Department of Industrial Engineering and Management

Let's figure it out together: Inter-organizational collaboration in the daily practices of complex construction projects

Anne Kokkonen

Aalto University

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Let's figure it out together: Inter-organizational collaboration in the daily practices of complex construction projects

Anne Kokkonen

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Abstract

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Abstract

In complex construction projects, an adequate combination of skills and knowledge is often achieved by involving multiple organizations. However, the execution of collaboration between these organizations has not always been efficient, and construction projects have recently explored methods to improve it. One key for to efficiency is to support learning between organizations. Research has approached collaboration using various definitions, which has led to a vague understanding of the phenomenon. This dissertation clarifies collaboration by exploring the practices that are situated in daily project life. The research objective is to examine how collaboration practices in construction projects support collective learning.

The investigation begins by systematically reviewing the literature that addresses the practice approach to learning in construction projects. Then, the dissertation presents three empirical studies of two complex construction projects that were investigated qualitatively. The empirical data consists of interviews, observations, and documents that were analyzed concerning reflective learning, managing collaborative space, and participation practices.

The findings conclude that: 1) studies have applied the practice approach to learning in five categories, for observing the informal practices in construction projects in particular; 2) individuals adapted to change in collaboration practices through reflective learning, in processes of deconstructing and reconstruction, 3) managers can actively shape collaborative space during the project by creating both physical and social affordances of the space, 4) participation practices in an integrated project supported the active involvement of individuals, which increases their impact on collective learning. The dissertation contributes to construction management research and organization studies.

The practical implications of the dissertation indicate that, for collective learning, managers ought to ensure individuals' participation in collaboration practices. Managers should provide possibilities for reflection upon the changing practices. In the case of collaborative spaces, managers should consider both the physical design for the specific collaboration and as the desired social practices of collaboration in the space throughout the project. Overall, the dissertation highlights the individuals' daily collaboration practices as an essential part of the successful collaboration between companies in complex projects.

Keywords Inter-organizational collaboration, construction project, case studies, project practices, collaborative space, participation, practice-based learning

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Tiivistelmä

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Tekijä
Anne Kokkonen

Väitöskirjan nimi
Selvitetään yhdessä: Yritysten välinen yhteistyö kompleksisten rakennusprojektien päivittäisissä käytännöissä

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Tiivistelmä

Monimutkaisissa rakennusprojekteissa sopiva yhdistelmä taitoja ja tietoa saavutetaan usein ottamalla mukaan useampia organisaatioita. Yhteistyön toteutus ei kuitenkaan aina ole ollut tehokasta, minkä vuoksi rakennusprojektit ovat viime aikoina selvittäneet menetelmiä, joilla yhteistyötä voisi parantaa. Yhteistyön tehokkuuden kannalta keskeistä on tukea toimijoiden välistä oppimista. Tutkimukset ovat lähestyneet yhteistyötä erilaisin käsittein, mikä on johtanut epäselvään kokonaiskuvaan ilmiöstä. Tämä väitöskirja selventää organisaatioiden välistä yhteistyötä tutkimalla käytäntöjä, jotka ovat osa päivittäistä projekti elämää. Tutkimuksen tavoitteena on tarkastella miten rakennusprojektien yhteistyökäytännöt tukevat kollektiivista oppimista.

Tutkimus alkaa tarkastelemalla systemaattisesti kirjallisuutta, jossa käytäntönäkökulmaa oppimiseen on sovellettu rakennusprojektien tutkimiseen. Tämän jälkeen väitöskirja esittelee kolme empiiristä tutkimusta kahdesta monimutkaisesta rakennusprojektista, joita tarkasteltiin laadullisin menetelmin. Empiirinen data koostuu haastatteluista, havainnoista ja dokumenteista, joista analysoitiin reflektiivistä oppimista, yhteistyötilan johtamista sekä osallistumisen käytäntöjä.

Tuloksista voidaan päätellä, että 1) tutkimusten soveltama käytäntöteoreettinen näkökulma oppimiseen voidaan jakaa viiteen kategoriaan. Näissä tutkimuksissa on tarkasteltu erityisesti rakennusprojektien epävirallisia käytäntöjä. 2) Yksilöt sopeutuivat yhteistyön muutoksiin reflektiivisen oppimisen
avulla, josta on eriteltävissä dekonstruktio- ja rekonstruktioprosesseja. 3) Johtajat voivat aktiivisesti muokata yhteistyötilaa projektin aikana tuottamalla tilan sekä fyysisiä, että sosiaalisia affordansseja. 4) Aktiivisen osallistumisen käytännöt integroidussa projektiyhteistyössä tukivat yksilöiden mahdollisuuksia vaikuttaa kollektiiviseen oppimiseen. Väitöskirja edistää rakentamistalouden ja organisaatiotieteen tutkimusta.

Tulosten pohjalta voidaan ehdottaa, että johtajien tulisi varmistaa yksilöiden osallistuminen yhteistyön käytäntöihin tuottaakseen kollektiivista oppimista, sekä tarjota mahdollisuuksia reflektoida työkäytäntöjä teknologisten ja organisatoristen muutosten onnistumiseksi. Yhteistyötilaa johtaessa tulisi huomioida, sekä yhteistyön fyysiset tarpeet tilalle, että myös tilassa tavoitellut sosiaaliset yhteistyön käytännöt. Kaiken kaikkiaan väitöskirja korostaa yksilön aktiivista osallistumista onnistuneen organisaatioiden välisen yhteistyön aikaansaamiseksi monimutkaisissa projekteissa.

Avainsanat Organisaatioiden välinen yhteistyö, rakennusprojekti, tapaustutkimus, projektikäytännöt, yhteistyötila, osallistuminen, käytäntöteoreettinen näkökulma oppimiseen

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Helsinki, 13 January 2018
Anne Helena Kokkonen

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List of Publications

This doctoral dissertation consists of a summary and the following four publications that are referred to in the text by their numerals.

1. Kokkonen, A. & Alin, P. (2015) Practice-based learning in construction projects: a literature review. *Construction Management and Economics*, 33(7), 513–530. https://doi.org/10.1080/01446193.2015.1062903

2. Kokkonen, A. & Alin, P. (2016) Practitioners deconstructing and reconstructing practices when responding to the implementation of BIM. *Construction Management and Economics*, 34(7–8), 578-591. https://doi.org/10.1080/01446193.2016.1164327

3. Kokkonen, A. & Vaagaasar, A. L. (2017) Managing collaborative space in multiparty projects. *Construction Management and Economics*, 36(2), 83-95. http://dx.doi.org/10.1080/01446193.2017.1347268 Avalible as an open access article at http://www.tandfonline.com/doi/full/10.1080/01446193.2017.1347268

4. Kokkonen, A. (2017) Integrated project emerging within the daily project life through active participation. *Proceedings of the 33th annual conference of Association of Researchers in Construction Management (ARCOM)*, 115–123. The conference was held in Cambridge, UK, 4–6 September 2017. Available at http://www.arcom.ac.uk/-docs/archive/2017-Indexed-Papers.pdf

The Author's Contribution

Publication 1: Practice-based learning in construction projects: a literature review
The author of this dissertation, Anne Kokkonen, was responsible for the idea for the article, collecting data, and presenting the early version of the manuscript in the 7th Nordic Conference on Construction Economics and Organization 2013, Trondheim, Norway, 12–14 June 2013. Both of the authors participated in analyzing data, preparing the manuscript, and managing the review process. The second author, Prof. Pauli Alin, acted as the corresponding author.

Publication 2: Practitioners deconstructing and reconstructing practices when responding to the implementation of BIM
The author of this dissertation, Anne Kokkonen, collected the data together with two researchers D.Sc. (Tech.) Rita Lavikka and doctoral student Teemu Lehtinen from SimLab, Aalto University. Prof. Riitta Smeds participated in planning the data collection. Anne Kokkonen created the idea for the article and analyzed the data with the help of the second author. The second author, Prof. Pauli Alin, assisted in preparing the manuscript and managing the review process. Anne Kokkonen acted as the corresponding author.

Publication 3: Managing collaborative space in multiparty projects

The author of this dissertation, Anne Kokkonen, collected the data together with D.Sc. (Tech.) Rita Lavikka and doctoral student Teemu Lehtinen from SimLab, Aalto University. Prof. Riitta Smeds participated in planning the data collection. Anne Kokkonen generated the idea for the article that she developed together with the second author Prof. Anne Live Vaagaasar. Anne Kokkonen conducted the analysis, while the authors prepared the manuscript and managed the review process together. Anne Kokkonen presented an early version of the manuscript at the 31st EGOS Colloquium 2015, Athens, Greece, July 2–4, 2015 and acted as the corresponding author.

Publication 4: Integrated project emerging within the daily project life through active participation
The author of this dissertation, Anne Kokkonen, was responsible for the idea of the conference paper, collecting the data, preparing the conference paper and presenting it in the conference of the Association of Researchers in Construction Management (ARCOM), Cambridge, UK, 4–6 September 2017. Anne Kokkonen acted as the corresponding author.

Subcontracting

This dissertation work used external service providers for proofreading and transcription. The company Proof-Reading-Service.com performed a proofreading for Publications 1 and 2. The author of the dissertation, Anne Kokkonen, accepted or declined the suggestions made by the company. In addition, the company Same Day Transcriptions, Inc. transcribed the interview data for the Publications 2 and 3. The author of this dissertation, together with doctoral student Teemu Lehtinen and D.Sc. (Tech.) Rita Lavikka, made corrections to these transcriptions, if needed, by listening to the audio files and reading the transcriptions. Lastly, the company Tutkimustie proofread the Summary of the thesis. The author of the dissertation, Anne Kokkonen, accepted or declined the suggestions made by the company. At this point, the Publications 1-4 could not be modified since the Studies are published. The companies providing the above-mentioned serviced did not affect the interpretations or the scientific contribution of the dissertation.

1. Introduction

1.1 Collaboration As a Popular (Albeit Amorphous) Phenomenon

Collaboration between organizations assists organizations to achieve complex results, innovative solutions (Gulati et al., 2012), share risks, and obtain access to new markets (Pittaway et al., 2004). It has already attracted interest among authors and industries for several decades (Astley, 1984; Davis, 2016; Gray and Wood, 1991; Gustafson and Cooper, 1978; Hardy et al., 1998; Huxham and Vangen, 2000). Over the years, the circumstances of collaboration have evolved, especially because of the diffusion of numerous digital communication tools. Nonetheless, face-to-face interaction is still needed, offering unique possibilities for collaboration (Hinds and Cramton, 2014). Collaboration is performed in various forms, such as R&D partnership, collaborative manufacturing, and co-marketing (Powell et al., 1996). The characteristic that defines these different forms of collaboration is the involvement of multiple independent participants (Bedwell et al., 2012). Scholars approach collaboration in different ways, labeling it in various manners, such as consortia, strategic alliance, partnering, joint venture, network, inter-organizational, multi-party, and multi-firm collaboration. Within this doctoral dissertation, I call the phenomenon *inter-organizational collaboration* and follow authors such as Clegg et al. (2002), Cropper et al. (2008), and Loosemore and Lim (2015). This concept can include public organizations and does not propose any specific type of collaboration. The concept of inter-organizational collaboration refers here to the phenomenon where more than one organization integrate some of their resources (from knowledge and workforce resources to financial resources) for a defined solution (Gray, 1998). Substantially, collaboration contains learning between organizations (Vandaie and Zaheer, 2015; Vangen, 2016).

Despite the effort, the performance of inter-organizational collaboration has not always been successful (Clegg et al., 2002; Keyton et al., 2008). Luckily, organizations can develop their collaboration capabilities (Feller et al., 2013). Sometimes scholars and practitioners idealize collaboration by hoping that it automatically creates better outcomes (Keyton et al., 2008). This idealization can be a consequence of occasionally unclear and contradictory definitions of collaboration, which practitioners might see as a buzzword (Bedwell et al., 2012).

