on-one discussions with team members to be aware of all the capabilities of the individuals from the beginning. To get all team members to share their unique points of view during the project, practices supporting open communication among team members must be built during the early phases of the project (e.g. by enforcing regular sessions for reflection and feedback).</td>
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This article explores perceived managerial functions and the related activities of novice project managers at the very beginning of an exploratory project, in the same research context as Article I, *Adapting to the changing needs of managing innovative projects*. This study offers insight into my first research question: *How do novice project managers approach exploratory projects, and what type of challenges do they encounter in managing them?*

The front-end of innovation has been argued to bear particular importance – it is “not only where mistakes get engineered-in but where there is also the most opportunity to optimize value” (Morris, 2010, p. 141). Although many studies have acknowledged the uncertain nature and complexity of the front-end phase, project management practice during this precarious phase is still poorly understood; for example, the predominant Project Management Body of Knowledge PMBOK® largely assumes that most project management functions can be applied in all stages (Edkins et al., 2013). Even today, the project management literature tends to be very execution oriented, focusing on planning activities that assume that projects are highly analyzable (Loch et al., 2006). However, many conventional project management approaches require relatively complete definitions of outcomes and scope, which may be difficult to apply within the front-end phase.

This article is based on a qualitative, exploratory research approach conducted in an inductive manner. Data for the study was collected from a graduate-level product development course taking place at a Finnish University during the semester of 2010–2011. The 15 novice project managers were interviewed when the projects were in the midst of the front-end phase. We were particularly interested in the “lived experience” of the novice project managers – what functions, aims, or concerns they portrayed as relevant to managing the uncertain front-end of innovation.

Based on the analysis of 15 novice project managers, this article identifies four significant managerial functions emerging among the project managers in the front-end phase: providing structural support, coordinating and acting as links, empowering the team, and encouraging and providing social support. Interestingly, traditional, task-oriented managerial functions dominated, with emphasis placed on clarifying roles, setting goals, and coordinating the entire project. Although recognized as important, activities aiming to create a climate supporting creativity were less emphasized, while the previously mentioned traditional management activities dominated. However, earlier studies have emphasized the need for developing team membership and fostering an environment of mutual trust that supports the innovative pursuits of the team (Amabile and Khaire, 2008; Barczak and Wilemon, 2001; Edmondson, 1999). In this respect, a central contribution of the study is that a strategy of novice project managers for dealing with the fluctuating contingencies of the front-end phase is to aim to keep the projects in check, even when uncertainty and ambiguity abound. Clearly, the project managers were more concerned with
being able to define clear roles, set goals, and keep the project under control than with establishing a climate of trust.

Project managers also struggled to reap full benefit from the multidisciplinary teams and include team members from off-site locations. For project managers to be able to utilize the full potential of the team, they must be highly aware of all capabilities of team members early in the project. Furthermore, to reap full benefit from the heterogeneity of the team, project managers must simultaneously seek the best methods to work with each team member by demonstrating concern about their unique concerns and approaches to work (Bass, 1988; Keller, 1992), while also creating shared working practices that accommodate and enhance the effectiveness of collaboration between individuals from different backgrounds. Finally, unlike previous research has suggested (Barczak and Wilemon, 1989; Clark and Wheelwright, 1992; Edkins et al., 2013), the domain knowledge of the novice project managers had a fairly small influence in this study. These findings suggest that when aiming for novelty, the inclusion of heterogeneous and non-domain perspectives can be beneficial for avoiding design fixation, and thus the degree of domain knowledge of project managers may not be as relevant as perhaps in latter, more evaluative phases of innovation.
<table>
<thead>
<tr>
<th>Article</th>
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<th>Primary practical implications</th>
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<tbody>
<tr>
<td>II. Perceived managerial functions in the front-end of innovation</td>
<td>How new project managers portray and make sense of their roles in the front-end of innovation</td>
<td>Front-end of innovation, novice project managers</td>
<td>Qualitative research Semi-structured qualitative interviews</td>
<td>Provides new insight into project management discussion by exploring specifically the front-end phase of innovation.</td>
<td>To take full benefit from the heterogeneity of the team, project managers must simultaneously seek the best ways of working with each team member by demonstrating concern for their unique concerns and approaches to work, while at the same time creating shared working practices that accommodate and enhance the effectiveness of collaboration between individuals from different backgrounds. Explorative settings require taking initiative and identifying, proposing, and pushing forward possible solutions. In addition to defining clear roles and directions in the project, the project manager must create a supportive framework within which it is easier for team members to proactively pursue their creative efforts in a fruitful way. For the project manager to be able to fully utilize the diverse set of skills, knowledge and expertise of the multidisciplinary team, s/he must already be well aware of these capabilities in the front-end phase. The better the project manager knows the capabilities of each member, the easier it is to define roles and delegate tasks along the different phases of innovative projects.</td>
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5.3 Article III. The struggle of sensemaking in exploratory projects

This article follows two project teams during an exploratory project and investigates the challenges the teams face in these types of projects, where the needed information must be created through iterative experimentation. This article provides insights into the second research question of the dissertation: *How should experimentation be supported by the project manager in exploratory projects?*

Over the last decade, an increasing amount of research has focused on the management of exploratory projects (Brady & Davies, 2004; Loch et al., 2006; Lenfle, 2008, 2016; Lenfle & Loch, 2010). Characteristic for these type of projects is that both the goals and the means to reach the goals are unknown at the outset of the project (Lenfle, 2008). Furthermore, recent research in project management has proposed that problems in exploratory projects are similar to those for which design thinking is relevant (BenMahmoud-Jouini et al., 2016). In addition, earlier research noted that adopting some designerly practices for addressing complex and open-ended challenges may be useful, as design disciplines have developed elaborate professional practices for these types of challenges (Dorst, 2011). Creative design projects with the aim of pursuing novel and innovative outcomes are by nature exploratory projects, as they are characterized by wicked problems and uncertainty in both what the desired end goal comprises and how to achieve it (ibid). Therefore, looking into designers’ core practices and their management in these projects offers a promising avenue for better understanding the logic of exploratory projects.

Existing studies have identified management principles necessary for exploratory projects that differ from those applicable for more traditional development projects (see e.g. Loch et al., 2006; Lenfle, 2008). Although these studies recognize the central role of sensemaking and learning through experimentation (Lenfle, 2008) and suggest different strategies for coping with the learning required (Loch et al., 2006; Sommer, Loch, & Dong, 2009), they provide limited understanding regarding the experiences of project teams who aim to make sense of and proceed in the unknown landscape. Furthermore, case studies describing what is really occurring in these projects remain rare (Lenfle, 2016).

This study followed two project teams during an exploratory project and interviewed the 12 team members at the beginning, in the middle, and at the end of the project. Based on a longitudinal case-study approach and the analysis of 36 interviews, this study proposes that sensemaking and convergence are challenging for project teams working in exploratory projects and hence are something that a project manager must be aware of and be able to support. First, the findings of the study suggest that sensemaking plays a central role in exploratory projects. Sensemaking in design can be described as designers’ method of seeking relationships or themes in the research data and attempting to uncover hidden meaning in the behavior that is observed and is relevant to the design task at hand (Kolko, 2010). Collaborative sensemaking refers to a shared activity in which teams of people work together to create a collaborative
sense of the information they possess (Kirschner, Buckingham Shum, & Carr, 2003). The findings of this article propose that the inability of sensemaking leads to challenges in moving from the divergent toward the convergent, which, on the other hand, may lead to difficulties in decision-making. The inability to make decisions, eventually leads to a stagnation of the project and manifest itself in frustration, a lack of motivation, and challenges in team dynamics. Hence, sensemaking enables convergence, and in the studied teams, it surfaced as an overarching theme underlying or directly related to difficulties and frustration with the project.

Furthermore, the findings propose that transition from divergence toward convergence is difficult if collaborative sensemaking is lacking. This applies to both narrowing the challenge or problem being solved and to the selection between ideas or concepts. Moving from the conceptual thinking of a higher abstraction level to the practical thinking of lower level abstraction and concrete doing, for example experimenting, was a significant challenge in both of the studied teams. Often, the teams proceeded to converging only when they needed to, for example, when the time pressure of course deadlines forced them to choose an idea to test. The findings imply that the managers of exploratory projects should devote close attention to supporting timely experimentation and learning as well to the transition between divergence and convergence.

Furthermore, sensemaking has been identified as capabilities, through which expert designers display far superior performance to novices (e.g. Björklund, 2013), and hence, efforts should be focused on transferring learning from the strategies and approaches of expert or exceptional designers to the discussion of the management of exploratory projects. As argued by Dorst (2011, p. 526), the value “is not so much to be found in a general adoption of something as amorphous as ‘design thinking,’ but it lies in the application of these specific professional design practices”.

Currently, the literature on the management of exploratory projects offers limited understanding regarding the experiences of practitioners working in these types of ambiguous projects. In this article, we argue that the need exists to better understand the nature of work in exploratory projects as well as the experience of practitioners working in these projects to support and manage the work in the best possible manner.
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<td>III. The struggle of sensemaking in exploratory projects</td>
<td>What key challenges do project teams working in exploratory projects face and what implications do these challenges and their effect/manifestation have on the management of these projects?</td>
<td>Exploratory project, experimentation, novice design team</td>
<td>Qualitative research, Longitudinal study and case-study approach, Semi-structured qualitative interviews</td>
<td>Offers a rare example of a longitudinal case-study approach following two teams along an exploratory project. Argues that one of the main challenges for project teams working in exploratory projects is the transition between divergent and convergent phases. Suggests that collective sensemaking and decision-making act as enablers for the team to move toward convergence.</td>
<td>Suggest that moving from a divergent (i.e. generating alternative solutions) toward a convergent (i.e. narrowing the problem space to choose the one to continue working with) approach might be problematic for the project team and must be supported by the project manager. As the studied project teams had challenges in feeding the information gained from the experiments back to the design of the solution in a meaningful manner, explicit managerial attention should be put to ensuring learning from experiments. Due to the nature of ill-defined problems in exploratory projects that lack the definitive measures for the “correctness” of the solution, it is unlikely that first iterations would provide best solutions. Hence, the managers must be aware of the possible inertia of the project team for further exploration and be able to mitigate it.</td>
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### 5.4 Article IV Impediments for experimentation in novice design teams

Based on a case-study and action-research approach, this article investigates team-level impediments that appear for experimentation in novice design teams when adopting design-thinking methods for the development of internal processes. The findings of the study provide insight into how experimentation as a method for development is adopted among practitioners new to such an approach and hence answers my second research question: *How should experimentation be supported by the project manager in exploratory projects?*

This article explores experimentation as part of the design-thinking concept and draws upon expertise from the design literature to illuminate the core design practices related to design-thinking. Design thinking can be defined as applying methods and attitudes beyond the traditional scope of professional design to promote innovation in a variety of businesses. A central insight of design thinking is that “design has become too important to be left to designers” (Brown and Katz, 2011, p. 381). A key idea of design thinking is that organizational problems should be approached as design problems (Kimbell, 2011). In this, the concept of design thinking and its key methods are transferred to a non-design environment, and people approaching these “design problems” are, in many cases, employees with little or no experience with the approach. Experimentation (i.e. creating accumulated learning through iterative trial-and-error cycles) is a key element in design thinking. Despite increasing interest in design thinking, a lack of empirical understanding remains regarding what occurs when design thinking, or elements of it, are adopted in organizations not accustomed to such approaches. The central methods of design thinking, such as experimentation, are usually investigated under experimental conditions, or as used by experienced teams (Seidel & Fixson, 2013). Furthermore, rather than studying the messy situations of real-life, everyday work (Schön, 1983), studies on expert design often explore through working on simplified tasks in simplified situations (Lawson, 2004). In this respect, one contribution of this article its exploration of the experience of a novice team in adopting experimentation as part of design-thinking methods in a real organization, in real time. Empirical studies on adopting the central methods of design thinking in established organizations are rare, and studies following the process of adoption in real time are even more so.

