JÖNKÖPING UNIVERSITY
Jönköping International Business School

Doctoral Thesis

Cross-boundary knowledge work in innovation

Understanding the role of space and objects

Marta Caccamo

Jönköping University
Jönköping International Business School
JIBS Dissertation Series No. 142 • 2020

JÖNKÖPING UNIVERSITY
Jönköping International Business School

Doctoral Thesis

Cross-boundary knowledge work in innovation

Understanding the role of space and objects

Marta Caccamo

Jönköping University
Jönköping International Business School
JIBS Dissertation Series No. 142 • 2020

Doctoral Thesis in Business Administration

Cross-boundary knowledge work in innovation: Understanding the role of space and objects
JIBS Dissertation Series No. 142

Publisher:
Jönköping International Business School, Jönköping University
P.O. Box 1026
SE-551 11 Jönköping
Tel. +46 36 10 10 00
www.ju.se

Printed by Stema Specialtryck AB 2020

ISSN 1403-0470
ISBN 978-91-7914-005-2

D'una città non godi le sette o le settantasette meraviglie,
ma la risposta che dà a una tua domanda.
Italo Calvino

To all the amazing friends who shared this journey with me.

To my deeply caring family whose love and affection made this work possible.

Acknowledgement

I can no other answer make, but, thanks,
And thanks, and ever thanks.
William Shakespeare

Four years ago, I booked a one-way trip to Sweden with a suitcase filled with great enthusiasm and countless doubts. Four years later, I am profoundly thankful for the opportunity to pursue my PhD at Jönköping International Business School (JIBS), a place that welcomed and supported me beyond all expectations. Writing this dissertation led me on an intense journey of academic and personal development. I was lucky enough to work on a topic I'm deeply passionate about and even more fortunate to share this journey with many astounding researchers and friends. I certainly got more than I could hope for.

Many people played a critical role in making this dissertation happen. First, I want to thank my extraordinary supervision team: Karin Hellerstedt, Daniel Pittino, and Sara Beckman. Karin has been my advisor throughout the whole process, and she trusted and encouraged me since the first day. I owe her a special thanks for the patient understanding, thorough feedback, and continuously open door. Without Karin's guidance, my thesis would be very different, and my experience of the PhD process not as rich and rewarding. Daniel's mentorship, friendship, and invaluable academic support motivated me to stay focused and get to the finish line. I cannot express in words my gratitude for all the talks and office visits that gave me a confidence I did not know I had. I had been fond of Sara's work on design thinking before meeting her in person. Therefore, I could not believe her invite to join Haas School of Business at UC Berkeley as a visiting researcher was for real. Sara's precious advice, endless energy, and contagious positivity have been a great source of inspiration and learning.

Although my supervisors have been fundamental to the development of this dissertation, I'd also like to extend my gratitude to several colleagues who played a key role during my time at JIBS. During the PhD process, I have experienced many challenging moments, but I experienced loneliness on no occasion. My time at JIBS has been animated by insightful conversations and a community spirit that will accompany me the years to come. For this reason, I want to thank all the colleagues who took time to talk about my thesis topic, when I wasn't even sure I had one; those who attended my seminars with interest and constructive feedback; those who shared many coffees and laughter; and those who joined me for daily "active breaks".

In particular, I'd like to thank Norbert Steigenberger and Oskar Eng, who reviewed my research proposal and helped me to get much-needed clarity on the way forward. Thanks to Daved Barry and Andrea Resmini for many afternoons spent brainstorming around spaces and design. Thanks to all my fellow PhD candidates, who make JIBS such an interesting and funny place. It has been great to know, no matter what, we are in this together. Thanks to my numerous amazing co-teachers from whom I've learned a lot on how to sharpen my teaching abilities. A special mention to Massimo Bau, who allowed me to combine my research and teaching interests in the course of Entrepreneurial Creativity. His inputs and reflections greatly helped me to make

sense of the process of open-ended inquiry our student teams went through. To conclude, thanks to Susanne, Rose-Marie, Barbara, Ina, Ingrid, and Philippa, who always have a kind answer to any administrative question (and beyond!).