This work aims to clarify the understanding of collaboration through studying construction projects that have increasingly paid attention to the way collabo-

ration is performed. Particularly, complex construction projects actualize a demanding context for collaboration. Construction projects include multiple companies and occasionally public organizations that gather for a temporary goal. To meet the goal, these companies need to combine their efforts.

1.2 Collaboration in Construction Projects

The construction industry is a significant sector because it creates buildings and infrastructures for society and, in this process, acts as the largest industrial employer in Europe (OECD, 2008). In the European Union, the construction industry accounts for 28.9 percent of industrial employment (FIEC, 2017). Large construction projects involve several professions that often perform within different organizations (Chynoweth, 2009; Pauget and Wald, 2013). The organizations temporarily work together towards a complex target, which is fixed to a specific geographical location (Buvik and Rolfsen, 2015; Naderpajouh and Hastak, 2014). These circumstances set challenges for collaboration that practitioners execute through planning, design, and construction processes. The practitioners of different professions and organizations have to interact in processes of multiple interdependencies (Nicolini et al., 2001). Unfortunately, these processes are often fragmented (Clegg et al., 2002). Further, professional education and training have not shaped shared identities for construction professionals, but the professionals see themselves as distinguished groups of actors (Hartenberger et al., 2013). As a result, poor communication, industry-level fragmentation, and adversarial relations have characterized collaboration in construction projects while hindering project outcomes (Nicolini et al., 2001; The Economist, 2017).

Scholars (Nicolini et al., 2001; Cicmil and Marshall, 2005), as well as practitioners (Lohilahti, 2017), have marked these problems and the need to develop collaboration in construction projects. This need has led practitioners to improve project delivery methods for enhanced collaboration that have initiated a transformation of the industry in many western countries (Hall and Scott, 2016; Lahdenperä, 2012). The project delivery methods that improve collaboration between the organizations include project partnering, project alliancing, and integrated project delivery (IPD) (Lahdenperä, 2012). For instance, the concept of project alliance has been employed in Australia (Lahdenperä, 2012) and Finland (Häkkinen et al., 2014), while industry in the USA discusses IPD (Hall et al., 2014). These three project delivery methods share the following basic ideas of how to improve collaboration: the early involvement of key participants, sharing financial risks and rewards, joint management, and multi-party agreements (Lahdenperä, 2012). In addition to these formal arrangements, the project delivery methods also include recommendations for improving informal collaboration, for example, through trust building, open communication, developing commitment, and the co-location of project members. These project delivery methods reduce centralized management and support interdependencies (Nicolini et al., 2001). Hence, improving collaboration means integrating actors in the common work.

Furthermore, the construction industry is transforming due to improving customer value with servitization (Leiringer and Bröchner, 2010). Moreover, the technological evolution that has brought new digital tools has also transformed the construction industry. Researchers have connected this evolution to the wider phenomenon of the digitalization of work (Paavola and Miettinen, 2013). The digital tools, often called building information modelling (BIM), include, for example, applications for digital design and estimations of the solutions (Paavola and Miettinen, 2013). The new applications of BIM have also increased possibilities for information sharing and modified the collaboration processes (Azhar, 2011; Davies and Harty, 2013; Succar, 2009). In addition, the benefits of BIM include reduced costs, increased control through the project life cycle, and saved time (Bryde et al., 2013).

As construction projects have begun to implement integrated collaboration and new technology, projects have confronted the need to change work practices. Despite the implementations that have already been made, research does not fully understand the mechanisms of intensified collaboration in detail yet. This lack of knowledge reduces the possibilities to manage collaboration between organizations well.

However, research has illuminated that inter-organizational collaboration enables collective learning, which then reduces project failures (Doz, 1996). Collective learning requires individuals from different organizations to participate in common work (Bruns, 2012). This participation is, to a great extent, created in conversations (Hardy et al., 2005). Management can hinder collective learning (Larsson et al., 1998) or alternatively enhance it, for example with spatial arrangements (Millward et al., 2007). While acknowledging these mechanisms of inter-organizational collaboration, research still lacks explorations of the collaboration processes that create collective learning at the level of the daily practices that are performed in the context of construction projects.

1.3 The Research Objectives

The overall purpose of this doctoral dissertation is to answer the following main research question regarding how collaboration practices in construction projects support collective learning. This question is addressed with sub-studies that aim to: 1) further examine the role of learning in performing practices in construction projects; 2) improve our understanding of changing collaboration practices through learning; 3) explore the management of collaboration with space; and 4) analyze individuals' participation in inter-organizational collaboration.

1.4 The Structure of the Doctoral Dissertation

This doctoral dissertation is composed of four studies and their summary. This summary began with an introductory section. Next, Section 2 explains the theoretical background and presents the research gaps that are based on the literature. Section 3 presents the research questions of the dissertation. In Section

4, the applied research methods are presented. After the methods, Section 5 shortly presents the main findings. Then, Section 6 covers the general contributions. Finally, in the last section, the dissertation is evaluated, and future research is proposed. The original papers of the individual studies are attached to the dissertation as appendices.

2. The Theoretical Background and Research Gaps

In this section, I first explore literature on inter-organizational collaboration. This theoretical scrutiny continues with subsections where firstly the role of learning is explained as part of performing socially constructed practices. Then, three specific situations of collaboration are explored; changing practices through learning, managing collaborative space, and participation in collaboration. These theory sections introduce the foundation of the research gaps that are identified in the presented literature.

2.1 Inter-Organizational Collaboration

A wide range of scholars has approached collaboration within a number of research fields, such as organization behavior, management, environmental science, and communication studies (Bedwell et al., 2012). This broad interest is a consequence of the wide occurrence of collaboration in industries and its character that touches multiple dimensions (Hardy et al., 1998).

Unfortunately, this research is partly incoherent, which is why Bedwell et al. (2012, p. 134) describe collaboration as a "superordinate construct, which subsumes and overlaps with several related variables" and is often discussed interchangeably with coordination, cooperation, and teamwork. For example, scholars such as Baiden and Price (2011) discuss collaboration as one of the elements defining teamwork, along with team identity and communication. Such a definition does not clarify the ways in which we can observe collaboration, but it instead offers a description of collaboration as an undefined positive encounter. While construction management research draws greatly upon other research fields (Bresnen, 2017), this vagueness also concerns construction management research.

In inter-organizational collaboration, the relationship between companies is an essential part of the phenomenon. Plenty of studies have analyzed this relation at the level of organizations. These studies have offered descriptions and explanations of topics such as choosing a partner (Ireland et al., 2002), contracts (Colombo, 2003), forming trust between organizations (Das and Teng, 1998), the symmetry of learning between companies (Hamel, 1991), competitive advantage gained through collaboration (Ireland et al., 2002), and relationship development (Bygballe et al., 2010). Authors have also discussed contradictions

between trust and control (Das and Teng, 1998), while other authors have explored the process of collaboration by considering it pre-alliance and during alliance, and the output of the process (Min, 2017).

Organizations have various reasons to be involved in an alliance; one of these reasons is to learn from others in order to gain competitive advantage (Hamel, 1991; Knoppen et al., 2011). Apart from this reason, organizations can also learn together new ideas by combining their knowledge. In order to do so, organizations might first need to learn to perform a collaboration process (Cicmil and Marshall, 2005; Doz, 1996). Partnering is one project management tool that assists in increasing the collective learning that emerges between organizations (Barlow, 2000; Barlow and Jashapara, 1998). These above-mentioned studies observe inter-organizational collaboration at the level of organizations, which can only be observed indirectly as organizations are not tangible systems (Keyton et al., 2008).

A level of inter-organizational collaboration that researchers can observe more directly is the individuals' actions of collaboration. The literature that has studied individuals' actions in the context of collaboration has applied concepts such as teamwork, communities of practice, and cooperation (Bedwell et al., 2012; Brown and Duguid, 1991; Suprapto et al., 2015). However, only some of the studies applying these concepts have been conducted in an inter-organizational context. The difference between intra-organizational collaboration and inter-organizational collaboration is not always visible in the individual's actions, but these two different contexts influence and motivate the actions differently. Each individual who participates in inter-organizational collaboration is likely to be employed by one of the organizations and not by the alliance organization.

Inter-organizational collaboration, at the individual level, includes essential interaction activities and also work that is performed alone, even when performed in a co-location (Heerwagen et al., 2004). The interaction activities can include, for example, events, training, and joint working (Marrewijk et al., 2016; Suprapto et al., 2015). The work that is performed alone can include, for example, writing reports or designing drawings. If these collaboration activities are planned in advance, they are formal. If the activities are unplanned, they are informal (Bresnen, 2009). Managers might act as the facilitators of the collaboration activities (Plotnikof, 2016). Yet, separate organizations may possess different strategies for collaboration that vary between controlling and creating connections with other organizations (Hardy et al., 1998; Sundaramurthy, 2003).

Research that has explored individuals' activities in inter-organizational collaboration has covered topics such as reciprocity, trust, and collective identity (Beck and Plowman, 2013; Hardy et al., 2005; Sloan and Olivier, 2013; Swärd, 2016). These studies found that trust between organizations seems to enhance learning (Sloan and Olivier, 2013), while too much formalization may obstruct collective learning (Janowicz-Panjaitan and Noorderhaven, 2009). While learning explicit knowledge can be organized quite easily, transferring tacit

knowledge across organization boundaries usually requires close interaction between individuals (Kale et al., 2000).

The activities of interaction have gained the interest of multiple authors in the context of inter-organizational collaboration. Interaction includes engagement in common and private discussions (Hardy et al., 2005). Some interaction is performed directly, face-to-face, while at other times interaction can be achieved through digital tools or documents such as memos, letters, or e-mails (Hardy et al., 2005; Singh et al., 2011). Interaction can be facilitated over boundaries (Kislov et al., 2017) and result in interpersonal bonding (Rosenkopf et al., 2001). The conversations that are produced in collaboration can concern the substance of work as well as the collaboration processes including, for example, political struggles over role patterns (Marrewijk et al., 2016). Thus, interaction can lead to collective sense-making concerning the substance of collaboration or collaboration itself (Bresnen, 2009).

Further, research on intra-organizational collaboration has discussed issues that can also be found in the research on inter-organizational action, such as a mutual focus in group work (Metiu and Rothbard, 2013) and the influence of physical arrangements on engagement (Millward et al., 2007). In inter-organizational collaboration, the actions gain the meaning of not only the task that is performed together but also of the inter-organizational context. To overcome the division between the systemic and individual levels of collaboration, we can apply the practice approach. The practice approach can acknowledge local practices that are developed in the specific context of partnering (Bresnen, 2009).

2.2 The Practice Approach to Learning in Construction Projects

The practice approach has become popular among the scholars of organization studies (Corradi et al., 2010). It has also been applied to, for instance, project management research (e.g., Floricel et al., 2014; Gustavsson and Gohary, 2012; Hällgren and Söderholm, 2010) and construction management research (Bresnen, 2009; Boyd, 2013). The benefit of the approach is the ability to investigate the actual work practices in the reality of a construction project instead of forming abstract management models separated from their context (Bresnen, 2009). However, the approach is not unified and it forms a collection of theories and ideas that assume that materially mediated sayings and doings are central for understanding organizational phenomena (Korica et al., 2015).