Another contribution of the study is the multi-stage view on experimentation it offers. In this study, rather than a one-step activity, experimentation is regarded as consisting of an iterative process of testing and learning that forms the various stages of an experimentation cycle. These stages are defined as follows: identifying uncertainties, designing the experimentation setup, building the prototype, running the actual experiment, and reflecting and iterating. This cycle formed the framework for teams’ actions and enabled the researchers to follow how teams were able to proceed with each stage. This study provides a critical understanding regarding what occurs on a micro level when adopting central elements of design thinking among non-design professionals. Four central themes that may impede the adoption of experimentation in novice
design teams were identified: resistance to ideation, overlooking the experimentation ideas of others and oneself, losing sight of the initial problem to be solved, and a bias toward planning.

The current discussion regarding building design-thinking capability in novice organizations focuses greatly on design methods and tools (see e.g. Brown, 2008). However, a central contribution of this article is the finding that without an appropriate mindset toward the nature of work in the design approach, these skills, methods, and tools may be difficult to obtain. Although mindset is mentioned in the design-thinking management discussion, how the lack of this manifests in design thinking novice teams and the consequences thereof have been largely ignored. In particular, this study suggests that a key impediment for adopting experimentation as part of design-thinking methods in novice design teams is resistance toward the iterative approach. The teams investigated were defensive throughout toward further experiments, and hence they did not understand that experiments are conducted in service of learning about the idea at hand. This is linked with the other key finding of the article, which suggests that to adopt the iterative nature of experimenting, teams must move away from a decision attitude. Such an attitude leads to the premature convergence of the idea and prevents the team from identifying uncertainties, from which it could gain further valuable learning via experiments. One contribution of this article is to open the discussion regarding the importance of first adopting an appropriate mindset that allows for obtaining the central methods and skills of design thinking.

Finally, the design-thinking management discussion has been criticized for its inability to build on the existing knowledge regarding “designerly thinking” that has been exploring design as an activity for over 50 years (Johansson-Sköldberg, et al., 2013). To date, very few references link these two discourses. This article contributes to the current literature by linking the design-thinking discussion with the design research discourse to deepen our understanding of the elements that design thinking consists of.

The findings are supported through a multiple-case study conducted in a single-case setting and the action-research approach. This research design allowed real-time study and provided in-depth understanding regarding a complex phenomenon in its natural context (Eisenhardt, 1989). The journeys of four novice design teams engaging in six-week experimentation sprints launched by the authors were followed in tutoring sessions, in which researchers actively supported the work of the teams. Data was gathered via video recordings of 12 total tutoring sessions and 15 qualitative, semi-structured interviews.
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<tr>
<td>IV. Impediments for experimentation in novice design teams</td>
<td>What team-level impediments appear for experimentation when adopting design-thinking methods for the development of internal processes?</td>
<td>Experimentation, design thinking, novice design team</td>
<td>Qualitative research, Case-study and action-research approach, Video recordings, Semi-structured qualitative interviews</td>
<td>Offers unique insight into the adoption of experimentation as part of design-thinking methods by investigating novice teams in real organizations in real time. Offers a multi-stage perspective of the activity of experimentation by defining experimentation as consisting of five stages. Provides critical micro-level understanding of the adoption of experimentation among non-design professionals. Identifies four central themes that might impede the adoption of experimentation in novice teams. Argues that adopting an appropriate mindset toward the nature of work in the design approach is the starting point for obtaining the methods and tools for design thinking. Highlights that for a team to adapt experimentation as a way of developing, the team must buy into the logic of an iterative approach to experimentation and move away from a decision attitude.</td>
<td>As adopting the iterative nature of experimenting turned out to be one of the bottlenecks, project managers must ensure the novice team is aware of the nature of experimenting and the fact that conducting several experiments and building on learnings is the key. Novice design teams had challenges in keeping in mind the initial problem to be solved, which seemed to make it more difficult to find new angles for further developments. Hence, the project manager must ensure the initial, more abstract, problem is involved in the discussion of the teams and that the outcomes of the experiments are reflected with the initial problem. Ensuring the team is taking the needed time for reflection and learning is essential for experimentation to serve its purpose. Project managers must build structures that facilitate this. The iterative process requires a certain mindset: keeping the idea open for modifications and moving fluidly between abstract and concrete as well as divergent and convergent realms. Reframing the problem must be supported (e.g. in cases where the outcomes of the experimentation suggest updating the solution idea). Furthermore, the project manager must be aware when the team is slipping back to the decision attitude, which leads to premature convergence of the idea and eagerness to close the idea and “carry the project through” rather than to stay open for further developments and additional experiments.</td>
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5.5 Article V. How individual characteristics promote experimentation in innovation

This article focuses on the same phenomena as Article IV, *Impediments for experimentation in novice design teams*, but examines experimentation on the individual level and, more precisely, which individual characteristics promote experimentation among novice designers. This article answers my second research question: *How should experimentation be supported by the project manager in exploratory projects?*

This article draws primarily from the innovation (management) and creativity literatures and positions experimentation as part of the idea-implementation stage of innovation. In this study, experimentation behavior is examined as a subset of innovative behavior, which has been defined as an individual's behavior toward the initiation and application of new and useful ideas (Farr, and Ford, 1990). We define experimentation behavior as that behavior directed toward designing, executing, and learning from experiments. Although implementation is a crucial part of the innovation process and is every bit as demanding and time consuming as initial idea generation (Mumford, 2003), most research in innovation and creativity has focused on understanding idea generation, leaving less attention for idea implementation (Jong & Hartog, 2007; West, 2002). Drawing from the existing literature, we define a cycle of experimentation as consisting of five stages: identifying uncertainties, designing an experimentation setup, building a prototype, running an experiment, and finally, reflecting on the feedback and iterating.

This article contributes to the knowledge regarding idea implementation and experimentation in innovation in several ways. Its primary contribution is the proposal of a multiple-stage view on experimentation and a linkage between these stages and various individual-level characteristics that promote experimentation. Previous research has studied the idea-implementation stage at a more general level (see e.g. Den Jong and Hartog, 2007; West, 2002) and does not suggest links between various activities and different individual characteristics that are required for innovative behavior to happen.

Based on the empirical findings, the study presents several propositions for each stage of the experimentation cycle below:

Stage 1: Identifying uncertainties

Proposition 1a. When identifying uncertainties, an individual iterating between abstract and concrete thinking is more likely to be able to break down the conceptual idea into smaller component parts without losing sight of the overall objective of the idea being developed than is an individual who lacks this characteristic.

Proposition 1b. When identifying uncertainties, an individual with intellectual humility is more likely to be able to question the current understanding of certainties and thereby facilitate the identifying of remaining uncertainties than is an individual who lacks this characteristic.
Proposition 1c. When identifying uncertainties, an individual with sensitivity toward uncertainties is more likely to notice remaining uncertainties in the idea being developed, without rushing past them, than is an individual lacking this characteristic.

Stage 2: Designing an experimentation setup

Proposition 2a. When designing the experiment setup, an individual iterating between abstract and concrete thinking is more likely to identify concrete actions that could produce the desired learning related to the identified uncertainty than is an individual who lacks this characteristic.

Proposition 2b. When designing the experiment setup, an opportunity-focused individual is more likely to discover alternative ideas for running the experiment in the midst of scarce resources than is an individual who lacks this characteristic.

Proposition 2c. When designing the experiment setup, an individual able to design valuable experiments is more likely to identify the smallest and quickest action or arrangement to produce the required learning than is an individual who lacks this characteristic.

Stage 3: Building a prototype

Proposition 3. When building a prototype, an action-oriented individual is more likely to move from planning the experiment setup to creating something concrete that aids in generating the desired learning and complete necessary arrangements for the experiment than is an individual who lacks this characteristic.

Stage 4: Running the experiment

Proposition 4a. When running the experiment, an individual with intellectual humility is more likely to accept and collect new information as it arises from the experiment, even when it is unexpected or contrary to the initial assumptions, than is an individual who lacks this characteristic.

Proposition 4b. When running the experiment, a courageous individual is more likely to leave his comfort zone to share unfinished work with potential users for feedback than is an individual who lacks this characteristic.

Proposition 4c. When running the experiment, an action-oriented individual is more likely to move from planning for the experiment to executing the plan than is an individual who lacks this characteristic.
Stage 5: Reflecting on the feedback and iterating

Proposition 5a. When reflecting on the feedback and iterating, an individual able to conduct unattached exploration is more likely to perform an open-minded search for alternative solutions when considering the implications of the feedback and deciding the potential new direction for the idea than is an individual who lacks this characteristic.

Proposition 5b. When reflecting on the feedback and iterating, an individual with intellectual humility is more likely to accept the new information resulting from reflection and revise his own beliefs about the idea based on the new understanding than is an individual who lacks this characteristic.

Proposition 5c. When reflecting on the feedback and iterating, an opportunity-focused individual is more likely to find new directions for the idea when conclusions from the experiments require changes than is an individual who lacks this characteristic.

Proposition 5d. When reflecting on the feedback and iterating, a mentally resilient individual is more likely to remain motivated and continue working on the idea after conclusions from the experiments are critical of the idea than is an individual who lacks this characteristic.

Proposition 5e. When reflecting on the feedback and iterating, an individual with the ability to extract learning is more likely to identify information in the results of the experiments that is valuable and meaningful for the idea than is an individual who lacks this characteristic.

Proposition 5f. When reflecting on the feedback and iterating, an individual able to implement learning and adapt the idea is more likely to utilize the learning created, by interpreting its implications to the idea and making the necessary changes to the idea, than is an individual who lacks this characteristic.

During all stages of the experimentation cycle:

Proposition 6. During all stages of the experimentation cycle, an individual with the ability to conduct continuous reflection is more likely to notice new information and consider its implications on the idea being developed than is an individual who lacks this characteristic.