During my PhD process, I also had the great pleasure of meeting colleagues from other institutions who shaped this dissertation with sharp comments and helpful advice. I'm incredibly grateful to Ann Langley for her precious feedback during the final seminar. I very much appreciated her constructive suggestions that allowed me to improve the manuscript until the current form. Many thanks to the editors and anonymous reviewers of the Creativity and Innovation Management paper for a very fulfilling revision process. Moreover, I want to acknowledge the participants of the second studio summit in Toronto. Special thanks to Sebastian Fixson, Stefan Meisiek, and Nabil Harfoush. The discussions we had about studio methods for creative work played a strong influence on the direction I gave to this dissertation. Thanks also to the reviewers and participants from EGOS, AOM, EAM, and R&D Management Conference who eagerly commented on earlier versions of the four papers included in this manuscript. I am also grateful to Henry Chesbrough and to the Open Innovation group at Haas for giving me the chance to present my research about startup accelerators in a welcoming and informal setting. Finally, thanks to the MOSAIC group, in particular Olivier Irrmann, Jean-Charles Cailliez, Patrick Cohendet, Laurent Simon, and Louis-Etienne Dubois for igniting my interest in the topic of collaborative innovation.

During my PhD I benefited from generous financial support. I'm thankful to the Jan Wallander & Tom Hedelius Foundation for making my visit to Haas School of Business possible and to the Stiftelsen Inger, Arne och Astrid Oscarssons Donationsfond for sponsoring several research trips and data collection efforts. In this respect, my sincere gratitude goes to all the people who provided data for this dissertation. Thanks to all the bright minds in the Entrepreneurial Creativity class for their critical reflections about space and creativity. Thanks to the hundreds of participants and mentors at the InnoDays, whose feedback and collaboration have been essential to complete the second study included in the dissertation. Finally, thanks to the program directors, investors, experts, and entrepreneurs who introduced me to the Silicon Valley ecosystem. This dissertation has been a great learning experience. I hope it will (at least partly) give justice to the time and effort so many people dedicated to my work.

Finally, my greatest thanks go to my friends and family in Italy and Austria. Thanks to Gaby, Hugo, Angela, Judith, and Matthias, for welcoming me with open arms. Just saying thank you will never repay your kindness. Grazie nonno, nonna, mamma, Carlo e Gigi per l'affetto e il supporto che non mi avete mai fatto mancare. Grazie per la pazienza nell'avermi lontano e per l'entusiasmo a ogni chiamata. To conclude, many thanks to my best colleague, Thomas, for pushing me all the way and providing constant support at the same time. To many new adventures…

Abstract

This dissertation studies the topic of cross-boundary knowledge work from the perspective of sociomateriality. Cross-boundary knowledge work refers to the collaboration of actors belonging to different social worlds to achieve shared knowledge outcomes. Sociomateriality is a theoretical perspective that acknowledges the role of objects and spaces in organizational life. The empirical field of collaborative innovation provides a context for this dissertation.

Cross-boundary knowledge work is an important topic given the emergence of novel challenges that require collaboration across disciplines and organizations. Innovating across social and organizational boundaries is a demanding task that calls for new ways of working. Working in new ways refers to using new organizational models and engaging in new organizational practices. To address the increasing need for cross-boundary knowledge work, this dissertation turns to the design of objects and spaces as a defining aspect of organizational life.

The overarching goal of the dissertation is to understand what role spaces and objects (physical and digital) play within cross-boundary knowledge work. The dissertation is structured into four papers. Paper 1 builds the foundation of the dissertation by providing an extensive literature review about boundary objects—a theoretical construct that denotes objects that enable knowledge-based collaboration across diverse social worlds. The subsequent empirical papers study cross-boundary knowledge dynamics in three different collaborative innovation contexts. Paper 2 addresses how boundary objects can be designed to enable knowledge integration during interdisciplinary corporate hackathons. Paper 3 shows how innovation spaces and the objects that are part of them support collaborative innovation through knowledge integration and the development of new practices. Paper 4 conceptualizes startup accelerators as boundary spaces that lead to the creation of different types of knowledge communities.