One of the main aims in the practice approach is to connect individualist and structuralist approaches when studying human activities (Lave, 1988). Traditionally, individualist approaches concentrate on understanding how individuals constitute an organization. Meanwhile, structuralist approaches observe an organization as a unity that cannot be understood by only looking at individuals and their interactions (Schatzki, 2001). The combination of these two approaches is situated in the core concept of *practice*, which refers to both the activity performed by an individual and the collectively known meanings related to the activity (Schatzki, 2001). In the context of construction projects, the duality could refer to, for instance, an individual performing her or his tasks on the

construction site and the safety guidelines that he or she is required to follow while performing the work (Gherardi and Nicolini, 2002). Despite the collective knowledge, an individual can actively create new solutions, for instance a solution to specifically installing electric cords while following the general design plan of a building. Some scholars describe this ontological approach as *flat ontology* while others refer to the *texture of practices* (Nicolini, 2017). These ontologies aim to see connections between different levels of activities instead of concentrating on one level.

Before an individual can perform practices, she or he needs to first learn how to act, speak, and make sense of the situation (Nicolini, 2012). Thus, learning is the mechanism through which practices diffuse. It is seen as the mechanism through which individuals can both perform the existing practices and create new practices. Consequently, the individual's learning preserves the existing practices of an organization as well as enables creating new practices for the organization (Feldman and Orlikowski, 2011).

If we compare the practice approach and a more traditional approach to learning, both of the approaches begin from the idea that learning leads to changes in individual's cognition and/or activities. The traditional approach is based on literature that draws from March (1991) and Simon (1991) and explains learning as an individual's cognitive action. The practice approach considers learning essentially as behavioral alteration that is based on an individual's cognitive actions (Gherardi, 2006). Concurrently, learning connects individuals to collective understanding that is created together by communicating meanings and interpretations (Corradi et al., 2010). Communicating between individuals includes activities such as negotiation and reformulation (Gherardi, 2006).

While the traditional theories of learning propose limited rationality (e.g., Simon 1991), the practice approach considers that organizational activities are not necessarily based on conscious cognitive reflection (Hutchins, 1991) or plans (Orlikowski, 1996). The practice approach also highlights that practices and learning are always situated in a specific context (Lave, 1988; Nicolini, 2012) while approaches that are more traditional usually consider learning as separable from the context (Argote and Miron-Spektor, 2011). For example, a classroom differ from a supermarket as a place to learn to solve mathematical problems, which can lead to different learning results (Lave, 1988).

As previously mentioned, the practice approach originated from various traditions (e.g., Bourdieuian, Giddensian, and Marxian traditions), resulting in diverse methods and a lack of shared definitions (Nicolini, 2012). While the approach has become quite popular, authors have sometimes even employed the central concepts differently. For instance, scholars have described a "community of practices" as both a process and an entity (Thompson, 2011). Thus, scholars have applied the approach with different ontologies and epistemologies. This diversity can lead construction management scholars to apply the approach in very different ways, potentially leading to confusion and causing a stagnating research program that does not produce novel findings (see Lakatos, 1970a, 1970b; Kilduff et al., 2006).

Still, the practice approach has been claimed to be useful for the construction industry in developing its work practices (Boyd, 2013). Bresnen (2009) has called for more investigations within construction management research, especially with the practice approach, because practices might even be more important for managers than industry-wide models of partnering. While some reviews of the practice approach used in organization studies have been completed (e.g., Erden et al., 2014; Parmigiani and Howard-Grenville, 2011), no systematic review exists in construction management research that applies the practice approach to learning. As a result, *we do not have a good understanding of how the practice approach to learning has been applied to construction project research*.

- Gap 1: *There is a lack of understanding of how the practice approach to learning has been applied to construction project research*

2.3 Practitioners Reflecting on Their Practices in Project Change

The implementation of ICT systems (such as BIM) and new project delivery methods (such as IPD) in construction projects poses a great demand for learning and change in individual organizations and their practices, including their inter-organizational collaboration practices. Even though construction projects have already implemented BIM in building processes for a while, the construction industry continues to implement the applications of this new digital technology as it keeps evolving (Dainty et al., 2017; Papadonikolaki and Wamelink, 2017). The implementation of BIM can be challenging for reasons such as the temporary nature of projects (Jacobsson and Linderoth, 2010) and the embeddedness of this technology in complex social activities (Cao et al., 2014). BIM has been claimed to enhance the collaboration in projects (Succar, 2009; Jaradat, 2013). To enhance collaboration, projects have also applied IPD (Hall et al., 2014). BIM is essentially a digital technology whereas IPD defines a project management task (such as bringing in all the key stakeholders early in the design process so that individuals related to construction can also influence designing).

As BIM and IPD transform project practices, practitioners need to develop new skills, which requires learning (Liu et al., 2017). Some of this learning can be gained through training, but some learning practitioners need to develop themselves (e.g., see Mäki and Kerosuo, 2015). Managers rarely define all the components of change but rather generate situations for individuals to act in and make initiations (Burnes, 1992). Managers seldom possess all the knowledge of the daily work practices of each employee. For this reason, they might not be able to define changes at the level of employee's practices. The practitioner's role is essential in the implementation of BIM (Mihindu and Arayici, 2008).

Practitioner's learning is formed through both professional education and active engagement in practices (Yanow and Tsoukas, 2009). This learning leads to expertise in the knowledge and skills they have about some particular work. The

practice approach considers a practitioner as an engaged agent whose knowledge becomes meaningful in the social context (Yanow and Tsoukas, 2009). For instance, architects can easily communicate with each other because they hold, at some level, the same set of definitions (Schön, 1983).

When change occurs in work, practitioners can change their practices through reflective learning (Gorli et al., 2015), for instance, to implement BIM or IPD in their work. Reflective learning is both engaged in and with practices, and hence it is not performed independently from its context (Yanow and Tsoukas, 2009). Reflection that occurs in the middle of action is induced by interruptions to routine work. The interruption requires an individual to investigate new ways to perform through improvisation (Yanow and Tsoukas, 2009). This reflection on practices can lead to learning if a cognitive adjustment occurs (Boyd and Fales, 1983). Practitioners reflect on their practices under the influence of the environment while they are also embedded in their understandings of the past and the future (Mullarkey, 1999). The interruptions that induce reflective learning while one is working occur at different levels. The different levels of interruption, which range between a minor malfunction to a total breakdown, introduce different demands for reflective learning (Yanow and Tsoukas, 2009). Different demands result in reflecting on practices on different levels, ranging between reconstitution and analytical reflection (Yanow and Tsoukas, 2009). Reflective learning is produced by the active involvement of practitioners. Some recent studies in construction research have acknowledged the relevance of the reflective practitioner in construction projects (Walker, 2016).

The implementation of both BIM and IPD produces changes to collaborative work practices (Succar, 2009). The implementation of BIM has often been reported as a top-down management effort, whereas few scholars have researched implementation at the level of practitioners (Arayici et al., 2011; Mäki and Kerosuo, 2015). Even though learning is seen as part of implementing IPD and BIM, *little is known about how practitioners learn new practices for implementing BIM and IPD in their work*, even though learning is seen as part of implementing IPD and BIM (Chiocchio et al., 2011; Taylor, 2007). At the same time, some studies in construction research have acknowledged the relevance of the reflective practitioner in construction projects (Walker, 2016).

- Gap 2: *There is a lack of empirical research on how practitioners learn new practices for implementing BIM and IPD in their work*

2.4 Managing Collaborative Space

To improve collaboration, project management can implement a collaborative space, as an increasing number of construction projects has done (Henisz et al., 2012; Lahdenperä, 2012; Nicolini, 2002). By collocating project members, a collaborative space increases face-to-face interaction and this can be valuable when completing complex tasks (Bulte and Moenaert, 1998; Cannella et al., 2008; Hua et al., 2010; Naar et al., 2016). A common space also offers accessibility and assists creating personal relationships (Beck and Plowman, 2013). Moreover, it

can assist individuals in learning about a project by overhearing and observing project members from other organizations (Heerwagen et al., 2004; Vaagaasar, 2015). Overall, collaborative spaces enable collaboration that would not be possible in a similar way without the space.

The workspace literature indicates the possibility of space influencing collaboration (Elsbach and Pratt, 2007; Heerwagen et al., 2004); however, the influence is not clear, but rather ambiguous (Bulte and Moenaert, 1998). The ambiguous relationship between space and behavior might be the reason why some space-related initiations have sometimes finished with outcomes that were desired, while other times they have not (Elsbach and Pratt, 2007). Some initiations have also finished without any transformation (Bulte and Moenaert, 1998). By looking at these studies, it seems that influencing collaboration behavior with a space is challenging. In addition, a new kind of collaborative space may require individuals to learn new ways of working (Edenius and Yakhlef, 2007). This relationship between space and collaboration behavior has been explored through three mechanisms: proximity (Cannella et al., 2008), office design (Heerwagen et al., 2004), and space as formed within social processes (Taylor and Spicer, 2007). The third of these mechanisms includes affordance theory. It combines both the physical and the social aspects of space while including individuals as part of the process as they actively consider the space for their purposes (Fayard and Weeks, 2007). Thus, affordance theory enables considering space to propose possibilities for behavior instead of determining behavior. This theory facilitates observing the influence of space as a more complicated phenomenon than causality. Further, if space is considered as formed within social processes and performed in practices (Lefebvre, 1991), collaborative space is only active when collaboration appears in the space. This assumption highlights behavior as an important part of a collaborative space.

Based on the complicated relationship between space and behavior, it seems that collaborative space requires careful management in order to support the collaboration significantly. However, *the existing literature on collaborative space has discussed the implementation and results of collaborative space while studies omits the practices of actively managing the space*. In practice, the lack of knowledge on how to manage and organize a collaborative space requires managers to use the trial and error technique of managing the space. This technique can lead to a space that does not increase collaboration (Bulte and Moenaert, 1998).

To approach management as an activity, the practice approach can be consulted in order to see management as emerging in the project context. The daily practices of managers do not always follow the management models presented in literature (Cicmil and Marshall, 2005; Winter et al., 2006) and are formed in time, situated in context, and connected to sociomateriality (Korica et al., 2015). Thus, besides decision-making, managing includes negotiations and sensemaking through interaction (Korica et al., 2015).

By combining the affordance theory of space with management that is approached as practice, one can explore managers aiming to influence both the social and physical affordances of collaboration within a space. Forming social

affordances could include management activities such as aiming to develop understanding of collaboration. Further, managers forming physical affordances could include designing spatial solutions that influence collaboration, such as desk layout. While managers can consider and take actions related to one or both of the affordance types at a time, the project employees experience these two types of affordance as merged.

- Gap 3: *The existing literature on collaborative space omits the practices of actively managing the space*

2.5 Participation Practices in Integrated Projects

Construction projects have confronted hindrances when implementing project delivery methods that enforce collaboration (Lahdenperä, 2012). These project delivery methods have been named with titles such as IPD, alliance projects, project partnering, and relational contracting (Lahdenperä 2012; Suprapto et al., 2015). Here, these projects that apply methods to enhance collaboration are called *integrated projects*. In each project, individuals adjust the general ideas of project delivery methods to the present project circumstances (Bresnen, 2009). However, there is some ambiguity regarding what an *integrated project* means in terms of daily practices (Bresnen, 2010).

In organization studies, collaboration has been discussed in numerous articles for decades (e.g., Gustafson and Cooper 1978; Zuckerman, 1967). Some scholars refer to collaboration as *working together* or *interacting* (see Bedwell et al., 2012). However, these definitions do not specify wheter or not all interaction is collaborative or how one can recognize if interaction is collaborative. Other authors, such as Chompalov et al. (2002), have described the quality of collaboration by defining poor collaboration as bureaucratic and good collaboration as participative. In their empirical research on the collaboration between scientists, Chompalov et al. (2002) found that bureaucratic collaboration included hierarchical activities, written rules, formalized responsibilities, and a division of labor. On the other hand, they found that participative collaboration included participative decision-making, communicating for a shared understanding, and less hierarchical activities (Chompalov et al., 2002). The participative type of collaboration is formed with social relations and communication between individuals. Bureaucracy aims for predictability and accountability; however, it can form isolation and resentment (McCaffrey et al., 1995). Yet, these two aspects of bureaucratic and participative collaboration exist along a spectrum and can have many forms, even in one organization.