In summary, the findings suggest that reflecting and iterating form the essentials of experimentation behavior, a subset of innovative behavior. This is understandable as both are closely related to learning, which lies at the heart of experimenting. The ability for continuous reflection is connected to all stages of the experimentation cycle, suggesting that this reflection-in-action is required throughout the experimentation cycle. Further proof of the essential nature of
reflecting and iterating in experimentation is that the final stage of the experimentation cycle, “reflecting on the feedback and iterating,” required the most diverse set of individual characteristics of all the stages. This stage is also essential regarding learning, as the individual can either reflect on the previous activity and build upon it in subsequent steps or decide to interrupt the continuous learning process, most often prematurely.

This study is based on an empirical study of 18 individuals in five short-term experimentation sprints occurring within a Finnish financial organization. The study adopted a qualitative approach, conducted in an inductive manner. Data consists of video-recorded tutoring sessions and face-to-face, semi-structured interviews. Altogether, 12 individual-level characteristics that promote experimentation behavior in specific ways at different stages of experimentation cycle have been identified. These characteristics are grouped under three categories: thinking styles, personal traits, and experimentation skills.
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<td>V. How individual characteristics promote experimentation in innovation</td>
<td>How the characteristics of an individual promote experimentation behavior</td>
<td>Experimentation behavior, individual characteristics, novice developers</td>
<td>Qualitative research, Action-research approach, Video recordings, Semi-structured qualitative interviews</td>
<td>Contributions to the existing knowledge of idea implementation and experimentation in innovation by exploring individual characteristics promoting experimentation as part of innovation behavior. Presents a fine-grained view on one of the central activities of idea implementation in innovation, experimentation, and so offers an in-depth understanding of individual-level experimentation behavior. Provides unique perspective on the experimentation behavior of an individual by linking individual characteristics promoting experimentation behavior to the different stages of experimentation cycle. Presents 12 individual-level characteristics promoting experimentation behavior that are grouped under thinking styles, personality traits, and experimentation skills. Argues that for the experimentation behavior to happen, only having the thinking styles and personality traits promoting experimentation is not enough; experimentation skills are needed as well. Argues that thinking styles of continuous reflection and iterating between abstract and concrete thinking are central to experimentation behavior. Proposes that the last stage of the experimentation cycle, reflecting on the feedback and iterating, is especially demanding, as it calls for the most different individual-level characteristics.</td>
<td>The linking of characteristics to different stages of the experimentation cycle offers managers an indication of what type of thinking style, personality, or experimentation skill is needed at different stages. The identification of different individual characteristic requirements at different stages of the experimentation cycle also allows the managers to better recognize what types of support might be needed at various points. The recognized individual characteristics relevant to experimentation provide valuable insight into what types of training might be needed, if the organization is keen to adopt experimentation as a way of developing. The findings suggest reflection to be one of the central elements of experimentation behavior. The last stage of reflect on the feedback and iterate hence requires a pronounced managerial support, as does the characteristic of continuous reflection, which was required throughout the cycle.</td>
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This dissertation aims to enrich our understanding of managing exploratory projects. The empirical portion of this dissertation consists of four original articles published in peer-reviewed journals and one working paper. Although each article makes its own distinct contribution to the current theoretical understanding, they share common, underlying themes and all contribute to increasing the current understanding regarding the management of exploratory projects. Next, these implications are examined in more detail, and both research questions of the dissertation are discussed in reflection upon the primary findings of the research.

6.1 RQ 1: How do project managers approach exploratory projects and what types of challenges do they encounter in managing them?

Articles I (Rekonen and Björklund, 2016) and II (Rekonen and Björklund, 2016) provide insights into the first research question: How do project managers approach exploratory projects and what types of challenges they encounter in managing them? The primary findings in relation to this question are described below.

6.1.1 Reducing uncertainty and ambiguity through task-oriented approaches

Articles I and II both indicate that the managerial approaches of project managers were strongly tilted toward task- rather than people-oriented, including such practices as clarifying roles, setting goals, and coordinating the whole being dominant throughout the projects. Hence, providing structural support, coordinating, and acting as a link between the sub-teams, as well as the sponsor and the project team, appeared to be the core objectives of the project managers in both Articles I and II. Task-oriented practices related to developing a shared sense of direction, defining role expectations, forming and delegating tasks, and creating behavioral norms were emphasized in the early phases. Establishing a shared understanding of the project has been noted as a key task in leading a project team in the context of ill-defined problems (Mumford & Mulhearn, 2018). Furthermore, creative problems are inherently ill-defined and poorly structured, and progress in solving creating problems has been noted by Mumford and Mulhearn (2018) to depend on the imposition of appropriate
structure. Because problems in exploratory projects present novel and ill-defined tasks with no inherent direction, project managers must be capable of lending structure and direction to tasks (Amabile, 1997; Buijs, 2007). Amabile (1998), for example, has noted that central to creativity is providing people autonomy concerning the process, but not the ends, which supports the fact that more traditional managerial functions providing structure and clarity are also needed in the creative phases of the project. Hence, defining clear roles and direction to the project may possess an elevated significance in the context of exploratory projects that are characterized by high levels of uncertainty and ambiguity. In explorative settings, where the outcome is not known at the outset, the project team plays a central role in defining the problem and the possible solution, which requires taking initiative and identifying, proposing, and pushing forward possible solutions. Thus, creating a framework within which individuals can direct their efforts in a fruitful manner may make it easier for project team members to proactively pursue their creative efforts.

The findings of Article I, on the other hand, demonstrate that encouraging exploration was primarily highlighted in the very early phases of the project (e.g. by explicitly requesting that team members produce several solution alternatives to problems, encouraging team members to address multiple perspectives, minimizing the fear of failure by emphasizing the importance of learning, and suggesting the avoidance of any ready solutions). Moreover, as the project proceeded, managers emphasized keeping the project under control and ensuring its progress (Article I). It was characteristic for the early phases of the projects that decisions were largely made jointly with the team, monitoring primarily occurred in weekly meetings, and high levels of autonomy were provided (Articles I–II). This aligns with the creativity literature, which highlights the benefits of autonomy on employee motivation (see e.g. Amabile et al., 1996; Amabile, Hadley, & Kramer, 2002; Shalley and Gilson, 2004). However, the findings of Article I proposed that in the later phases, final decisions were primarily made by the project manager, and most project managers began more tightly monitoring the work of sub-teams. Moreover, during the early phases of the project, teams primarily worked as a whole, and sub-teams were usually established only after the concept to be further developed had been decided upon (Articles I–II). This required project managers to modify the team’s working methods to ensure that they continued working together as a whole.

Furthermore, project managers reported encouraging creative work by, for example, explicitly requesting that team members produce several solutions, avoiding the provision of ready solutions, and seeking different opinions and perspectives in the early stages of the project. Although all project managers recognized the importance of creating an open and trustful atmosphere and explicitly encouraged exploration, these approaches were less emphasized than clarifying roles, setting goals, and coordination. In the early phases, project managers were already more concerned with being able to define clear roles for team members, set goals for the project, and generally keep the project under control than, for example, with creating a supportive environment for creative
problem-solving, something emphasized in the organizational creativity literature (Amabile & Khaire, 2008). Indeed, previous research on learning, creativity, and innovation has highlighted people-oriented managerial approaches such as developing a climate for psychological safety (Edmondson, 1999, 2016), minimizing the fear of failure (Edmondson, 1996; Cannon & Edmondson, 2001; Farson & Keyes, 2002), and providing support (Amabile; Khaire, 2008; Amabile, Schatzel, Moneta, & Kramer, 2004; Mumford, Scott, Gaddis, & Strange, 2002). Nevertheless, these issues were not often highlighted in the actions of the studied project managers; while all project managers noted the importance of fostering an open climate within the project team, not all took concrete actions toward this. It may be that novice project managers do not yet possess the means to develop circumstances for exploration activities and thus tend to reduce their own uncertainty related to the project management role through attempting to maintain tight control over the project. This may occur at the expense of fostering more innovative and alternative solutions.

6.1.2 The role of the project managers’ domain expertise

The findings of Article I suggest that transitioning from early phases characterized by divergent approaches (i.e. generating alternative solutions to the problem or challenge at hand) toward convergent approaches (i.e. narrowing down the problem space to choose solutions to continue working with) is somewhat problematic for project managers. The transition between the two was regarded as challenging, due to project managers being required to shift from fostering an exploration to fostering an execution kind of an approach. This change in the nature of work seemed to require project managers to rethink their managerial roles and adjust their management approaches. Thus, in addition to ensuring that all team members possess dedicated roles after the nature of work had changed, project managers must also be aware of the need to reflect and adapt their own roles in the process. Previous research has noted the need for project managers to balance between “firmness and flexibility” (Tatikonda & Rosenthal, 2000) and emergent and planned management styles (Lewis et al., 2002) in the context of innovation and the necessity to identify and manage creative tasks accordingly (Brocke & Lippe, 2012). In the management of exploratory projects literature, however, the need to adapt project management approaches within an exploratory project has not received much attention.

This transition phase also necessitated changes in the degree of involvement in the actual development work among project managers (Article I). For example, while in the divergent phase, all project managers reported to have engaged in hands-on participation (e.g. by conducting user studies and taking part in ideation, in addition to facilitating it), but after the concept for further development had been decided, changes occurred. While some project managers began to participate in actual design activities, others distanced themselves from hands-on work. Project managers without domain expertise reported feeling uncertain, as they could not predict or aid in solving technical problems that had arisen and thus needed to tolerate more uncertainty than
project managers with domain expertise. Hence, the findings suggest that level of project-related domain expertise affects the adaption required by project managers. It seems that project managers who lack domain expertise must withstand a greater degree of uncertainty than those who do possess such knowledge, as they cannot predict or aid in solving technical problems. While project managers with domain expertise can actively participate problem-solving, those who lack expertise must trust that team members know what they are doing and that their estimation of the magnitude of technical challenges, for example, are accurate. However, during the early phase, all project managers participated in the actual hands-on work, for example, through ideation (Articles I–II). In this phase, domain expertise did not appear as critical; rather, the inclusion of non-domain perspectives was beneficial for avoiding premature evaluation and the criticism of ideas. As the findings of Article II demonstrate, the degree of domain experience did not clearly impact project managers’ perceptions or approaches, and one could ask whether the absence of technical domain expertise is helpful in delaying the judgement of ideas and focusing on management, rather than design, activities. Furthermore, one might wonder whether these benefits are surpassed by the costs of the reduced capability to estimate technological challenges and, on the other hand, of a professional project team’s lower acceptance of the project managers authority. The findings of Article II suggest that when aiming for novelty, the inclusion of heterogeneous and non-domain perspectives can be beneficial for avoiding design fixation, and thus the degree of domain knowledge of the project managers may be less relevant than it perhaps is in latter, more evaluative phases of innovation. However, the existing literature on managing innovation does recognize technical expertise as a desired leadership characteristic (Clark and Wheelwright, 1992; Barczak & Wilemon, 1989). For example, Kim and colleagues (1999) emphasize that particularly in the case of radical development projects, it is critical that leaders themselves suggest new ideas and alternative technological solutions and thus provide technical stimulation. Professional team members may also better accept authority based on expertise than hierarchy alone (ibid; Mumford et al., 2002). Furthermore, the literature on creativity highlights the need for leaders to be able to provide evaluation and feedback on creative research and development efforts, which, on the other hand, requires substantial expertise (Gibson and Mumford, 2013; Zhou, 2008). On the negative side, technical expertise in the domain may entice the project manager to delve too deeply into the role of technical expert at the expense of more fundamental leadership behaviors (Valle & Avella, 2003). Nevertheless, as the premature evaluation and criticism of ideas must be prevented by leaders (Farris, 1972), one could argue that a lack of domain experience may even be beneficial for leaders in exploratory projects and allow them to avoid judging ideas.