This study makes important contributions to the fields of cross-boundary knowledge work, sociomateriality, and collaborative innovation. First, the four papers show that cross-boundary knowledge work needs to consider other dynamics happening at the boundaries within interdisciplinary and interorganizational contexts. For instance, the creation of a shared identity appears to be a fundamental aspect to consider in order to achieve knowledge goals. Second, this dissertation deepens our understanding of the actual practices afforded by objects and spaces within collaborative settings. Each paper strives to provide an in-depth account of how individual objects, systems of objects, and spaces support knowledge work. Third, this dissertation offers a relevant theoretical perspective to illustrate the challenges involved in collaborative innovation, at the same time suggesting how material infrastructure may help collaborating actors achieve shared knowledge outcomes. Finally, innovation managers can find relevant advice on how to leverage the built environment to enhance their practice.

Keywords

cross-boundary knowledge work, knowledge management, knowledge sharing, knowledge integration, sociomateriality, boundary objects, affordances, material scaffolding, collaborative innovation, open innovation, business studios, corporate hackathons, startup accelerators

Table of Contents

1 Introduction

This dissertation explores the topic of cross-boundary knowledge work, which involves collaboration among actors with different backgrounds and organizational affiliations to pursue shared knowledge objectives. This dissertation addresses the central theme from the perspective of sociomateriality, a theoretical lens that considers the social and material dimensions of the production of practices. My main objective is to understand what role spaces and objects play within cross-boundary knowledge work. This is important because the design of spaces and (physical/digital) objects is more and more central to provide effective support for knowledge work among company units, disciplines, and internal-external actors. However, the existing research provides only limited insights into the role of materiality in cross-boundary knowledge work and the effectiveness of material elements, such as space and physical/digital objects, under diverse circumstances. To complete this research task, I focus on the field of innovation, which provides a suitable context for this dissertation since it frequently involves crossing knowledge boundaries to create new products and processes as well as business models.

The first chapter of the dissertation includes three parts: first, it introduces the conceptual foundations of the dissertation; second, it highlights relevant gaps in the literature and specifies research questions; and third, it defines the key concepts in use.

1.1 Setting the stage

Today's world presents us with increasingly interconnected and complex challenges (Ketchen, Ireland, & Snow, 2007). Developments in business, technology, and science are an important driver of this rising interconnectedness and complexity (Edmondson & Harvey, 2017a; Powell & Snellman, 2004). Knowledge specialization is increasing the speed at which new technologies are developed and scientific discoveries are made (Tell, Berggren, Brusoni, & Van de Ven, 2017). However, expert knowledge within the boundaries of only one discipline is insufficient to tackle complex problems (Edmondson & Harvey, 2017b). Collaboration across knowledge boundaries has become necessary to innovate and be competitive in the face of equally complex and fast-paced markets (Chesbrough, 2003; Cross, Rebele, & Grant, 2016; Ketchen et al., 2007). As a case in point, companies have started to recognize the shortcomings of traditional innovation models based on research and development (R&D) (Chesbrough, 2003; Tucci, Chesbrough, Piller, & West, 2016; World Economic Forum, 2015) to create novel products and reach new markets (Christensen, Raynor, & McDonald, 2015; Tucci et al., 2016). In contrast, collaborative innovation has become an increasingly popular approach to producing disruptive innovation (Tucci et al., 2016), leveraging the expertise of internal and external organizational players to create business improvements and sustained learning (Kodama, 2015).