Scholars have also proposed participation as a mechanism of collaboration (McCaffrey et al., 1995). It requires individuals to take part in decision-making (McCaffrey et al., 1995). This type of participation can embrace complicated conditions because it allows individuals to bring their knowledge into the decision-making process. Thus, this participation allows a broader information base for the decisions (Ashmos et al., 2002; McCaffrey et al., 1995). The participation in decision-making within inter-organizational collaborations can be

done either vertically (by including different levels of the hierarchies of organizations) or horizontally (by including a narrow or wide range of different organizations). As Ashmos (2002) argues, participation assists in dealing with complexity. For this reason, participation is potentially useful for complex construction projects.

At the individual level, scholars have discussed participation in various situations with various definitions. For example, Hardy et al. (2005) write that participation is performed through communicative processes. Communication can produce knowledge transfer over boundaries (Bechky, 2003) and further create new knowledge (Yanow and Tsoukas, 2009). Participation can also be dialogical (Tsoukas, 2009) and include elements of assertive and cooperative talk (Hardy et al., 2005). Moreover, participation differs from communication because participation means that an individual has the possibility to influence common issues, instead of only having the possibility to express herself or himself.

Overall, various definitions and descriptions have made participation seem obscure. While discussing integrated projects researchers often apply guidelines or formal attributes (e.g., Lahdenperä, 2012), while the situated practices that emerge in the project are the daily reality (Bresnen, 2009). *We do not know the character of the participation practices in integrated projects fully.*

- Gap 4: *The character of the participation practices in integrated projects is still unknown*

3. Research Questions

The present doctoral dissertation, with the four separate studies, investigates collaboration practices in construction projects that produced collective learning. The motivation for the individual studies was given in the previous theory section that illustrated the research gaps. These research gaps are the basis for the research questions displayed below.

RQ1: How have the studies of construction projects applied the practice approach to learning? (Study 1)

RQ2: How do practitioners reflect on their work when the implementation of BIM and IPD interrupts the traditional way of collaborating? (Study 2)

RQ3: How is collaborative space managed to increase collaboration? (Study 3)

RQ4: How are participation practices performed in integrated construction projects? (Study 4)

Table 1 shows the four research gaps, the research questions to fill these gaps, the main topic of the study, and the individual papers. Together these studies contribute to the understanding of the practices of integrated collaboration within complex construction projects.

Table 1. The topics, research gaps, research questions, and references of the studies.

Study	Topic of the study	Research gap	Research question	The paper
Study 1	Learning as part of performing practices	There is a lack of understanding of how the practice approach to learning has been applied to construction project research	How have the studies of construction projects applied the practice approach to learning?	Kokkonen, A., & Alin, P. (2015). Practice-based learning in construction projects: a literature review. *Construction Management and Economics*, *33*(7), 513–530.
Study 2	Practitioners changing their practices through learning	There is a lack of empirical research on how practitioners learn new practices for implementing BIM and IPD in their work	How do practitioners reflect on their work when the implementation of BIM and IPD interrupts the traditional way of collaborating?	Kokkonen, A., & Alin, P. (2016). Practitioners deconstructing and reconstructing practices when responding to the implementation of BIM. *Construction Management and Economics*, 34(7–8), 578–591.
Study 3	Managing collaborative space	The existing literature on collaborative space omits the practices of actively managing the space	How is collaborative space managed to increase collaboration?	Kokkonen, A. & Vaagaasar, A.L. (2017). Managing collaborative space in multi-partner projects. *Construction Management and Economics*.
Study 4	The practices of participation	The character of the participation practices in integrated projects is still unknown	How is integrated collaboration practiced in construction projects?	Kokkonen (2017) Integrated project emerging within the daily project life through active participation. *Proceedings of the 33th annual conference of ARCOM, 115–123.*

4. Research Design and Methodology

4.1 The Premise of the Research

Lately, the construction industry has encountered modifications as a result of digitalization, service logic, and integrated project models in western countries (including the USA and Finland). Also new actors have entered the industry through entrepreneurship. These changes have launched several research and development projects that have focused on the transformation of the industry. One of these projects was RYM PRE Model Nova (see more in RYM, 2014), in which I participated as a researcher in SimLab (Enterprise Simulation Laboratory) at the Department of Industrial Engineering and Management in Aalto University. During the RYM PRE Model Nova project, I began to work on the present dissertation and gained knowledge of the industry. The RYM PRE Model Nova project included two research units, a public building owner, and eight partner companies. Tekes (Finnish Funding Agency for Technology and Innovation) and partner companies funded the project. The aim of the project was to develop and research new collaborative business models and implementations of BIM. During the research project, the data were collected for the second and third study of this dissertation. After RYM PRE Model Nova, I participated in SimLab's CoCoNet research project that was funded by the Academy of Finland. Together with the team of CoCoNet, which included me and two other doctoral students, we elaborated the scientific findings of the RYM PRE Model Nova project. The data for the fourth study was collected by the author without connections to an externally funded research or development project.

This dissertation addresses collaboration in construction projects with qualitative and interpretative methods. Interpretative methods assume that researchers observe particular situations that are also constructed socially (Deetz, 2009). Further, the research object is considered as socially structured while the material reality exists independently of these social constructions. The interpretative methods differ from, for example, positivist assumptions, which include assumptions of dualist ontology, objectivist epistemology, and language as an accurate representation of objective reality (Sandberg, 2005).

For this dissertation, the practice approach has been the theoretical framework for understanding collaboration as realized through practices. Social scientists have applied the practice approach to observing phenomena that are complex, emerging, socially structured, and realized through the actions of individuals (Nicolini, 2012; Schatzki, 2001). These actions, if performed by more than one individual, can form practices that are known by a group of individuals.

Several practices together form a "network" of practices (Nicolini, 2012). The scholars of the practice approach also assume that micro and macro phenomena are not clearly separable (Nicolini, 2017; Schatzki, 2001). For this reason, the approach can assist observing practices that fall between these micro and macro levels by observing a network of different practices. Addressing reality without layers is also referred to as flat ontology (Nicolini, 2017).

The empirical data of this dissertation comes from two case projects that are explored holistically with multiple data sources to understand the connections between the practices. Observations enabled seeing the practices of the projects, interviews enabled understanding the difference between the traditional and new collaborative practices, and documents showed the formal descriptions of the project. The interviews assisted in gaining knowledge of the practices that were not physically present in the situation, such as contracts or motivations. While the observations offered the advantage of seeing individuals performing practices, individuals were also able to relflectively describe their practices in interviews (Hitchings, 2012). The empirical cases of construction projects implemented new project delivery methods. The implementation initiated adjustments to individuals' practices and made them more aware of the new and old project practices. Individuals are not just carriers of practices (Reckwitz, 2002) but also conscious agents who can discuss their practices in thoughtful ways (Hitchings, 2012).

All the four studies draw from the practice approach: The literature review investigates the ways to use the approach, while the empirical studies investigate project practices. However, the four studies were produced independently of each other and they included different analysis processes.

4.2 The Systematic Literature Review

4.2.1 The Methodology of the Systematic Literature Review

Recently scholars have increasingly applied systematic literature reviews to different disciplines (e.g., Erden et al., 2014; Knoben and Oerlemans, 2006; Stingl and Geraldi, 2017). The method has many variations. It was originally developed within the medical field and later adopted to management research (Tranfield et al., 2003). Within this dissertation, a systematic literature review refers to the method of collecting data to gain an overview of research in a systematic way (Tranfield et al., 2003). It includes the steps of data collection, data analysis, and synthesis (Crossan and Apaydin, 2010). The method offers a systematic way to perform a literature search instead of using heuristic methods (Crossan and Apaydin, 2010). This method also enables the search process to remain transparent (Tranfield et al., 2003), which can reduce the biases of a researcher when including articles. The literature on the analysis method does not specify the number of articles forming a synthesis. The principle idea is to create a synthesis that offers new knowledge for theory and not to report what was found during the search. The first study follows the existing investigations of systematic reviews examining the applications of practice-based theory—

such as those of Erden et al. (2014) and Vaara and Whittington (2012)— and investigates the textual practices of scholars who contribute to scientific discussions.

4.2.2 Data Collection and Analysis for Study 1

In the study, the unit of observation was published academic articles. At first, the articles were examined from two databases with search engines, after which the key academic journals were examined with the same keywords. The key academic journals included journals from the fields of organization and construction management, for example, the journals Organization Studies and Building Research & Information. The scope of the articles covered empirical studies on construction projects with an interest in learning with the practice approach. Following Rashman et al. (2009), we read the abstracts of the found articles and excluded non-relevant articles that did not meet the criteria. Altogether, we found 15 articles that were relevant for our purposes. Study 1, described in Publication 1, offers more details of the analysis method.

In Study 1, the analysis process concerned reviewing articles. It was managed with Excel software. The unit of analysis was the conceptual practices when applying the practice approach to learning in the context of construction projects. By following the example of Erden et al. (2014), we used the existing literature on organization studies to form analytical categories of the practice approach. The categories then form a toolkit for the practice approach, which follows Nicolini's (2012) advice of using the approach. The categories are based on the core principles of the practice approach, but the categories themselves are considered as more adaptive theoretical constructions (see Lakatos, 1970a). The theoretical categories that we applied to divide the published articles included (1) participation, which concentrates on how an individual's engagement in work practices enables learning; (2) meaning production, which refers to the processes of producing perceptions that can lead to learning; (3) power, which refers to individuals' different interests that shape learning; (4) context, which refers to the idea of how learning is influenced by its context; and finally, (5) becoming a practitioner, which refers to the idea of learning enabling to turn into a skillful practitioner. The 15 articles found were divided into these categories based on what the articles described studying with the practice approach.

Lastly, with the help of Lakatos (1970b), we evaluated if these studies would form a separate research program of the practice approach that differs from the more traditional studies. Research programs are separate study fields that together form science (Kilduff et al., 2006). Each research program consists of core principles, methods for producing new knowledge, and the novelty created by the research program (Lakatos, 1970b). For evaluation, we compared the found articles with both the practice approach and a more traditional approach to learning (e.g., Fiol and Lyles, 1985; March, 1991; Simon, 1991).

4.3 The Case Studies

4.3.1 The Methodology for the Case Projects

The empirical data of this dissertation consists of two single case studies. The case study method was chosen because it enables developing theory, providing strong examples, and testing theories brought from other fields (Dubois and Araujo, 2007). Since the context is essential for understanding findings in case studies (Flyvbjerg, 2006), this method fits investigating situated practices. Further, with case studies one can investigate the phenomenon as embedded in a real-life situation, instead of exploring it in isolation from the real world (Yin, 2003).

Studies 2 to 4 of the dissertation each explore a single case, which allows investigating the details of one case more closely than exploring multiple cases would allow (Eisenhardt and Graebner, 2007). Thus, the single-case method is especially beneficial for studying complex projects because the method can embrace the complexity (Buvik and Rolfsen, 2015). The data from a single case study represents one situation, and it might not enable generalizing findings alone. However, the method provides possibilities to develop theory by providing new knowledge (Siggelkow, 2007). This possibility means creating a conceptual argument that is plausible, including the case as one of the justification methods (Siggelkow, 2007). Thus, a single case can assist in seeing the empirical world differently than before (Siggelkow, 2007).

Overall, the cases that were investigated in the dissertation form descriptive knowledge of the events and the context (Yin, 1989), which promotes understanding the project practices in a new way.

4.3.2 The Case Projects

The cases represent complex hospital buildings that have special needs for design and construction. I chose the two specific cases for the dissertation because the complexity creates an extreme case of collaboration practices. The project collaboration in hospital buildings is especially challenging because of the large size of the building, the constantly evolving medical technology, and the care delivery processes that change the requirements for the building. Further, the supervision processes are heavier, and the projects can include political (municipal or governmental) decision-making if a public organization is involved.