6.1.3 Challenges in project team member participation

Most project managers noted having faced considerable challenges in eliciting full benefit from the heterogeneity of the team, such as finding ways to work
with diverse (multidisciplinary and multicultural) team members and including team members from off-site locations and minority backgrounds. To maximize the diverse perspectives and expertise in the multidisciplinary team, project managers made many attempts to activate team members by actively requesting opinions, explicitly encouraging participation in tasks, dividing the team into smaller subgroups, and contacting quieter members to elicit their views. However, challenges related to team diversity were already visible in the early phases of the project, as project managers struggled with integrating the various approaches and perspectives of multidisciplinary teams into idea generation (Articles I–II). Also, differences in educational and cultural backgrounds and off-site team members made creating a common vision and understanding of the project a challenge. This problem appeared to be exacerbated by the vast majority of, if not all, team members working together and with the project manager for the first time. This challenge may be somewhat mitigated in a company setting, where often, at least part of the team possesses previous experience working together; however, innovative projects do tend to utilize, at least partly, novel team compositions. Hence, project managers must simultaneously identify the best ways of working with each team member, demonstrate concern for their unique problems and approaches to work, and provide developmental opportunities according to individual needs and desires (Bass, 1988; Keller, 1992), as well as create shared working practices that accommodate and enhance the effectiveness of collaboration between individuals from a wide variety of backgrounds.

Utilizing the skills of a multidisciplinary team in a rapidly changing project environment remained a challenge throughout the project (Article I). In fact, challenges related to identifying suitable roles and establishing active participation more than doubled as the projects proceeded, while reported activities decreased. Hence, the accumulation of problems seemed to lead to eventual disregard, and it seemed that once a certain threshold was passed, project managers shaped their roles to emphasize those activities that seemed to bear the most fruit and, instead of continuing to reformulate, abandoned those that were unsuccessful. Earlier research (Selmer, 2002) has found that in response to stressful project problems, project leaders may choose mental avoidance as their strategy to cope with the situation, which eventually leads to a task-oriented approach. Furthermore, previous research has found that active information exchange contributes to team creativity (DeDreu and West, 2001) and that leaders play a critical role in encouraging effective intellectual exchange in teams (Atwater and Carmeli, 2009). In solving ill-defined or wicked problems, as in exploratory projects, the ability to enable knowledge sharing within a diverse team is crucial (Edmondson, 2016).

### 6.2 RQ 2: How should experimentation be supported by the project manager in exploratory projects?

Articles III (Rekonen & Laakso, working paper), IV (Rekonen & Hassi, 2018), and V (Hassi & Rekonen, 2018) answer the second research question: How
should experimentation be supported by the project manager in exploratory projects? Next, I describe primary findings relating to this question.

6.2.1 Supporting transitioning between divergent and convergent phases

The findings of this dissertation suggest that moving between divergent (i.e. widening the problem space by generating a variety of ideas) and convergent (i.e. narrowing the problem space by refining and selecting best options) is a challenge for practitioners novice to experimentation, something acknowledged in previous research (Beckman & Barry 2007). To move from divergent toward convergent, the team must switch from conceptual thinking (abstract) toward concrete doing (concrete). This, on the other hand, requires the team to process a large amount of data related to the challenge at hand and extract crucial pieces of information. However, the studied project teams (Articles III–IV) and team members (Article V) faced difficulties in utilizing the data gathered (e.g. user studies, expert interviews) to create a better understanding of the problem to be solved, for example, identifying which key elements should be considered and how to move forward. Furthermore, moving toward convergent, and through that experimentation, necessitates the team’s selecting between potential ideas and concepts to be further developed and agreeing on the next steps to be taken. In other words, the team must make decisions. Nevertheless, as the findings of Article III demonstrate, team members may possess very different thoughts on which idea or concept should be selected for further development, thus making proceeding and choosing the correct time to move toward the concrete more difficult. As in ill-defined problems, completely objective or quantifiable evidence is not available to base decisions upon for choosing the idea or concept for further development, careful consideration of each alternative and willingness to consider various perspectives from team members is necessary. Without this, the team might revert to complying with the one who holds the strongest opinion and, in doing so, waste the innovative potential required for solving the ill-defined problems that characterize exploratory projects. Furthermore, the understanding of when the data had been sufficiently analyzed for deciding what to experiment on appeared to differ among team members. Often, teams proceeded toward experimenting from analysis only when the time pressures of deadlines forced them to choose an idea to test (Article III) or the researchers acting as facilitators forced the teams to decide on the next steps toward experimenting (Articles IV–V). Indeed, there appeared to be “an invisible barrier” causing procrastination in actually beginning the experiments, even in situations when the team could recognize the elements that should be experimented upon (Articles IV–V). The abilities to make sense of the information available, narrow the problem, and select between ideas and concepts (i.e. move from divergent toward convergent) are preconditions for experimentation. Therefore, it is crucial to note that these activities must be supported and that the project manager plays an important role in facilitating the idea or concept selection process as well as recognizing when diverging is sufficient and it is time to move toward converging.
6.2.2 Fostering iterations

The existing literature acknowledge the necessity of iterations for learning through experimentation (Thomke, 2014). Indeed, experiments should not be thought as one-off activities but as continuous, and this requires utilizing the analyzed results from previous experiments for designing subsequent experiments (Loch et al., 2006). Furthermore, the findings of Article V propose that the thinking style of iterating between the abstract and concrete is central to experimentation. This thinking style is highlighted in the early stages of the experimentation cycle in Stage 1. Identify uncertainties and Stage 2. Design an experimentation setup. In the former, the thinking style of iterating between the abstract and concrete allows breaking down the conceptual idea into smaller component parts without losing sight of the initial problem to be solved or the overall objective to be reached, whereas in the latter, it enables identifying concrete actions that could produce the desired learning related to the identified uncertainty of the idea. These resonate with the idea of Kolb (1984), where learning is considered something requiring opposing abilities: combining concrete experiencing with abstract conceptualizing as well as combining active experimentation and reflective observation. Furthermore, according to Beckman and Barry (2007), innovation can be regarded as an iterative learning process that requires moving between abstract and concrete realms. Iterations are a key element, occurring frequently in the design process (Adams et al., 2003; Jin & Chuslip, 2006).

However, the findings of this dissertation propose that the iterative approach is demanding for practitioners novice to experimentation. For example, iterating between the conceptual thinking of a higher-level abstraction, such as the overall objective of the project, and the practical and concrete thinking of, for example, how to design the experiment, turned out to be difficult for practitioners (Article V). Articles III and IV, for example, revealed that most participants struggle after having completed the first experiment; they were either unwilling to conduct further experiments or unable to recognize the remaining uncertainties of the idea that required further testing. The findings thus reveal that the mindset toward the nature of experimenting (i.e. the attitude toward the iterative nature of development, where learning is accumulated through multiple experiments) is central for experimentation to occur in the first place. If the iterative nature of the approach is not properly understood, novice design teams may interpret the need for conducting further experiments as failure, since they could not isolate all of the uncertainties related to their idea in the first experiment. The findings of Article III also demonstrate that for some, experimenting with an idea is associated with locking down the idea, not with remaining open to exploring different options, which again may increase reluctance to begin experimenting. Hence, considering experimentation as, first and foremost, a vehicle for learning to inform future activities that may be both divergent or convergent is not self-evident and must be clearly communicated to project teams. These findings support earlier research that has noted that experienced designers tend to iterate more often, while practitioners with less design-thinking capability tend
to move to the convergent mode earlier (Adams et al., 2003; Seitamaa-Hakkarainen & Hakkarainen, 2001). When it comes to experimentation, this urge to converge has far-reaching effects (Articles III–V). First, it affects how well the team can keep in mind the initial, upper-level problem to be solved. If the professionals do not see the value of the iterative approach, they most probably are not motivated to conduct further experiments, to recognize remaining uncertainties that would require further testing (Articles III–IV) nor to switch back to the divergent thinking that allows keeping the idea open for different development opportunities (Articles III–V). This results in overlooking ideas for the experimentation setup of both others and oneself and hence impedes the team from moving forward in the experimentation cycle (Article IV). As the findings of Articles IV and V demonstrate, the studied teams and individuals were more eager to quickly implement ideas rather than learning about the problem at hand. This may also be because experimentation for practitioners novice to such an approach requires courage and stepping out of one’s comfort zone, as the findings of Article IV propose. In this, practitioners must open their unfinished ideas to early evaluation by the user and be prepared to receive instant feedback. The only way to discover how users respond to an idea is by placing oneself in a vulnerable situation and facing the risk of refusal and failure. Moreover, if teams are not mentally prepared or receptive for further development, they will most probably lack the motivation for iterations and be eager to freeze the idea sooner. Hence, a crucial task for project managers in exploratory projects is to mentally prepare the project team for the nature of experimentation and ensure that they are aware of the iterative nature of development and are acting accordingly.

Previous studies on experienced designers have proposed that experienced designers make a preliminary evaluation of their tentative decisions and take the time to consider whether or not it is worthwhile to move forward with the possible solution (Ahmed, Wallace & Blessing, 2003). The findings of the current study, on the other hand, suggest that once a satisfactory solution has been identified, reluctance toward further exploration exists among practitioners novice to experimentation. However, due to the nature of wicked problems in exploratory projects (BenMahmoud-Jouini et al., 2016) and a lack of definite measures for the “correctness” of the solution (Rittel & Webber, 1973), it is unlikely that the first iterations will produce the best possible solution. As the findings of Article III demonstrate, locking in on a direction to pursue brought high levels of relief and satisfaction for the project teams. Hence, project managers must be aware of the possible urge to converge and inertia for further exploration through experiments and work to mitigate it.