The first case study was chosen with the help of a company representative in the USA The company was involved in a few hospital projects at the time. The particular project that was chosen for investigation performed well with the help of new integrative project methods, despite the very large project size. This case project, situated in the USA, was a large construction project with a budget of 1.5 billion dollars for completing two hospital buildings with 289 patient beds and an energy center. The project began in 2007 and was finished in 2015. The collaborative space for project personnel was established in 2009. The project

execution involved 29 partners. The owner had separate contracts with the following main partners: an architect, a general contractor, designers, and a construction management consultancy.

The second case was chosen together with a company representative in Finland. The case was also a hospital project but smaller in size. This Finnish project also applied IPD methods. Similarly to the first case project, the construction practitioners were not very familiar with these practices beforehand. The change in practices that the practitioners experienced offered insights into the difference between the old way of performing collaboration practices and the new way. The Finnish project included a virtual organization and a contract formed between the owner, the architect, an engineering design company, a general contractor, and the contractor for HVAC (heating, ventilation and air conditioning) and electricity. In this project, the design phase started in April 2015, and construction started in January 2017. The project will complete a hospital building of 47 000 square meters.

Both of the projects, at the initiation of the owner, applied integrated project methods in order to enhance collaboration between organizations. The practitioners in the USA called the integration method IPD, while the practitioners in Finland called it *the alliance project*. Both projects applied the following parts of the project delivery method: a carefully selected team, the involvement of contractors in the design phase, co-locating members, applying monetary incentives, team-building activities, jointly formed decisions, collaboration practices, and joint project goals. These collaborative project methods included practices that the project participants experienced for the first time. The co-location greatly affected these practices. In the USA, co-location was applied full time (see more in Study 3), whereas in Finland the project was smaller and only applied co-location for two days every week in the design phase and every other week at the beginning of construction phase. Following by the partial co-location, the Finnish practitioners used more phone calls, messages, emails, and conference calls to communicate from their home offices, situated in different cities. In addition to the collaborative project features, the project in the USA paid a lot of attention to implementing BIM technology, for example they offered some BIM training. The project in Finland applied BIM but already in more advanced ways. In this dissertation, BIM technology is perceived as a contextual artifact that is part of work practices.

4.3.3 Data Collection and Analysis for Studies 2 and 3

The data were collected with two other researchers from SimLab, Aalto University. We traveled to the USA in the fall of 2012 and visited the case project for three weeks. In practice, this meant staying at the co-location situated beside the construction site during the workdays. Together we collected the data and reflected on the data collection process. The collection aimed to gather knowledge about the practices related to BIM and IPD. The unit of observation was the project practices among participating organizations.

At first, we attended the space and meetings to observe and become familiar with the project personnel. Then we conducted informal conversations, observed the work in the space, paid visits to the construction site, made notes, took photos, and recorded videos. We also had access to the project documentation to see, for example, presentations and process charts. Eventually, we conducted semi-structured interviews, at first with the project managers and then with the individuals mentioned by the interviewed individuals. This process followed snowball sampling (Biernacki and Waldorf, 1981). At the time of observation, the co-location included around 200 individuals working for the project. Altogether, we conducted 41 interviews, including interviews of the building owners (7), architects (5), construction management consultants (4), an inspector (1), general contractors (19), and subcontractors (5).

In Study 2, the unit of analysis is individual reflection on the implementation of BIM and IPD. The analysis follows abductive logic because this logic offers an option to include the earlier theoretical understanding of the phenomenon in the analysis (Richardson and Kramer, 2006). The data analysis began with coding the interview transcriptions concerning learning and reflection. Then we excluded the quotes describing training and education. As reflective learning has been studied earlier, we consulted philosophical research to form an adaptive set of heuristics for analysis (see Gigerenzer et al., 1999). Literature and data were iteratively read to find matching frameworks (Dubois and Gadde, 2002), which resulted in using two concepts: Jacques Derrida's deconstruction (e.g., 1985) and Dewey's reconstruction (e.g., 1916). Deconstruction refers to the idea of learning the limitations of the existing categories (Rasche, 2011). Reconstruction refers to the idea of learning based on past experiences and ideas of future (Dewey, 1916). Lastly, the coded data was divided into these two categories.

In Study 3, the unit of analysis is managers' practices influencing space. The analysis process followed the thematic qualitative analysis of Braun and Clarke (2008). At first all the data were read, after which the initial codes were created, and these codes were collated into themes. Next, affordance theory was consulted when reviewing the data again, and, finally, the eventual themes for the study were formed. The interview data for both of the studies were analyzed with the software Atlas.ti.

4.3.4 Data Collection and Analysis for Study 4

I collected the data for Study 4 alone in Finland, in two different cities. The unit of observation was the project practices of individuals in the participating organizations. At first, I interviewed individuals working in the project and observed them working at their desks. Additionally, I participated in meetings while making notes. Finally, I travelled to observe the activities performed in the co-location where I had participated in the meetings (during which I had made notes) and conducted interviews that were tape-recorded. During my visit, around 30 individuals occupied the co-location space. Visiting the co-location space was essential to gain insights into the daily practices.

Altogether I attended 11 meetings and conducted semi-structured interviews, including interviews with building owners (4), architects (8), HVAC and electricity designers (from the same company as the architects) (5), contractors (2), and contractors for HVAC and electricity (2). I also reviewed project documents on the project website, some unpublished project documents to which I had access, and newspaper articles. I conducted the interviews in Finnish; I translated the quotations in Study 4 into English.

The unit of analysis in the fourth study was collaboration practices in the integrated project. The data analysis began with reading and reviewing all the data. The interviews formed the main data, which were further analyzed by seeking similarities and differences (see Gioia et al., 2012) while coding collaboration practices that then were collated into themes (Braun and Clarke, 2008). Then, the themes were defined and named. At the end, the themes were compared with the literature on collaboration. The field notes from observations and documents were also reviewed and the sections related to participation were coded. The analysis was managed with Excel software.

Table 2 presents an overview of the empirical research conducted in Study 2, Study 3, and Study 4: the cases, the data collection methods, the unit of analysis, and the main theories that were applied.

Table 2. Summary of the chosen empirical research methods of the dissertation.

	Study 2	Study 3	Study 4
Research approach	A single case study in the USA		A single case study in Finland
Case project	A large hospital project with IPD and BIM implementation; full time co-location		A hospital project with alliance implementation, advanced applications of BIM, part-time co-location
Data collection	Observations, video and tape recording, conducting interviews (41), and access to project documents. Three researchers collected this data.		Observations (11 meetings), tape recordings, conducting interviews (21), and exploring project documents. The author collected this data.
Time of data collection	October 2012		November 2016 to January 2017
Unit of analysis	Reflective learning in collaborative processes caused by BIM and IPD	Management practices influencing collaborative space	The collaboration practices of integrated project
The main theories applied in data analysis	Using the framework of deconstruction and reconstruction to understand reflective learning	Applying affordance theory to understand management practices	Seeing participation as a framework to understand collaboration practices

5. The Main Findings and Contributions

5.1 The Practice Approach to Learning in Construction Management Research

5.1.1 Findings

Study 1, which explored research that applied the practice approach to studying learning, acquired findings through reviewing research articles. The findings show that the 15 studies found included discussions that covered all the categories derived from the practice theory. The most popular categories were *participation* (5 studies) and *context* (6 studies). Within the participation category, two articles (Ruikar et al., 2009; Schenkel and Teigland, 2008) applied the concept of community of practices, describing it as improving organizational performance. Schenkel and Teigland (2008) argued further that the development of a community of practices could lead to cumulative learning and changes in work practices. Two other articles, from Bresnen (2009) and from Forgues and Koskela (2009), discussed participation at the level of the project team. Bresnen (2009) discussed participation activities during a construction project, while Forgues and Koskela (2009) explored the influence of a contract on participation. The last article (Gustavsson and Gohary, 2012), in the category of participation, analyzed participation at the level of project activities by discussing cross-boundary participation.

Within the category of context, the first article by Bresnen et al. (2003) discussed social processes as a context. This connection led to highlighting the role of social processes in learning within construction projects. Elsewhere, Styhre (2006) analyzed time as a context for learning. He argued that learning is created through engagement with others and one's experiences connected to the ideas of past, present, and future. In two other articles, Styhre (2009; 2011) analyzed materiality as context. In construction projects, materiality includes, for example, the ground, tools, and technologies. This materiality connects to the social processes and when combined these two create ambiguity in work practices because of their difference in form (Styhre, 2009). The last articles concerning context explored technology as context. Groleau et al. (2012) explored how the new technology caused conflicts between institutional and local practices. The study shows that technology includes socio-historical traditions. The second article regarding technology, by Bailey and Barley (2011), studied the impact of technology and environment on teaching and learning activities. Here, change was caused by technology, which led to changes in organizational structures.

The categories that appeared less often in construction management research included *meaning production*, *power*, and *becoming a practitioner*. The category of meaning production included two articles. The first article (Styhre et al., 2006) analyzed how written and verbal communication increased the learning between co-workers. The second article (Hällgren and Maaninen-Olsson, 2009) analyzed how informal reflection was used to overcome deviations in projects. These articles presented meaning creation as a part of normal work, as well as a result of solving unexpected problems. The category of power was found in one article. In this article, Bresnen et al. (2005) studied how changes in project management routines can cause a shift in the balance of power. Also, the category of becoming a practitioner included only one article. In this article, Voronov (2008) investigated how politics can influence learning and sense-giving in construction projects. This process can then shape identity processes and lead to delegitimizing some identity types. The above-mentioned articles are presented in more detail in the publication for Study 1 (Kokkonen and Alin, 2015).

After categorizing the articles, with the help of Lakatos (1970b) we evaluated, wheter these articles formed a separate research program of the practice approach to learning that differed from more traditional studies. First, we evaluated if the studies described learning consistently within the practice approach or if the studies used other traditions to define learning. We concluded that most of the studies were consistent with the practice approach when defining learning, but we also recognized that a few articles applied definitions that were not consistent with the principles of practice theory. Secondly, we evaluated if the applied methods were consistent with the methods of the practice approach. We found that the studies applied similar methods, which indicates a coherent use of methods. Thirdly, we evaluated if the novelty claims were consistent with the practice approach. Two-thirds of the studies produced findings that were not possible to produce with the traditional understanding of learning. Concurrently, the rest of the articles presented findings that could have been produced with traditional learning theory.

5.1.2 Contributions

Study 1 answers the research question: "*How have the studies of construction projects applied the practice approach to learning"* The findings show that the practice approach has been applied to construction management research, but at a limited level. Nevertheless, the found studies describe multiple ways of in which learning is connected to construction practices.

According to the findings, the practice approach to learning seems to be a relevant theoretical approach for construction management research because it can offer specific findings, and, in that way, it can uniquely develop the knowledge of the construction industry. At the same time, some of the studies did not produce findings that are specific to the practice approach. This vague use of the approach indicates that scholars should be careful while applying the practice approach and that they should be aware of the reasons for applying this specific approach. The usefulness of the practice approach can diminish if it

does not offer unique findings. Scholars are also encouraged to consider the areas of meaning production, power, and becoming a practitioner, as these are possible places for research gaps in the practice-based learning approach to construction projects.

Overall, by analyzing the existing studies, this study offers construction management research new knowledge on how to apply the practice approach in order to study learning. It adds to the selection of reviews on the practice approach (also Erden et al., 2014; Parmigiani and Howard-Grenville, 2011) by discussing both the future possibilities of the practice-based learning approach in construction management research and the uniqueness of the approach. The study also furthers the applications of the practice approach that have been expressed as useful in construction management research, for example by Bresnen (2009) and Boyd (2013). The study contributes to this discussion by defining the theoretical themes of the practice approach to learning and the use of these themes. Also, the practice-based learning approach (e.g., Corradi et al., 2010) can benefit from the study as it offers an example of how to separate the studies in this research program from other research programs.