6.2.3 Supporting learning from experiments

Furthermore, the findings of the dissertation propose that in addition to supporting the project teams in moving between the divergent and convergent phases and fostering iteration, how the project team can reflect on the results of the experiments and extract learning from them requires special attention from the project manager. For experimentation to serve its purpose, the project team
must be able to attain learning from them. The findings of Article IV demonstrate that the urge to converge hindered reflection upon feedback and iteration. For continuous reflection and iteration to occur, postponing fixation on an idea and remaining open to exploring different possible directions before closing in on a single option (i.e. unattached exploration, Article V) is required. Unattached exploration is needed in the final stage of the experimentation cycle (Stage 5. Reflect on the feedback and iterate), as it allows for an open-minded search for alternative solutions when considering the implications of the feedback received from experiments and when deciding on potential new directions for the idea being developed. Moreover, the findings of Article V suggest continuous reflection as a thinking style central to experimentation. Continuous reflection was noted to be needed throughout the different stages of the experimentation cycle, as it supports noticing new information and considering its implications on the idea being developed and hence plays a particularly highlighted role in promoting experimentation behavior. This aligns with the view of experimentation as a learning process (Thomke, 2014). Kolb (1984) has noted that learning is a continuous process, in which the learner reflects from various perspectives on the action taken. Reflection is also a key element in design. In this, design is regarded as a process of reflection-in-action, where the problem at hand is gradually restructured and improved, which rarely occurs in a single burst at the beginning of the design process (Schön, 1983). Moreover, the findings of Article V propose that the final stage of the experimentation cycle, reflecting on the feedback and iterating, is particularly demanding, as it calls for certain thinking styles, personality traits, and experimentation skills simultaneously. This is also the stage where the practitioner can either reflect on the previous activity and build upon it in the subsequent steps or decide to interrupt the continuous learning process, most often prematurely.

Moreover, analyzing the feedback received from experiments requires special attention from the project manager. As the findings of Article V propose, extracting learning and implementing learning and idea adaption are central experimentation skills, yet they might be difficult to attain. The findings demonstrate that practitioners novice to experimentation experienced difficulties in realizing what information is valuable for the project at hand (i.e. extracting learning, Article V). When reflecting on the feedback and iterating (Stage 5 of the experimentation cycle) practitioners often overlooked unexpected information or events, bypassed meaningful comments, or failed to see their significance or how the feedback could be used to improve the original idea (Articles IV and V). However, even if the team or members of the team excel at reflective discussion and extracting meaningful learning from the experiment, this does not guarantee that the learning is reimplemented into the project or that the idea is adapted accordingly (i.e. implementing learning and idea adaption, Article V).

Furthermore, the findings of Article IV demonstrate that feedback from experiments appears to have multi-fold effects. First, if the first experimentation further supports the assumed need behind the idea, and the
team can quickly process this strengthening experience, the team may become more empowered and confident and also resistant to possible future setbacks. However, receiving supportive feedback from the first experiment may also have counter-effects: it may again make the team less willing to further develop the idea and unable to recognize the value that conducting further experiments could offer. The prevailing attitude appeared to be that the idea is ready to be implemented if the first experiment receives supportive feedback; this thinking easily leads to the convergent mode, from which it is difficult to switch back to the divergent mode. Practitioners may also be so confident about the assumed need for their idea that they only seek supportive information from experiments and are unable to utilize learning from other types of signals. Hence, if the team is very confident in their idea being “ready” and their possessing all of the relevant information to successfully implement the idea, little motivation generally exists to revisit the idea for further experiments. The findings of Article V suggest that a psychological characteristic of intellectual humility, or a mindset that is humble in the face of new information and open for learning by acknowledging the limits of one’s own knowledge, enhances learning in experimentation. On the other hand, if the team is hesitant about the “importance” of their idea in the first place, and they receive non-supportive feedback from the first experiment, they will probably become even more doubtful and uncertain about how to proceed. Article IV also demonstrates that in these cases, teams may lose track of the overall vision, which makes them unable to see other possible paths through which the same vision could be reached. Hence, the key lies in being able to objectively analyze and discuss the results of the experiment with an open mind and without prejudices, and the project manager is in a natural position to support this.

The findings of all three articles that address the second research question demonstrate the difficulty of meaningfully feeding the information gained from experiments back into the design. As one interviewee from Article III noted, “This feedback loop was missing.” Thus, the findings of these articles propose that explicit managerial attention should be directed toward supporting learning from experiments, first by acknowledging what the learning goals for experiments are and second, by transferring the learning back to the iterative and gradual learning process.
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| How do project managers approach exploratory projects, and what types of challenges do they encounter in managing them? | I, II   | • Managerial approaches of novice project managers were strongly tilted toward task-oriented (vs. people-oriented).  
• Within task-oriented approaches, developing a shared sense of direction and defining role expectations are highlighted in the early phases, whereas the allocation and scheduling of resources dominated the latter development phases.  
• Within people-oriented approaches, activities such as encouraging exploration and minimizing fear of failure were highlighted primarily in the very beginning.  
• The transition phase from divergence, “fostering exploration,” to convergence, “fostering execution,” phases revealed to be somewhat challenging, as the change in the nature of work required project managers to rethink their roles.  
• Project managers lacking the domain expertise needed to bear more uncertainty, as they were unable to predict or help to solve technical problems that occurred during the project.  
• Utilizing the skills of a multidisciplinary team through team member participation remained a primary challenge during the exploratory projects.  
• Although all project managers recognized the importance of having an open and trustful atmosphere within the project team, not all took concrete actions toward it. |
| How should experimentation be supported by the project manager in exploratory projects? | III, IV, V | • Moving from divergent toward convergent seemed to be a challenge for practitioners novice to experimentation and, hence, must be supported by the project manager in both facilitating the idea or concept selection and recognizing when diverging is sufficient and the time is ripe for moving toward converging.  
• Iterative development approach of experimentation requires special attention from the project manager; the practitioners accustomed to a more linear approach were facing challenges in keeping the idea open for further development after the first experiment and often were reluctant to conduct further experiments.  
• The last stage of experimentation cycle, reflect on the feedback and iterate, seems especially challenging and in many cases become the bottleneck for practitioners for proceeding in the experimentation cycle. Explicit managerial attention should be put in supporting this stage and ensuring the project team is taking time to objectively analyze and discuss the results of the experiments.  
• Practitioners novice to experimentation often neglected valuable information regarding their idea being developed. Hence, project managers must place special attention on acknowledging what are the learning goals for experimentation and ensuring the learnings are transferred back to the iterative and gradual learning process.  
• Different stages of the experimentation cycle call for different types of approaches from the project team and, hence, must be supported differently. For example, Stage 2. Design an experimentation setup calls for pure idea generation and thus creativity, while Stage 5. Reflect on the feedback and iterate requires analytical thinking and the ability to extract learning. |
This section focuses on describing how this dissertation contributes to the project management literature, particularly to the research stream on the management of exploratory projects. The findings provide valuable insight by broadening our understanding of the practical actions and managerial approaches that project managers use in their daily coping with exploratory projects and, on the other hand, by providing an in-depth understanding of the experiences of project teams working in these ambiguous projects that aim to create knowledge in an unknown territory.

7.1 Reflection on the primary findings

Although the project teams investigated in this dissertation comprised members who are not experienced professional designers (Articles III–IV) but can be considered novice or, at best, advanced beginner according to the levels of design expertise proposed by Lawson and Dorst (2009), they resemble a typical situation of project teams composed of non-designers with basic-level knowledge on design-thinking methods and approaches embarking on exploratory projects. Furthermore, the studied project managers (Articles I–II) could be considered novices or advanced beginners in the terminology of Dreyfus and Dreyfus (2005) and were facing a given problem and a given situation for the first time or possessed very little real-life experience. Nevertheless, as the project management discipline is largely built on the optimizing model as a dominant paradigm (Davies et al., 2018), highlighting “control over flexibility” (Lenfle & Loch, 2010), project managers will, in many cases, possess only minimal real-life experience in managing exploratory projects in which the goal or the means to reach the goal are not known at the outset (Lenfle, 2008). Hence, the findings indicate issues that are likely to be faced in a significant share of exploratory projects in various contexts.

Existing studies on exploratory projects recognize the central role of knowledge creation (Lenfle, 2008, 2016; Loch et al., 2006). It has, for example, been argued that exploratory projects should be viewed as reflexive probes and learn processes (Lenfle, 2008) or conceptualized as “experimental learning processes” (Loch et al., 2006) and that the efficiency of managing exploratory projects comes down to the efficiency of managing knowledge creation (Lenfle, 2008). The findings of this dissertation demonstrate the difficulty of dealing with wicked or ill-structured problems; the studied participants struggled with, first, identifying fruitful directions to pursue in attempts to solve the initially
ambiguous problem and, second, in being able to move toward concrete and create learning about the problem at hand through iterative experimentation. Furthermore, previous research on the management of exploratory projects has identified project reviews as a critical point for sensemaking (Loch et al., 2006; Lenfle, 2011) in managing knowledge creation. The findings of the dissertation propose, however, that the need for supporting sensemaking begins at the very beginning of the exploratory project. As discussed above, a primary difference between exploratory projects and more traditional development projects is that exploratory projects begin by finding the right problem to be solved, not by solving a predefined problem. For the project team to be able to proceed toward experimentation in the first place, they must move from observations toward creating ideas to be further explored (Beckman and Barry, 2007), which is a process that requires the analysis and synthesis of the data (i.e. sensemaking). As the findings of the dissertation suggest, project teams novice to exploratory projects and the iterative development process struggled with transferring from abstract thinking toward the concrete, which hindered their ability to move toward experimentation, the central activity of exploratory projects.

Furthermore, the existing literature on the management of exploratory projects acknowledges the central role of experimentation (Lenfle, 2008, 2016; Loch et al., 2006). For experimentation to serve its purpose, the project team must be able to obtain learning from experiments (Thomke, 2014). Furthermore, the importance of project reviews (Article III) and tutoring sessions (Articles IV–V) was evident as deadlines, which drove the experimentation activities. However, due to its central role in learning (Liedtka, 2014), experimentation could and should have been initiated earlier and relied less on pressure from imminent deadlines. Moreover, a key aspect of successful experimentation has been noted to be the analysis and interpretation of the findings of the experiment (Loch et al., 2006; Thomke, 2014), and the role of the project manager to be tracking the experimentation cycle to ensure what is being learned, what should be solved next, and whether the problem can be redefined (Loch et al., 2008). Nevertheless, the findings of this dissertation propose that learning from experimenting is not a straightforward process, and project teams (novice to experimentation) may, for example, easily bypass even valuable information received from experiments. Furthermore, according to Lenfle (2016), project reviews in exploratory projects work as a moment of “reflection in action” (Schön, 1983), during which results are jointly discussed and the course of action decided. This reflection-in-action, however, must be supported and facilitated by the project manager; the findings of the dissertation suggest placing explicit managerial attention on ensuring learning from experiments, both by acknowledging what the learning goals for experiments are and by transferring the learning back into the iterative and ongoing sensemaking activity.