The practice approach to learning seems to be especially suitable for studying learning that is socially constructed through informal or unplanned interaction between organizations. Informal learning can be increased with partnering that aims for integration (Bresnen, 2010). As the practice approach suggests, practices are situated in local and institutionalized contexts that include power relations. Changing these collaboration practices may be challenging.

5.2 Deconstruction and Reconstruction as Two Ways to Reflect on Changing Work Practices

5.2.1 Findings

Study 2 explored the reflection that individuals performed during the construction project in the USA when learning new practices that were initiated by BIM and IPD implementation. Through the analysis, we found that individuals reflected on their changing practices while designing and constructing the buildings as either a deconstructing process or a reconstructing process.

Practitioners applied a deconstructing process when BIM and the new collaborative processes of IPD required them to transform their existing ideas of work before they could work along with the new processes. These deconstruction processes included 1) deconstructing the work practices of architectural design, MEP (mechanical, electrical, and plumbing), and structural design; 2) deconstructing the practices of IT and construction work; and 3) deconstructing the goals of separate organizations in order to create common project goals. For example, architects were confused when construction design with BIM began earlier than in traditional projects. This caused architects and construction designers to work more interactively than before. The mindsets in the two separate disciplines differ; architects design iteratively while structural designers design more linearly. In traditional projects, architects perform design in the design phase, and construction designers work in the construction phase. In integrated

projects that apply BIM, these two different disciplines work more concurrently and exchange information with BIM. This development caused confusion among practitioners and the need to reflect on how to perform their practices with deconstruction.

Practitioners applied a reconstructing process when their existing understanding of work was in line with the new processes, but when they noticed challenges in some practices of collaboration. The reconstruction of practices included 1) reconstructing new practices based on the experience gained from the project, 2) reconstructing new practices based on collaboration, 3) reconstructing new practices while working in the project. For instance, practitioners who worked collaboratively in the co-location could reconstruct the collaborative practices with the help of the easy interaction in co-location. Modelers who sat close to other modelers could learn by observing others working and asking questions about their work. This knowledge assisted the modeling work that the different professionals used. When different disciplines work separately, it is harder for practitioners to learn about others' needs.

Because BIM and IPD relate to the practices performed by several companies collaborating in the same project, the changes in processes caused modifications to different disciplines. The changes concerned different companies that were connected to each other through practices. When collaborative processes were integrated—for example, by engaging construction stakeholders already in the design phase—the practices of different companies were linked more closely together. This integration can result in practitioners' need to deconstruct their understanding of their work practices and the ways in which those practices connect to others' work. The publication of Study 2 includes citations that illustrate these two types of reflection.

Overall, practitioners initiated both deconstructing and reconstructing processes when they needed to adjust their work practices to new processes, whereas project managers initiated the overall implementation of BIM and IPD processes. Both BIM and IPD implementation can produce extensive breakdowns of practitioners' work, which requires deconstructing their conceptions of work, especially work related to others, and minor breakdowns, which require reconstructing the practices related to others in collaboration. Thus, these two ways of reflecting on practices complement each other rather than exclude.

5.2.2 Contributions

Study 2 answers the research question: "*How do practitioners reflect on their work when the implementation of BIM and IPD interrupts the traditional way of collaborating?*" The findings show that practitioners applied both deconstructing and reconstructing processes when reflecting on their changing work practices in order to implement general BIM and IPD processes in their work.

In the analysis process, we applied Derrida's concept of deconstruction as an analytical tool in construction management research for one of the first times. Management studies have applied it earlier, although in a different manner (e.g., Boje, 1995).

Overall, Study 2 indicates that implementations of BIM and IPD require practitioners to reflect on how they should adjust their work practices to new processes. Studies have especially investigated the technological solutions of BIM (Oraee et al., 2017) or implementation from the perspective of managers, but only a few scholars have discussed the implementation at the level of practices (e.g., Arayici et al., 2011; Mäki and Kerosuo, 2015). IPD studies have acknowledged the need for both informal and formal mechanisms (Bygballe et al., 2014) and the relevance of interaction in achieving succeed (Mollaoglu-Korkmaz et al., 2014). However, IPD studies have omitted the active role of practitioners as part of the implementation. Study 2 adds to the BIM and IPD literature with two reflective processes that practitioners apply to change their practices in order to implement change.

Further, the case study shows how practitioners actively build their expertise by themselves in the evolving circumstances. This notion of reflective expertise has been recognized as a relevant topic for construction management research (Walker, 2016). Managers do not always possess all the knowledge of the contextual practices that is required to be able to describe the changes beforehand. When the implementation concerns many organizations, it is difficult to know in advance how to change the practices of one single organization.

In addition, the study supports studies of co-location (e.g., Beck and Plowman, 2011) by indicating that the co-location offers increased possibilities to reflect on the collaborative situation because it enables access to see the work of other stakeholders and discuss issues with them. As practices are connected, the reflection on practices is assisted by knowing the others' work.

While reflection is recognized as a process of creating common understanding between individuals in inter-organizational collaboration (Vlaar et al., 2006), Study 2 shows that reflection is also used to understand individuals' work in the changed collaboration processes, as well as to develop better solutions. The new collaboration practices in the case project also showed new opportunities to learn informally from other companies, through accessibility, overhearing, and observing. Few studies on inter-organizational learning have discussed these methods.

5.3 Management Practices Creating Physical and Social Affordances of the Space

5.3.1 Findings

Study 3 analyzed the case project in the USA to understand how collaborative space can be managed in a construction project. The findings show that managers did not just implement the space but also managed it throughout the project. The space was remarkably transformed in the beginning of the construction phase. For this reason, we compared the managing practices of the space between the design phase and the construction phase.

Managing the collaborative space was performed through creating social and physical affordances for collaboration between individuals. The managers influenced both the physical and social features of the space where individuals chose

their behavior for each situation. The construction project in the USA included managing the physical space through designing the building and the layout of the workstations. Both phases, design and construction, included managers performing these actions but in a different manner. In the design phase, the layout was designed collaboratively with all participating organizations, whereas in the construction phase each organization designed their part of the layout individually.

The managers' practices that influenced the social construction of collaborative space included dealing with resistance, continuously reflecting on the functionality of the space, gathering insights from the employees, promoting a common reason for collaboration, guiding collaboration practices in the space, and reminding others of the desired collaborative behavior. Our findings on the practices of managing the space are presented in Table 3, originally published in the publication of Study 3 (Kokkonen and Vaagaasar, 2017). A few adjustments have been made to the table here to increase clarity.

Table 3. Management practices related to the physical and social construction of collaborative space (from Study 3: Kokkonen and Vaagaasar, 2017, p. 5)

Management practices realted to	**In the design phase**	**In the construction phase**
The physical features of collaborative space	Deciding the form of the space (size and style)	Deciding the form of the space (size and style)
	Designing the layout for workstations together	The managers of each organization design the layout for workstations separately
The social constructions of collaboration practices	Reflective management of collaboration with the participating companies; overcoming resistance by persuading employees to work in the space	Reflective management of collaboration with the participating companies; managing less attentively by relying on employees' earlier experiences of space
	Promoting a common understanding of collaboration for the project with an emphasis on intensive communication	Gathering insights from the employees with surveys and discussions
	Promoting fixed periods for collaboration practices and individual work	Reminding others of the desired collaboration practices while performing daily work

The managers' practices relating to both physical and social affordances did not always result in the planned results. For instance, promoting fixed periods of collaboration and individual work did not prevent individuals from disturbing others, during the period of individual work. Further, the management of space was not only implemented once but also emerged during the project. For

example, the layout needed to be changed in the design phase because the detailers did not have enough space for their work. As the different phases contained different types of collaboration processes, the space was managed differently to support the collaboration in these different phases.

Project managers were not the only ones to manage the space. Rather, the project executive decided the general guidelines, while the project managers of different companies executed these decisions. Project employees also made decisions on some specific solutions. Also, in the construction phase, the project managers of each company acted more independently from the other companies, resulting in a collaborative space that located each company separately instead of mixing the companies.

5.3.2 Contributions

Study 3 answers the research question: "*How is collaborative space managed to increase collaboration?"* The question is answered with a case study of a large, full-time collaborative space that showed managers not just implementing the space but also managing it throughout the project. This management of collaborative space included management practices that influenced both the physical and social affordances of the collaborative space. Affordance theory enables scholars and practitioners to understand space as an environment that can nurture or "nudge" a specific kind of collaborative behavior. Additionally, affordance theory enables us to see individuals actively influencing their behavior within the environment (Fayard and Weeks, 2007). In workspace research, there is less discussion of social affordances when discussing collaboration and space (e.g., Elsbach and Pratt, 2007).

In Table 4, we have collected the elements of the physical and social affordances, and the related managing practices, based on the findings and existing literature. The literature is described in the theoretical background of Study 3, which is explored in Publication 3. The table enables us to investigate the physical and social elements of collaborative space through affordances and it assists in the identification of related management practices. The table also provides a separation between the two types of affordances that are constructed differently.

Table 4. The physical and social affordances of collaborative space based on existing literature and findings (from Study 3: Kokkonen and Vaagaasar, 2017, p.10)

Two types of affordance of a collaborative space	**Physical possibilities for using a space for collaboration**	**Social understanding of collaboration possibilities within a space**
Examples of affording elements from the collaboration literature	The space's design related to proximity (Beck and Blowman, 2013; Cannella et al., 2008), open office layout (Maher and von Hippel, 2005; Värlander, 2012), walls (Heerwagen et al., 2004); co-working rooms (Heerwagen et al., 2004), a shared service area (Hua et al., 2011)	Awareness of what happens in the space, brief interactions (max. 1 min), individuals working together over time (Heerwagen et al., 2004), consulting, verifying (Sapsed et al., 2005)
Management elements	**Choosing a design for a space**	**Defining collaboration practices for a space**
Examples of managing affording elements based on the results of this study	Designing the building and layout together with companies or separately, considering the needs of various companies	Spreading a common understanding of collaboration, guiding collaborative practices for fixed time, reminding of desired collaboration practices

Study 3 contributes to workspace research by offering a new way to see the connection between space and behavior. Existing research has mostly discussed the physical features of a space and, on the other hand, the activities performed in the space (e.g., Heerwagen et al., 2004). This dissertation presents management as a relevant factor in the investigations of how a space influences behavior. Study 3 shows how managers can influence behavior in space by creating physical and social affordances. Thus, within the study, affordance theory (Fayard and Weeks, 2007) is connected to the workspace literature, and management is included in the same literature as an activity influencing affordances of the space, which in turn influences collaboration behavior.

Additionally, the findings contribute to the literature of co-location and collaborative space in construction management research and project management literature where organizing collaborative space has only been discussed briefly (e.g., Beck and Plowman, 2013; Dietrich et al., 2010; Lahdenperä, 2012). Study 3 initiates the discussion of managing collaborative space and seeing a collaborative space as a complex phenomenon. In essence, this refers to the collaborative behavior enabled by the space. Following this, managers can define the types of collaborative activities that are desired in the space.

Further, the case shows how the collaborative space might need adjustments to be made by managers during different project phases. Collaborative space

literature should also consider challenges, such as disturbances to individual work in open spaces, which is mentioned in the workspace literature.

In the context of inter-organizational collaboration, if management involves the practitioners from the collaborating organizations in the design of the collaborative space, the needs of each organization can be incorporated. The space can be designed to enhance specific connections between individuals from different companies or the connections between individuals within their company. If the organizations have different aims and attitudes towards collective learning (Huxham and Hibbert, 2008; Zhang and Baden-Fuller, 2010), it might influence their will to use the space. Study 3 also presents a new spatial way of governing inter-organizational relations (see Dagnino et al., 2016).