Moreover, while existing studies describe the process of experimentation (Loch et al., 2006) and what trial-and-error learning systems require from the perspective of planning and monitoring (Loch et al., 2008), little is written about how the nature of work differs between stages or, further, the need for
managerial support. However, the findings of this dissertation demonstrate that
the different stages of the experimentation cycle or process require different
types of approaches from the project team and hence different types of support
from the project manager. For example, the findings of the study demonstrate
that while some phases require pure idea generation (e.g. Stage 1. Identifying
uncertainties and Stage 2. Design and experimentation setup), others call for
analytical thinking and an ability to extract learning (e.g. Stage 5. Reflect on
feedback and iterate). Recent research on project management has noted that
in exploratory projects, project managers come to address the creative issues in
the upstream of projects (BenMahmoud-Jouini et al., 2016). The findings of the
current research support this view by arguing that creativity is essential in
experimentation. The findings propose that experimentation skills designing
valuable experiments and implementing learning and idea adaption, both
involve generation of novel and useful ideas and hence, creativity (Article V).
Furthermore, as experimentation is a central characteristic of an exploratory
project, project managers must increasingly foster creativity in project teams.

Although the existing literature on the management of exploratory projects
notes that entering exploration requires a fundamental shift in project
management (Lenfle, 2008), discussion on the nature of work in exploratory
projects is rather limited. Exploratory projects move away from delivering given
targets to open problems for which the projects propose solutions (Lenfle &
Loch, 2010). As the findings of the dissertation suggest, the process of
approaching ill-defined problems, suggesting alternatives for possible
solutions, and accumulating learning through iterative experiments may be
challenging. Existing research on managing innovative projects highlights the
role of domain expertise in project management (see e.g. Barckzak and
Wilemon, 1989; Clark and Wheelwright, 1992; Kim, et al., 1999). However, the
findings of current research suggest the central role of process knowledge in
exploratory projects, as the role of the project manager moves from overseeing
the efficient execution of the project on time and on budget toward facilitating
the iterative development process by ensuring the project team is not
converging too early and can extract learning from experiments. As noted by
Loch et al. (2006), the more exploratory the learning in the project, the less
efficient progress toward the target becomes.

Indeed, entering exploration entails a fundamental shift in project
management, as noted by Lenfle (2008). This shift implies that in many cases,
project managers are novice to the process and methods useful in the context of
exploratory projects. Furthermore, addressing wicked problems with
incomplete and changing requirements necessitates transcending analytical
problem-solving approaches and integrating experts from different fields
(Edmondson, 2016). However, these experts are not necessary experienced in
applying the approaches proven to be useful for solving these wicked problems:
that is, design-thinking approaches. As Johansson-Sköldberg et al. (2013, p.
131) have noted, design thinking is sometimes presented as a “designer’s specific
methods taken out of the context as tools ready to use and ignoring the fact that
the person using the tools must have an appropriate knowledge and skills –
competence that comes with training – to be able to use them.” The findings of the dissertation support this notion and highlight the need to better understand the nature of work and the experience of practitioners in exploratory projects to know how these types of projects should be managed.

Finally, academics (Lenfle et al., 2018) in the field have noted that to fully understand the logic of exploratory projects requires abandoning “the traditional view of the firms as rational machine-like entity” and drawing on the social and creative character of businesses revealed in design thinking (Hobday, Boddington, & Grantham, 2012, p. 18). However, it is noteworthy to acknowledge that these design-thinking practices highlighting diverging, interpretative, generative, and ambiguity-tolerant approach toward problem-solving (and problem finding) have been found to clash with the more linear approaches to problem-solving dominant in many organizations (Carlgren, Elmquist, & Rauth, 2016). The clash of logics between design and rational methods of thinking prevailing in many organizations has been stressed in design research (Rylander, 2009) as well as in project management research (Lenfle & Loch, 2010). The findings of the dissertation also highlight the struggle of adopting the divergent/convergent nature of working that facilitates problem reframing and idea generation at different phases of a project as well as for iterative experimentation among practitioners accustomed to more linear approaches. Hence, changing from the “decision attitude” toward a “design attitude” is easier said than done: the former serves well linear processes when solving existing, relatively stable problems with clearly indicated alternatives, and the latter maneuvers with the iterative approach, moving between the problem and the solution in a parallel manner to tackle open-ended, ill-defined problems (Boland & Collopy, 2004; Dorst, 2011; Dunne & Martin, 2006). Although design-thinking approaches have been suggested to provide important contributions to the management of exploratory projects (BenMahmoud-Jouini et al., 2016), this only occurs if the nature of these approaches are well understood, as the findings of this dissertation suggest. This, I believe, is an area of specific significance in the research stream on the management of exploratory projects.

7.2 Limitations and transferability of findings

The empirical data for this dissertation was collected within two graduate-level courses taught by a Finnish (Articles I and II) and a US University where the Finnish University is one of the collaboration partners (Article III), and within one Finnish financial institution (Articles IV and V). Hence, the findings are based on three datasets and five sub-studies, which adopt different perspectives on exploring the management of exploratory projects.

In exploring how project managers approach exploratory projects and what types of challenges they encounter in managing them (RQ 1), the findings are limited to the perspectives of the project managers (Articles I–II) and do not investigate or include the perspectives of their project team members. This was a conscious choice, and it is obvious that in this perspective, these findings
provide a one-sided view in answering the first research question. It is, for example, possible that the experiences of project team members in relation to the managerial approaches and challenges would differ. It is also possible that the project managers were unaware of some of the challenges faced by project team members during the projects that would have required the project manager to act. However, to provide a holistic picture of the management of exploratory projects, three sub-studies (Articles III–V) explored this phenomenon from the perspective of a project team and its members.

It can always be speculated that how well interviewees were able to make a distinction between the used managerial approaches and those they intended to use. However, the interview rounds occurred while the projects were running, and the author aimed to back up the reported managerial approaches and challenges by asking interviewees to provide concrete examples of how these reported managerial approaches, as well as challenges, manifested.

The empirical data of Articles I and II is situated in the context of university course, in which the students are in the late stage of their master’s studies. It is possible that some of the challenges faced by the interviewees are due to their being “novices” (i.e. facing a given situation for the first time or possessing scarce real-life experience) (Dreyfus and Dreyfus, 2005). However, most of the interviewed project managers possessed several years of working experience in their fields, although it was accrued in various summer and part-time jobs. Furthermore, as acknowledged in the discussion on managing exploratory projects, entering exploration entails a fundamental shift in project management, as project management moves from optimizing toward an approach that is creative and open-ended (Lenfle, 2008; BenMahmoud-Jouini et al., 2016). Hence, being experienced in project management per se does not necessitate one being better in managing exploratory projects. Rather, as existing studies have identified, management principles necessary for exploratory projects differ from those applicable for more traditional development projects (see e.g. Loch et al., 2006; Lenfle, 2008; Davies, 2014), and hence, in many cases, experienced project managers may be novice to the process and methods useful in the context of exploratory projects. This highlights the need to better understand how novice project managers deal with exploratory projects and what type of challenges they encounter in managing them.

The empirical data of Article III is also situated in the context of a university course. As with the empirical data collected for Articles I and II, in the empirical context of Article III, students were also working with real-life cases of company sponsors and, hence, were working for a real client throughout the projects. Furthermore, both courses provided a structure and a process for concept development that is arguably comparable to those in organizations. As with employees in organizations, the students in these courses also needed to acquire, share, integrate, and synthesize knowledge.

Furthermore, one could argue that due to the university course setting, some of the students did not take their roles as seriously as they would in an industry setting. However, in both of the courses, the students were selected for the
course based on applications. In addition, regarding the empirical data of Articles I and II, all of the project managers were required to apply separately for the project manager position. Hence, each of the interviewees of Articles I and II were willing to adopt the duty of managing the projects.

The empirical data collected for Articles IV and V being collected within one case organization can be regarded as a limitation to our study. It is also noteworthy that the participants were developing internal processes of the organization, not products or services for customers, which may affect the findings. The experimentation sprints launched by the researchers were rather short in duration, which may pose limitations; longer periods may have allowed additional issues to arise. It is also notable that the organization under study was only beginning to apply experimentation in their innovation activities. Therefore, the existing organizational culture and structures may not be supportive toward experimentation, which may affect the perceived challenges.

One might also argue that in the empirical context of Articles IV and V, the participants were less motivated to exploit experimentation efforts, as this was not something directly required in their everyday work. However, in this study, top management was interested in introducing experimentation as an additional approach to its innovation activities, and management strongly encouraged participants to actively take part in experimentation activities during the sprints launched by the researchers. Furthermore, for the second experimentation sprint, launched by the researchers at the Finnish financial institution, the participants were asked to apply for the sprint and by doing so indicated their motivation to participate. For Sprint 1, participants were selected based on the recommendation of their superiors. However, the challenges faced by participants were quite similar in both experimentation sprints.

In exploring how experimentation should be supported by the project manager in exploratory projects (RQ 2), the findings (Articles III–V) are limited to the perspectives of practitioners new to such an approach. It is possible that the need for experimentation support would differ in cases of experienced practitioners. Recent research in project management has proposed that problems in exploratory projects are comparable to those for which design thinking is appropriate and that approaches central to design thinking, such as experimentation, could benefit project management to address challenges in this context (BenMahmoud-Jouini et al., 2016). However, as noted by Edmondson (2016), addressing wicked problems with incomplete and changing requirements necessitates transcending the analytical problem-solving approaches and integrating experts from different fields. In many cases, these experts are not necessarily experienced in applying the design-thinking approaches and hence might stumble with the iterative approach where learning must be created through experiments. Therefore, increasing our understanding of how experimentation among practitioners new to such an approach should be supported by project managers provides valuable knowledge on the management of exploratory projects. The findings are transferable to other project contexts with ambiguous goals requiring learning-
rather than decision-oriented approaches and involving participants from various disciplines.

### 7.3 Theoretical contributions

The research settings in this dissertation provided an opportunity for real-time study, which is rare among studies on exploratory projects. Many existing studies on the management of exploratory projects adopt a retrospective approach in their investigations (see e.g. Lenfle, 2016) or provide illustrative examples to enhance reader understanding on these types of projects (see e.g. Frederiksen & Davies, 2008). The research design of the current study, on the other hand, enabled project managers and teams to be followed during different phases of exploratory projects, and doing so provides insights into the first-hand experience of practitioners immersed in solving ill-defined problems in such projects and reveals interesting insights into the dynamic nature of exploratory projects. The findings of the dissertation make several theoretical contributions to the existing knowledge on managing exploratory projects, which are discussed next.