5.4 Project Practices of Active Participation in Integrated Projects

5.4.1 Findings

The analysis of the case project from Finland concentrated on participation practices. The participation practices enabled individuals to be involved in common issues. Collaboration in the case project was performed differently than the project members had experienced in previous projects. I analyzed the collaboration with the framework of participation and found that the project members performed active participation in the situations of project management, meetings, and individual interaction. Project management produced active participation by using instruments such as a multi-party contracts and the early involvement of the contractors and engineering designers. Also, managers defined processes that ecouraged collaboration such as forming rules for interaction together (e.g., putting the principles for communication up on the wall) and involving all alliance companies in decision-making. In meetings, active participation was produced by introducing facilitative management that, for example, enabled individuals to have an opportunity to express their opinions. Also small groups were used to make conversation and problem solving more interactive.

Active participation was also produced in the interaction between individuals. These interaction practices included actively questioning common understandings, actively crossing company boundaries, and actively offering knowledge and comparing it. As these participation practices were new to the practitioners, they sometimes experienced the new practices as uncomfortable and requiring more effort. Table 5 presents a quotation and coding for each active participation practice produced in interaction. The table has been adjusted from the table in Study 4 to increase clarity.

Table 5. The active participation practices of individuals in the integrated project in the Finnish case (from Study 4 Kokkonen, 2017, p. 120)

Quotations from the interviews	1st cycle theme	2nd cycle theme
Trust—you need to work for it all the time and have the courage to say, for example, if you feel that you don't trust what I am doing. You need to bring that up and handle it openly. It is hard for Finnish people to take criticism. The central piece of alliance is collective trust and for that you need to have the courage to bring those things up and have the courage to hear them—they do not mean that you are bad at your work. (A representative of project management consultancy)	The need to have the courage to bring up defects	Actively questioning common understanding
Contractors did the main part; so I was mostly observing, as a cost inspector: questioning and watching the process if everything had been considered, and, on the other hand, keeping an eye on it for our company. (A representative of project management consultancy)	Asking if everything has been considered	
Make others have commitment. Also demand decisions and statements … when we go further, then the blaming begins and sort of only doing what has been discussed should be done … for the alliance. It suits challenging each other all the time. (A representative of architect)	Asking opinions	
We started to design immediately and begin with the characters of spaces before any layout … Our plans were visible to everyone, even when we were in a really early phase. Everyone has been able to comment on our design—it has been this Big Brother-type ... and it was like we were in an aquarium; we make a design and everybody immediately says "this works" and "this does not" and "this costs a lot". (A representative of architect)	Bringing one's work under the eyes of others	Actively overcoming organizational boundaries
It [communication], happens more over company boundaries; the roles get a bit mixed up. In the traditional [type of project] it is quite specific that you do this and that is your playground, but in an alliance they are a bit mix up; people may overlap in the task fields. (A representative of project management consultancy)	Making tasks overlap	
When you are in an APG [alliance project group], you should be able to deal with multidisciplinary issues and comment on them. I have to admit that I am quite out of my comfort zone— I do not understand anything about the strength of concrete studs, and I am from another field. In normal projects, we are not making proposals about similar issues. (A representative of building services engineering)	Commenting on issues outside of one's expertise	

Table 5 continues.

Quotations from the interviews	1st cycle theme	2nd cycle theme
After going through things in the technical section, a solution comes out. We do investigation after investigation on the technical side. There is also investigations on life cycle costs and we compare them to the alliance targets … During the design phase, all system solutions required justification. (A representative of structural engineering)	Conducting investigations	Actively offering knowledge
When we think of the costs of investments, the contractor has a central role in acknowledging the prices. But it is not only if we should purchase, for example, a door with a glass window—a contractor can tell us that a door without a window is *x* euros, and a door with a window costs *y* euros. While the architects offer the prospect of how the door aesthetically influences natural light, users tell us how they can observe through the door, if they need to go in; everybody has their role and opinion and it is decided together... There is a large panel that is thinking about these solutions. (A representative of contractor for building service engineering)	Comparing options together	
Many times, a situation arises where you say "This cannot be done." After this you need begin explaining. (A representative of project management consultancy)	Explaining the reasoning behind one's solutions	

Next, I shortly compare the active participation, in the integrated case project to the participation in more traditional projects, which are hierarchical and task oriented (see Barlow, 2000; Nicolini et al., 2001). This comparison assists in understanding active participation. The comparison is based on the descriptions of the interviewees of the active participation in the integrated project and their descriptions of the participation in traditional projects that the interviewees had experienced earlier in their career.

According to the respondents, the participation performed in traditional projects included, for example, working in sequences where individuals give the outcome of their work to the next person in the process. In the integrated project with active participation processes, individuals could influence the work of others while the work was not yet completed. The participation performed in traditional projects was also more passive because the individuals often waited to be asked for inputs. The individuals in integrated projects performed active participation by asking questions and offering their knowledge independently.

In traditional projects, participation was reduced since individuals mainly concentrated on their work. In the integrated project, the multi-party contract increased the interest in the work of the individuals from the other companies according to the respondents. A multi-party contract also assisted renegotiating, if necessary, which company will perform a specific task. Further, performing active participation included a higher level of communication.

Furthermore, some of the interviewees described the integrated collaboration in the case project as a more fun way of working than the traditional ways of collaboration of their previous projects, which were described as more reserved.

5.4.2 Contributions

Study 4 asked the question: "*How are participation practices performed in integrated construction projects?"* The findings illustrated the participation practices of the collaboration produced in project management, meetings, and individuals' interaction in the context of an integrated project. The findings identified these participation practices as active in order to highlight the specific style of participation. Thus, the answer to the research question is that they are performed via the active participation that is managed in the project, facilitated in meetings, and performed in individuals' interactions. This active participation means that individuals are more likely to influence common issues.

The literature on integrated projects has rarely discussed integrated collaboration at the level of practices (Bresnen, 2009), but it has used concepts such as open communication (Lahdenperä, 2012) and joint working (Suprapto et al., 2015). These guidelines, however, do not capture daily collaboration practices. Some studies have referred to collaboration with abstract concepts such as a culture and trust. Study 4 shows, by exploring the practices, what the collaborative culture in an integrated project can mean in terms of daily practices.

Collaboration was addressed with the concept of participation, which has been explored earlier in organization studies, for example by McCaffrey et al. (1995) and Chompalov et al. (2002). This earlier literature, which discusses participation as a mechanism for collaboration or participation as a type of collaboration, focuses on the level of organizations and groups. In Study 4, I widened the description of participation by showing how active participation is performed in a construction project at the level of project management, meetings, and interaction. Further, I showed, in more detail than many other studies have explored, how an integrated project can differ in its interaction practices (e.g., Bresnen, 2009). Participation, according to Ashmos et al. (2002), assists embracing complexity, which is why it can be necessary for complex projects.

The findings of Study 4 contribute to construction management research by describing collaboration practices of integrated projects with the help of a participation framework. The findings continue the explorations of project practices addressed by Bresnen (2009) and increase our understanding of the difference between emerging interaction in integrated projects and more traditionally performed projects.

In inter-organizational collaboration, participation practices are created within the project, while the individuals also have experience from earlier projects. Establishing the participation practices for a specific project requires common understanding of the project (Vlaar et al., 2006). Study 4 describes in detail how common understanding can be increased through participation practices in construction projects. Many studies on inter-organization learning discuss the exploration and exploitation of knowledge of one organization (Holmqvist,

2003). Study 4 shows participation practices that increase collective exploration of the existing knowledge and enable creating together new knowledge.

Study 4 that is presented in Publication 4 could still be developed further. Further development could enable a submission to a journal.

6. Discussion

6.1 Theoretical Discussion

This dissertation has explored the overall research question of how collaboration practices in construction projects support collective learning. I answered this question by first using a systematic literature study to show how research has applied the practice approach to learning in the context of construction projects. The findings especially highlighted learning in the informal practices of construction projects. Second, I showed how individuals adapted to changes in inter-organizational collaboration in the reflective learning processes of deconstructing and reconstructing. Third, I illustrated how managers actively shaped a collaborative space to enhance inter-organizational collaboration during the design and construction phases. Fourth, I showed how participation was constructed in an alliance project on the levels of project management, meetings, and individual interaction. The participation practices were aimed towards active involvement that emphasized the individuals' initiatives in collective learning.

The studies of this dissertation add to the partnering literature by exploring further how partnering practices emerged in two complex construction projects (see e.g., Bresnen, 2009; Vlaar et al., 2006; 2007). While the literature of partnering has understood the value of materiality (Bresnen, 2010), the value of space has scarcely been explored. Study 3 adds to this by showing how space can be managed in order to have an influence on partnering outcomes, for example, by offering easy access to the individuals from different organizations.

Projects that apply partnering require some collective learning to implement this sometimes ambiguous project delivery method (Bresnen, 2010). This dissertation has explored this learning process further by exploring how individuals actively reflected on changes in collaboration and how they used integrated collaboration to learn from others. Partnering has also been recognized to enhance collective learning between organizations (Holt et al., 2000). By exploring the management of a collaborative space and the practices of participation, this dissertation illustrates two partnering mechanisms that can enhance interaction, which then supports collective learning.

The literature on inter-organizational learning has often discussed R&D collaboration where absorbing and exploiting knowledge from other organizations is a relevant risk (Barlow and Jashapara, 1998; Holmqvist, 2003). In construction projects, this risk is reduced because organizations in construction projects

have more specialized roles. In construction, the organizations represent complementary sources (e.g., Das and Teng, 2000), which produce a combination of knowledge to create a purposeful design for a building. In the Finnish case, however, the alliance contract made the roles of the different organizations more flexible, which might have introduced more possibilities for the exploitation of knowledge between organizations. In the case project in the USA, the individuals described that they learned about the processes of the project by observing others in the collaborative space. This kind of knowledge spillover can help a project succeed by creating an understanding of other organizations and their work practices.

Literature has also discussed the governance of inter-organizational collaboration and how the governance may improve the efficiency and speed of collaborative knowledge processes (Dagnino et al., 2016). The Finnish project illustrated how participation can be the leading principle in collective governance and how it can be realized in the project. In partnering projects in the construction industry, the governance includes all the key organizations. However, in some projects there is an asymmetry in governance if the owner of the future building does not have a professional background in construction. This was the case in the Finnish project.

In this dissertation, the practice approach has been the most influential theoretical framework that guided the interpretations. The practice approach is one of the multiple theoretical discourses used in organization studies. The different theoretical discourses are, on some level, contradictory. However, by complementing each other, the discourses together increase our understanding of organizations (Ketokivi et al., 2017). To gain progress, a research discourse is required to produce new knowledge while applying its core principles (Lakatos, 1970a). New knowledge also needs to go through a critical evaluation and gain acceptance among an audience (Ketokivi et al., 2017). For example, this evaluation could be gained with a peer review process that includes critical evaluation. Publication of the new knowledge can introduce acceptance, which can be confirmed if it is cited. Thus, producing new knowledge is also social process.

Like other theoretical discourses, the practice approach also evolves (Corradi et al., 2010) and includes various ontological understandings (Nicolini, 2012; Thompson, 2011). One course in the practice approach has been transforming the conversation from being on that covers practice-based learning (Gherardi, 2006; Lave, 1988) to one covering many other aspects of practices (Nicolini, 2012; Nicolini and Monteiro, 2016). This means the discussion about practice-based learning is not a separate discussion to that about the practice approach, but practice-based learning is more like a continuation of the discussion where the practice framework from learning is widening to encompass other organizational phenomena.