First, this dissertation provides new insight into the managerial activities and challenges of project managers in the context of exploratory projects. The categorization and description of project manager activities and challenges have not previously been presented or discussed in the research on the management of exploratory projects. Nevertheless, previous research has identified the need to better understand the difficulties faced by project managers in exploratory projects (Lenfle, 2016). In the current study, the categorized managerial activities and challenges were classified under task- and people-oriented approaches, which demonstrated that task-oriented activities, such as clarifying roles, setting goals, and coordinating the whole, were dominant throughout the project, while people-oriented challenges, such as integrating heterogeneous team members to the project, remained a challenge throughout the project. This finding is crucial, as solving wicked problems in exploratory projects often requires integrating the expertise of diverse disciplines (Edmondson, 2016). Although studies bridging project and innovation management acknowledge the necessity of integrating expertise from diverse functional areas (see for example Lenfle, 2008; Tatikonda & Rosenthal, 2000), how project managers actually aim to foster this multidisciplinary teamwork and the types of challenges they face in doing so has largely been left unattended. However, previous research has noted that if not properly managed, differences in skills and knowledge may lead to significant interaction difficulties among members (Milliken et al., 2003). Hence, returning to the role of project manager in enabling multidisciplinary teamwork in the context of exploratory project is necessary.

Second, this dissertation offers valuable new knowledge on the dynamic nature of exploratory projects by investigating the approaches and challenges of project managers and project teams alike during an exploratory project. As the findings of the current study propose, the concerns and approaches of project
managers did not remain static throughout the project but varied between phases. Although the research stream on the management of exploratory projects commonly acknowledges the need to tailor project manager approaches for these types of projects, the dynamic view is largely missing in the current discussion. The present study provides nine propositions that describe the evolution of managerial approaches and concerns during an exploratory project. Moreover, the findings of the dissertation suggest that in particular, the divergent (i.e. generating alternative solutions to the problem or challenge at hand) and convergent (i.e. narrowing down the problem space to choose solutions to continue working with) phases central to exploratory projects call for different types of approaches and mindsets from both the project manager and the project team and must be managed accordingly. Most of the studied novice project managers needed to reconsider their approaches when moving the project from the divergent, exploration-type approach toward the convergent, execution-type approach. Furthermore, transitioning between these two phases was a significant challenge faced by the project teams investigated. Managing divergent approaches and the transition toward convergence is a fundamental difference in exploratory projects compared to more traditional development projects, which begin from converging toward a predefined objective. Thus, acknowledging that these two approaches differ greatly by nature and call for different types of support is noteworthy. The nature of divergent and convergent approaches are discussed in the innovation management literature (Van de Ven, 1999; Buijs, 2007) and design research (Lawson, 2006; Beckman and Barry, 2007; Leifer & Steinert, 2014) (Badke-Schaub et al., 2010; Beckman, 2007; Leifer & Steinert, 2014) alike, but their connection to the literature on the management of exploratory projects has been absent from the discussion. Furthermore, although existing research in project management acknowledges that different managerial approaches are required (e.g. in the front-end phase as opposed to the later development phases) (Edkins et al., 2013) and that the creative parts of the project must be managed differently from routine parts (Brocke & Lippe, 2012; Lenfle & Loch, 2010), little attention has been given to identifying the various types of managerial approaches required within an exploratory project. However, the findings of the current research clearly imply that different managerial approaches are also needed during an exploratory project.

Third, the findings of the dissertation suggest that in the context of exploratory projects, the role of the project manager expands from planning and monitoring toward creating circumstances where creative problem-solving can occur. For example, the findings propose that creativity (i.e. the generation of novel and useful ideas) is essential in experimentation (Article V), a key characteristic of exploratory projects (Lenfle, 2008). Generating ideas for how to conduct the necessary experiments is a central activity in designing experiments, as this is where the project team designs how they can create the necessary learning and uncover the identified uncertainties. This is essentially analogous to any idea generation situation and calls for similar psychological safety as any creative efforts where project team members take the interpersonal
risk of suggesting new ideas or perspectives. The findings also suggest that practitioners novice to experimentation can easily overlook others’ ideas, which may have an discouraging effect within the team and impede their moving forward with experiments (Article IV). Managerial approaches fostering innovativeness and learning, such as creating a climate for psychological safety (Edmondson, 1999; Garvin, Edmondson, & Gino, 2008) and minimizing the fear of failure (Farson & Keyes, 2002), are well-acknowledged in the innovation management literature; however, they are not easily associated with project management. This is understandable, as traditionally, project managers are involved in the projects from the planning and development phase onward, when the objective of the project has already been defined (Besner & Hobbs, 2008), and hence, less need for creative approaches exists. However in exploratory projects, project managers must increasingly address creative issues in the early phases of projects (BenMahmoud-Jouini et al., 2016), and in this, approaches supporting the creative efforts of project teams are vital. Interestingly, the findings of the current study also demonstrate that although the project managers noted the necessity of creating an open climate supporting creative efforts, concrete actions toward this goal were rather scarce.

Fourth, this dissertation contributes to the research on the management of exploratory projects by investigating practitioners novice to exploratory projects and experimentation. This view is valuable, as it has been noted that “entering exploration entails a fundamental shift in project management methodology” (Lenfle, 2008, p. 477). This means that in many cases, project managers are novice to the methodologies central to managing exploratory projects. By providing new knowledge on the types of challenges novice project managers face during an exploratory project, the findings of the dissertation provide a productive basis for creating a better understanding on what this “fundamental shift” means and necessitates in practice. Furthermore, the current research investigates the experiences of project teams and team members novice to exploratory projects and through this provides valuable insights into the management of these projects. For example, the findings suggest that the iterative approach of exploratory projects, which requires moving between abstract and concrete thinking and divergent and convergent approaches, may be challenging for practitioners novice to such an approach. Furthermore, the perspective of the project team and individuals on the team is largely missing in the prevailing discussion on the topic. Current research on the management of exploratory projects has primarily been conducted on a “meso-level” (Geraldi & Söderlund, 2018), focusing on a project as a level of analysis and exploring the methods to manage these types of projects (see for example Lenfle, 2008, 2016 Sommer & Loch, 2004). Based on the findings of this research, it appears that a pronounced need exists for better understanding the experiences of individuals (project manager, team member) and project teams working in exploratory projects and, hence, of focusing on the “micro-level” (e.g. people and teams in projects; Geraldi & Söderlund, 2018) of analysis.

This brings us to the fifth contribution of this dissertation. The findings of the current research offer valuable insight into the management of experimentation.
in exploratory projects. By adopting a “micro-level” view in investigating how practitioners novice to the approach undertake experimentation, the current study offers new knowledge regarding the types of challenges project teams encounter during experimentation (Article IV). Examining the micro-level issues in experimentation has revealed that reflecting on the feedback of experiments and interpreting their influence on future steps is one of the most demanding features of experimentation for practitioners novice to such an approach. Moreover, the findings of the dissertation suggest that different stages of experimentation call for different individual characteristics and provide five propositions describing individual-level characteristics promoting experimentation behavior in various stages (Article V). These aspects have not yet received attention in the research on the management of exploratory projects, as currently, the same “what should be done” view characteristic to the project management field in general (Cicmil et al., 2006) is present in the current discussion on the management of exploratory projects regarding experimentation (Loch et al., 2006; Lenfle, 2008; Loch et al., 2008). However, the need to better understand the nature of experimentation and its implications on project management becomes increasingly important, as experimentation is a central element of exploratory projects.

Finally, the findings of the present study highlight the importance of continuing to bridge the gap between the project management and design research literatures (Gillier et al., 2015; Lenfle, 2016; Lenfle, Masson, & Weil, 2016; BenMahmoud-Jouini et al., 2016), but they suggest adopting a new perspective. While the existing research employs design theory to explain the logic of exploratory projects (Lenfle, 2016; Lenfle et al., 2016) or how approaches in design research could benefit the management of exploratory projects (BenMahmoud-Jouini et al., 2016), they provide only a limited understanding regarding the core practices of designers that are necessary for solving ill-defined, open-ended problems. Creative design projects with the goal of pursuing novel and innovative outcomes are, by nature, exploratory projects. They are characterized by ill-defined or wicked problems and uncertainty in both the desired end goal and how to achieve it (Dorst, 2011). As design disciplines have developed elaborate professional practices for these types of challenges, delving into designers’ core practices and cognitive processes offers a promising avenue for better understanding the logic of exploratory projects.

Research on the management of exploratory projects is in its infancy (Lenfle et al., 2018), and case studies are still rare (Lenfle, 2016), as is the action-research approach, both of which are employed in this dissertation. Nonetheless, action research has been proposed as a suitable strategy for engaging in critical dialogue with a practitioner, who then reflects and interprets their own experience (Cicmil et al., 2006), and thus offers a medium for creating rich insights into the logic of exploratory projects. Furthermore, the academic community of project management has called for innovative approaches in project management research (Müller & Söderlund, 2015; Müller, 2015); however, the majority of project-related research is very traditional in its design, as researchers rarely choose to utilize research methods other than interviews.
or questionnaires to discover new insights (Müller & Söderlund, 2015). With the action-research approach, the current study was able to find issues essential to consider when managing exploratory projects (i.e. the need to support learning in experimentation) and create understanding on the “lived experiences” of practitioners working in exploratory projects, something academics in the field have called for (Cicmil et al., 2006).

7.4 Managerial implications

The findings of the dissertation suggest several managerial implications that should be considered in managing exploratory projects. First, as the project managers faced challenges in moving from the divergent phase toward the convergent, which required a reconsideration of their managerial approaches, they may benefit from explicitly considering the need for changes in their approach and mindset between these two phases, which are central when solving ill-defined or wicked problems in exploratory projects. Furthermore, it is crucial to acknowledge that as the nature of work changes, it may demand establishing different types of norms for the work of the project team or updating existing ones.

Moreover, the findings suggest that building a supportive and trusting atmosphere in the context of exploratory projects is critical, as the problems tackled are ill-defined and require team members from various disciplines to share their ideas and openly propose new methods of approaching the problems without the fear of negative judgement (i.e. climate of psychological safety). The project managers studied were facing difficulties in coaxing team members to share their unique points of view during different phases of the project. Even though the project managers noted the importance of creating an open and trusting atmosphere to support the innovative pursuits of the team, active attempts seemed to be buried under concerns that more concretely ensured the progress of the project. Hence, for practices supporting the open and trusting atmosphere and communication among the project team to become natural, well-rooted ways of working, they must be purposefully established in the early phases of the project. The findings of the dissertation propose that project managers could benefit from enforcing regular sessions for discussing not only how the project is proceeding but also how the project members are playing together as a team and how the team members feel regarding their roles in the project. For example, providing both positive and constructive feedback on the individual as well as the team level can elicit important discussions within the team. Hence, utilizing existing tools supporting teamwork in an exploratory project is recommended (see e.g. the team feedback method developed by the author: https://ilikeiwish.org).

Furthermore, the project managers faced challenges in assigning meaningful roles to all team members. Moreover, as solving ill-defined and wicked problems usually require diverse perspectives and hence multidisciplinary teamwork, the project manager or team members may not be familiar with the fields of others, which may challenge full utilizing the diverse team. Therefore,
to define meaningful roles, it is critical that the project manager be well aware of all of the skills and capabilities of the project team. In this, taking the time to have one-on-one discussions with team members to become aware of their talents and motivations may be useful. However, it is critical to notice that in exploratory projects requiring creative problem-solving, limiting skills to only those fitting the organizational role may not suffice. Due to the nature of wicked problems in exploratory projects, which lack a definitive measures of the “correctness” of the solution, the problem must be approached holistically and by utilizing all possible understanding one has accumulated related to the challenge at hand. Hence, the manager of an exploratory project should be interested in getting to know the project team members beyond their organizational roles (e.g. what types of capabilities they have accumulated through hobbies, etc.).

To support experimentation, the project manager must ensure that the development team is prepared for the iterative nature of development, which involves conducting several experiments and repeating the activities of the experimentation cycle. The findings of this dissertation reveal that resistance to iteration may become a barrier to accumulating learning through experiments. After conducting the first experiments, practitioners novice to experimentation felt strongly impelled to converge (i.e. to choose the solution to develop further) and did not believe that conducting further experiments would be worthwhile or were unable to recognize the remaining uncertainties that required further testing. The prevailing attitude appeared to be that ideas were ready for implementation if the first experiment received supportive feedback, and maintaining openness toward alternative development solutions appeared difficult. In addition, the project manager must communicate the importance of unsupportive feedback (meaning the initial idea must be updated or even abandoned) from the experiments, which may lead to important learning regarding the idea or problem being solved. In the current study, practitioners quickly interpreted unsupportive feedback from experiments as the experiments having failed, and did they not recognize the valuable information that had been offered.

Moreover, the project manager must support the team in extracting learning from experiments. The findings of the dissertation suggest that a “facilitator” (e.g. project manager) who is not deeply involved in creating the solution with the project team and hence is able to objectively observe the discussion and actions of the team is critical to ensuring that the team is keeping the idea open and reflecting objectively upon the results of the experiment. In the current study, researchers acted as external facilitators and aided project teams in reopening their ideas to different possible solutions and convinced them of the importance of conducting further experiments. This demonstrates that with a kind nudge from the facilitator, the attitude and approach of the team toward the project can change notably.

Moreover, reflection is an essential component of creating learning via experiments. Reflection is necessary to process the information created by experiments. Without taking the time for reflection, learning – the primary
objective of experimenting – is unlikely, and though this, informed future actions are as well. As reflection so significantly impacts learning within the project, project managers must offer a supporting structure (e.g. time, place, and guidance) for systematic reflection and ensure that time is taken to reflect upon the accumulation of learning throughout the project. In summary, to an unprepared mind, the iterative approach, which demands continuous reflection upon and updating of the solution, may be frustrating and lead to a lack of motivation and interest. Therefore, project managers must explain the nature of the work in experimenting to the project team up front. This allows practitioners to comprehend and appreciate learning as a measure of progress in experimentation. For the project manager to be able to provide the necessary technical and emotional support for the team, exploratory projects require a project manager who possesses a deep understanding of the nature and process of experimentation.

7.5 Evaluation of the dissertation

Several suggestions have been made for modifications to the basic conceptions for the evaluation of research quality to reflect the features and nature of qualitative research (Miles, 1979; Lincoln and Guba, 1985). However, qualitative research still lacks consensus regarding specific evaluation criteria today (Pratt, 2008). The widely acknowledged evaluation criteria for case studies are those introduced by Yin (1994), who differentiates between construct validity, internal validity, external validity, and reliability. As noted by Dubois and Gadde (2002), these principles for evaluating qualitative case studies are not unproblematic, since the criteria were originally developed for quantitative research based on a positivistic and linear approach. Miles (1979) has also noted that an inherent conflict exists between validity and reliability in terms of qualitative research; while validity is what fieldwork is specifically qualified to gain, increased emphasis on reliability leads to the undermining of that unique purpose. As noted by Patton (2002), unlike in quantitative research, no straightforward procedures exist for determining reliability and validity in qualitative research. Dubois and Gadde (2014) have also criticized the fact that, for example, most of the measures used to achieve validity in qualitative research appear to be closely related to positivistic research ideals aiming to secure a “true picture rather than as providers of complementary aspects” (p. 1282).

This dissertation is evaluated in light of trustworthiness, introduced by Lincoln and Guba (1985), who propose it as a key aspect in qualitative research, including its four dimensions: credibility, transferability, dependability, and confirmability. One aspect of credibility is ensuring that the research is conducted “according to the canons of good practice” (Guba and Lincoln, 1985). To increase credibility, triangulation was used in all of the sub-studies of the dissertation. Triangulation refers to combining sources of evidence while shifting between analysis and interpretation (Yin, 1994; Denzin, 1978). The primary advantage of triangulation has been cited as the development of
converging lines of inquiry (Yin, 1994). Denzin (1989) distinguishes between four types of triangulation: data, investigator, theory, and methodological. Data triangulation (i.e. the use of a variety of data sources in a study) was used in Articles IV and V, where the data comprised audio-recorded interviews and video-recorded tutoring sessions. Investigator triangulation, which refers to the use of several different researchers or evaluators, was used in all five studies. In Articles I–III, the author collected the data, but in the analysis process, the insights were created together with the second author. In Articles IV and V, several researchers collected the data. The procedures for collecting the data had been agreed upon beforehand, for example, by using the same interview guidelines and writing the fieldnotes immediately after interviews in a commonly agreed upon platform. Also, in these studies, the two authors were involved in the data analysis process and in forming insights. Furthermore, methodological triangulation (i.e. the use of multiple methods to study a single problem or program) was utilized in Articles IV and V, which adopted action-research and case-study approaches. In Articles I and II, quantitative analysis was utilized to make the analysis process more transparent. Also, data analysis processes were drawn from the procedures of thematic analysis by Braun and Clarke (2006) and systematic combining by Dubois and Gadde (2002) to ensure an orderly approach.

Regarding transferability, thick descriptions of the research provide a “database” for others to evaluate whether the research is transferable to other milieux (Guba and Lincoln, 1985). Thick descriptions refer to descriptions of the context, participants, and situation in rich detail, which allows the reader to better understand and experience the events documented in the data (Denzin, 2001). The case-study approach employed in this dissertation offers a venue to provide rich descriptions. However, the “deep probing” (Dubois & Gadde, 2014, p. 1282) of case studies, which may lead to simply rich descriptions of events, about which the readers must make their own conclusions (Easton, 1995), has also been criticized. Hence, the researcher must recognize the relevant information central to the learning of the researcher (Dubois & Gadde, 2002). Stake (2005) has noted that an important strategy is for more than one person to gather as well as interpret most of the data. This may also help in “sorting out the bits and pieces central to learning” (Dubois & Gadde, 2014, p. 1282) as the researchers must make sense of the data collaboratively.

Dependability can be considered parallel to reliability in quantitative research (Guba and Lincoln, 1985). According to Guba and Lincoln (1985) researchers should adopt an “auditing” approach to ensure, for example, that complete records are kept for all phases of the research process. In the studies of this dissertation, all interviews were audio recorded and transcribed. Furthermore, in the Articles adopting an action-research approach (IV–V), the tutoring sessions where the researchers acted as tutors were video recorded. This enabled them to return to these moments later, during the data analysis process. Moreover, all of the documents, interview transcripts, and audio and video recordings were stored in a database available only to the researchers. Furthermore, prolonged engagement in the field has been noted to lead to a
better understanding of the context of participant views and more pluralistic perspectives, gained from the participants (Creswell & Miller, 2000). Four of the five studies included in this dissertation included prolonged engagements. In Articles I and III, the same participants were interviewed thrice within an eight-month exploratory project, and in Articles IV and V, within two months, the participants took part in two (Sprint 2) or three (Sprint 1) tutoring sessions and retrospective interviews. In Articles IV and V, researchers’ reflections were also a significant part of the process. These retrospective reflections occurred after the experimentation sprints, and these discussions were audio recorded.

7.6 Avenues for future research

Articles I and II address managerial approaches and the challenges of project managers in the context of exploratory projects. The findings of Article I demonstrate that the transition from the early divergent phases toward the later convergent phases was somewhat problematic for project managers, as they were required to adjust their managerial approaches to fit the nature of work during these phases. The findings thus indicate that different managerial approaches are required within exploratory projects and highlight the importance of adopting longitudinal study approaches in future studies. Furthermore, the findings of Article III demonstrate that transitioning between divergent and convergent phases was challenging for project teams. Hence, a deeper understanding of the transition between these two phases is needed, and future research could investigate, in more detail, how this transitional phase could be best supported and how the nature of work in these phases influences the roles of project managers as well as project team members within exploratory projects.

Moreover, the findings of Articles I and II suggest that a significant challenge for project managers is to fully involve the multidisciplinary team of the project and therefore highlight the need for more detailed study on how project managers aim to foster multidisciplinary teamwork within exploratory projects and what types challenges they face in doing so.

Although Articles I and II investigated project managers who were relatively mature and experienced master-level students working with a 10,000 euro budget for an actual customer, project managers working in exploratory projects within a corporation should also be studied during such projects. Future research could investigate whether, and if so, how, managerial approaches and challenges differ between experienced and inexperienced project managers during exploratory projects. For example, the findings of Articles I and II demonstrate that novice project managers emphasized task-oriented approaches above and beyond people-oriented ones, and it would be interesting to investigate whether more experienced project managers differ in this regard.

Furthermore, Articles IV and V investigated experimentation within teams novice to such an approach and in project teams without project managers. In these studies, the researchers acted as facilitators to ensure that the project
teams did not converge prematurely and that they could extract learning from experiments. The current research on the management of exploratory projects provides only a limited understanding regarding the role of project management regarding these activities. Therefore, investigating how project managers aim to support experimentation in exploratory projects would offer an interesting avenue for future research.

Overall, the findings of this dissertation highlight the need to provide a deeper understanding of micro-level concerns in exploratory projects. Because in such projects, the team must create a common understanding of the ill-defined problem to be solved, project-team-level interaction is underlined. In the context of exploratory projects, such factors as how the individuals and project teams can make sense of the information available, how they move toward convergence, or how they learn from experiments becomes critical and is something we must learn more about in future studies.
References


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Exploratory projects are means of organizing the fuzzy process of exploring emerging innovation fields in organizations, and their primary objective is knowledge creation. These projects are characterized by goals that are only broadly, if at all, defined at the beginning, and the necessary information and learning need to be created through iterative experimentation. Through a longitudinal approach based on 81 interviews and 7.5 hours of video data, this dissertation provides new information about the dynamic nature of managing exploratory projects. The findings suggest that in exploratory projects, the role of the project manager shifts from managing the efficient execution of the project towards facilitating the iterative development process by ensuring that the project team does not converge too early and is able to learn from experiments. Furthermore, to benefit from diverse point of views, practices supporting an open and trusting atmosphere and communication amongst the project team need to be purposefully established in the early phases of the project.