6.2 Managerial Implications

The first study explored practice theory within the context of construction projects. The practice approach assists understanding construction projects not

just as complex and evolving projects (Cicmil and Marshall, 2005) but also considering them as being primarily performed with practices that build the situated nature of collaboration (Bresnen, 2009). The practice approach can also help to see how a phenomenon, such as culture, is performed through practices by illustrating the acts of performing a culture. Thus, the practice approach aids managers to consider certain aspects, for example, how to manage the practices of construction projects instead of how to manage abstract ideas, such as culture, collaboration, and trust.

Study 2 of this dissertation explored the reflective learning of practitioners as part of BIM and IPD implementation. Managers should consider this reflective learning as an essential part of a successful implementation when they cannot offer solutions for each detail of the new process. If the implementation of new technology concerns several stakeholders, the reflection concerns the practices of them all. In this case, the new practices cannot be planned beforehand without collecting the knowledge of each participant in the process. In addition, managers should consider how BIM or IPD implementation creates different kinds of modifications to the work of different professionals. Different professionals might need different kinds of reflection to form new processes. Managers should encourage and assist reflectivity, for example, by offering space and time for it. Further, the findings suggest understanding professional expertise as something flexible and emergent, instead of seeing it as stable content. Managers can promote this development of expertise by offering possibilities for practitioners to develop their work processes. To develop collaborative processes between individuals from separate organizations, a collaborative space can be helpful because it offers possibilities for dialogical communication and forming relationships.

Study 3 offers insights into collaborative spaces. Managers implementing a collaborative space should consider both the physical dimensions of the space, including the building and the layout, and the socially constructed idea of the desired behavior in the space. One can design a physical space to foster collaboration. At the same time, however, the space can enable practices that are not collaborative. As a space does not determine behavior but instead enables several types of behavior, managers should consider how to create a common understanding of a specific kind of collaboration and the will to perform it. Sometimes resistance might occur among practitioners when faced by a new type of behavior. In considering the physical design, meeting rooms are important for small group work while an open plan design for desks enables dialogue, especially between closely situated individuals.

Further, the findings assist managers in considering some of the challenges and opportunities of a collaborative space for a specific project. Each construction project has specific needs for the space. The case study in the USA included a full-time space for collaboration, while the case study in Finland contained a part-time space where the stakeholders met twice a week during the design phase. The part-time space for collaboration was considered more useful because a large number of the participating individuals only worked permanently in other cities, and many individuals worked part-time in the project. Besides

deciding on the size of the space, managers should consider if the needs of the space change over the timeline of the project. The results suggest that managing a collaborative space is a continuous task that continues after the implementation. The need for collaboration can change, and the spatial solutions of the space should adjust to any such change. Finally, managers should take into account who and which organizations should be included in the decision-making for the collaborative space in order to include all the necessary knowledge in decisions. Different organizations can have different needs for a space, which should be considered while planning the space.

The fourth study offers insights into the practices of the integrated project model. Managers should consider participation as an essential part of collaboration. Participation means that individuals can influence common issues instead of only being present. Participation can occur across a horizontal range of different organizations and across the vertical hierarchy of individuals inside each organization. Participation in an integrated project requires individuals' active behavior, which managers should support, especially if this kind of performing is new for the individuals. However, careful planning of participation is necessary to include only those individuals that possess the required knowledge in meetings. Overall, it is important to define what kinds of collaboration practices are purposeful for the project. These practices form the daily culture of collaboration.

7. Evaluation and Future Research

7.1 Evaluation

To evaluate social studies, research has employed reliability, validation, and limitations. These concepts originate from quantitative studies, but they have also been adapted to qualitative studies. However, within qualitative studies, validation and reliability are less established concepts. Scholars have employed various criteria to describe these concepts (Whittemore and Chase, 2001).

Within this dissertation, *reliability* refers to the findings that a researcher has not derived randomly, by chance (Kirk and Miller, 1986; Whittemore and Chase, 2001). Reliability can be supported by performing methodological processes that limit the options for randomness. In the dissertation, the data gathering methods were a systematic literature search and two single case studies. In Study 1, the data were gathered systematically following previous examples. Following this, the data collection can be repeated in the same way, though it would give results from another period. To ensure a coherent process, the second author and I excluded the non-relevant articles. The details of data gathering can be found in the paper for Study 1.

I conducted the first case study together with two other researchers. We reflectively discussed the process, which assisted me in gathering the relevant data. I collected the data for the second case study alone. In this process, my previous knowledge of construction projects assisted in deciding if the data collection was comprehensive. Also, the multiple data sources promoted my understanding of the context of the findings and enabled gathering the relevant data in the case studies (Piekkari et al., 2009).

To process the data of Study 1, the found articles were managed with Excel software. The software helped to analyze the articles systematically. For the Studies 2 and 3, the transcriptions of the interview data was outsourced to a professional company, after which I checked the accuracy of the transcriptions made by that company with two other researchers. I placed the transcriptions into Atlas.ti software for a rigorous analysis process. I transcribed the data of the Finnish case, myself and applied the transcriptions in Excel software to gain a rigorous process for the data analysis. The reliability of the dissertation was also confirmed by comparing the analysis to the existing understanding of the phenomenon.

Validity in qualitative research refers to the degree of consistency between the interpretations of the data and social reality (Creswell and Miller, 2000; Maxwell, 1992). Within this dissertation, validity is promoted by forming consistent

interpretations from the data. Next, the process of interpretation is described with the following three forms of validity: descriptive, interpretative, and theoretical validity.

To build descriptive validity, one needs to describe the phenomenon accurately (Maxwell, 1992). In the case studies, this type of validity was assisted by a careful data collection process where recording the interviews and meetings captured the exact words of the interviewee or the observed individuals. In addition, I gained knowledge of the situation, the mood of the person, and his or her gestures by being present in the interviews and at the observations. Moreover, visiting the collaborative spaces and the company offices was useful in order to gain an understanding of the daily work situations. The combination of the different data sources also assisted in gaining a holistic understanding of the phenomenon (Ridder et al., 2014). Finally, the accuracy of the data was promoted with the quotations that assist the argumentation in the papers and show how the informants spoke.

Interpretative validity is consistency between the findings and the interpretations of the observed individuals of the events and behavior (Maxwell, 1992). In this dissertation, this consistency was accomplished through the interviews where the individuals described their understanding of the situations and actions. Conducting interviews with the individuals from separate companies also enabled the observation of multiple perspectives on the situations, providing deep understanding. In addition, the interviewed individuals are professionals in the construction industry, and most of them have experience from previous projects. For this reason, the interviewees could offer cultivated insights to the projects. Also, we discussed the preliminary finding of the USA case with two other researchers. Further, the analysis processes followed processes that have been used by other researchers.

Theoretical validity refers to the accuracy of the created theoretical concepts and the relationships between these concepts (Maxwell, 1992). By applying the practice approach, I have developed theoretical thinking with an interest in the daily practices of the project. This interest in practices means that researchers aim to build knowledge that acknowledges specific situation instead of aiming for generalized, abstract knowledge (Nicolini, 2012). Thus, the concepts that I have used are chosen with insights from the data. I do not create new concepts within the studies but combine the concepts that have been used before. This reuse of concepts supports writing with accurate concepts because scholars have defined and reflected on these concepts already. By following these writings, I can reflect on and develop their use in research.

Besides the previously mentioned evaluations, anonymous reviewers have evaluated all four studies. The published articles have been in a review process that included three anonymous reviewers. The review process of the fourth paper contained comments from two anonymous reviewers. Based on the suggestions of the reviewers, all the papers have been revised significantly to offer a contribution that is more precise.

7.2 Limitations

This dissertation includes a few limitations. The first limitation concerns the possibility of missing relevant data. In Study 1, the literature search may perhaps have been wider. Nevertheless, the chosen scope of data included the most relevant journals and offered enough articles to make a detailed analysis. While Studies 2, 3, and 4 may perhaps have contained more interviews, the data collection already included all the main organizations and individuals in different positions. The larger American project required conducting more interviews than the smaller Finnish project because the large size resulted in processes that were more complicated. The data collection was continued until similarities were found from the data and an understanding of the project was gained. It is possible that some knowledge is missing that hinders understanding. Nevertheless, the findings of the dissertation are supported by existing research.

The second limitation is based on generalization. Qualitative studies are not generalizable in a similar manner as quantitative studies. Nevertheless, qualitative studies can offer possibilities to develop theories (Eisenhardt and Graebner, 2007; Siggelkow, 2007). In the dissertation, the studies produce novelties that are compatible with earlier theories on collaboration and the practices of construction projects. The findings of the dissertation are situated in the context of complex construction projects that apply the methods of integrated projects. Future research might suggest some changes to this knowledge, especially in the context of different kinds of projects. Thus, future studies could investigate if different contexts influence the findings. Yet there is no reason why the findings would not also be applicable to some collaborative situations outside the construction industry.

The third limitation concerns the chosen empirical methods. Other research methods might also have been applied to understand the project practices. However, the applied methods offer knowledge that enabled covering projects that are large, complicated, and difficult to cover without a single case study approach. Concentrating on single cases assisted forming a comprehensive understanding of the case, which is more difficult with quantitative methods. Interviews enabled gaining knowledge of project practices and defining the difference between integrated project and other projects. Collaboration practices might have been studied with more extensive observations, called ethnography, however, in large projects observations have to be very extensive to capture all relevant participants who work in different parts of the co-location or in different locations and who might change during the project if it is executed over multiple years.

7.3 Future Research

Based on the dissertation, some avenues for future research were detected. Firstly, this dissertation has not introduced the differences between the professionals in the collaboration extensively. Some descriptions of the differences were described in Study 2, when architects wondered about the processes of contractors and vice versa. Architects' work processes are generally iterative

while contractors aim to decide on the details and execute them thereafter. This difference caused some challenges in the American project at the beginning. Based on the observations in the Finnish case, contractors may concentrate on reducing costs when architects concentrate on the spatial needs of the users and the functionality. These different points of views may cause tensions, but they also complement each other. Future research could further study the differences between professionals and the impacts of these differences on collaboration, especially in inter-organizational and inter-disciplinary work contexts.

In the construction industry, BIM and other digital technologies keep developing, which means that practitioners also need to continue reflecting on the implementation of the associated changes in work. Future research needs to investigate how to support reflective learning, which is performed within the daily project life. Managers should especially consider how an individual's reflection is promoted when several organizations are involved. The different professional backgrounds can influence the ways in which practices are performed (Bailey and Barley, 2011), and researchers could study how different professional backgrounds influence the individual's reflection.

While this dissertation has opened up a conversation on managing a collaborative space, the phenomenon could be further investigated to gain knowledge about the preconditions for managing the space. In addition, collaborative spaces that differ in their spatial and social solutions should be compared to gain an understanding of what kind of solutions benefit specific contexts. For instance, it is often too expensive to have a full-time collaborative space for a small project. In addition, further studies could explore how the nature of collaboration influences the need to manage the space.

Further, existing research rarely discusses the possibilities of facilitation as a way to increase the participation of individuals. More knowledge would be beneficial to understand how to make individuals participate in conversation at meetings and in other daily practices of a project. Some individuals work solely from a home office, others sometimes visit the project space, and some work solely in the project space. The individuals who do not constantly work in the space do not have similar access to all the information and activities.

This dissertation has taken one step further by clarifying inter-organizational collaboration, focusing on daily practices in construction projects. Yet, more studies are clearly needed. One attempt to do this could be a literature review that explores the similarities and differences among the articles on inter-organizational collaboration.

Finally, the dissertation has explored two construction projects from the USA and Finland. The different contexts of these countries influence the performance of collaboration in the projects. For example, the interaction culture and the work culture, as well as the role of unions, are different in these two countries. Future research could further compare, how the collaboration practices differ in these two national contexts.

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