The success of a collaborative approach to innovation rests on the ability of the collaborating actors to effectively perform knowledge work across boundaries (Edmondson & Harvey, 2017a; Majchrzak, More, & Faraj, 2012). Despite the potential benefits of working across boundaries, there are multiple challenges to collaborative innovation as well. First, cultural clashes may inhibit the collaborative mindset (Swink, 2006). Second, a lack of clear expectations and differences in business processes can hinder effective collaborative innovation (Swink, 2006; Usman & Vanhaverbeke, 2017). Finally, there may be a problem at the level of internal support for collaborative innovation projects involving executive endorsement and appropriate incentive schemes for employee engagement (Usman & Vanhaverbeke, 2017). The numerous challenges in effective collaborative innovation make it a daunting task (Kodama, 2015). Failed attempts at collaboration across organizations are common (Adner, 2012; Di Fiore & Vetter, 2016; Narsalay, Kavathekar, & Light, 2016). Additionally, collaborating across organizational divisions, functions, and departments generates costs that often go unseen (Cross et al., 2016). Companies have embraced collaborative innovation as part of their credo without fully preparing for it, often leaving the process unmanaged (Di Fiore & Vetter, 2016; World Economic Forum, 2015).

Scholars have studied the phenomenon of cross-boundary knowledge work from different perspectives, including teaming (Edmondson & Harvey, 2017a, 2017b) and organizational design (Maas, van Fenema, & Soeters, 2016; Tortoriello & Krackhardt, 2010). In this dissertation, I apply the perspective of sociomateriality (Jarzabkowski & Pinch, 2013; Nicolini, Mengis, & Swan, 2012). Sociomateriality is a suitable perspective for this study because companies increasingly look at the design of space and objects—the design of physical and digital infrastructures, such as workspaces and platforms—as a means to support cross-boundary knowledge work in different ways. For instance, corporate innovation labs aim to stimulate creativity and innovation among their employees (Gryszkiewicz, Lykourentzou, & Toivonen, 2016; Magadley & Birdi, 2009). These labs are often open to key partners and sometimes to customers. Likewise, startup accelerators, business studios, and incubator programs strive to establish generative relationships between large corporations in need of ideas and startups looking for capital and applications for their technologies (Usman & Vanhaverbeke, 2017; Yoon & Hughes, 2016). Physical and digital objects complement the design of innovation spaces. Physical objects include furniture (whiteboards, desks, walls, etc.), prototyping materials (sticky notes, Legos, cardboard, etc.), and artifacts (prototypes, sketches, icons, etc.). Digital objects include platforms (task managers, project management tools, social media, etc.), software, and files (documents and media). The choice of objects depends on the needs and characteristics of the users of the space (Fixson, Seidel, & Bailey, 2015). However, many organizations design innovation spaces following trends and replicating existing innovation spaces they consider a best practice.

The initial wave of excitement around innovation spaces has been replaced by doubt, as several innovation spaces have failed to deliver the expected outcomes. Companies have started to question whether investing in innovation infrastructures is worthwhile considering the value they actually produce. Evidence suggests that companies are increasingly coming to terms with the results of large investments that

do not meet expectations (Chesbrough, 2019). When looking at the costs and benefits, many organizations are reconsidering whether designing spaces is the answer to successfully engaging in collaborative innovation (Viki, 2016; Yoo, 2017). The continuous closures and downsizing of innovation labs (Yoo, 2017) is a case in point.

The existing literature on boundary objects (Carlile, 2002; Star & Griesemer, 1989) has helped to cast light on the role of materiality in cross-boundary knowledge work. Boundary objects are objects that support collaboration among diverse social worlds by virtue of their characteristics, chiefly their interpretive flexibility (Star & Griesemer, 1989). Despite the growing popularity of the concept of boundary objects, it is unclear how boundary objects and the space they inhabit help in overcoming the challenges involved in cross-boundary knowledge work. How can cultural clashes be mitigated? How can expectations be aligned? How can support be generated? Many of these challenges stem from issues beyond cognitive differences among collaborating actors, and meeting these challenges requires studying materiality as an integral and defining aspect of organizational life.

This dissertation aims to provide a more nuanced understanding of the role of space and physical and digital infrastructures in supporting cross-boundary knowledge work. In this dissertation, I focus on providing insights into how collaborative innovation spaces and the objects that are part of them support knowledge work across boundaries. The four papers included in the dissertation pay particular attention to how we can overcome the challenges of cross-boundary knowledge work for innovation by fostering effective collaborative practices.

1.2 Purpose of the dissertation

The aim of this dissertation is to advance our understanding of the role space and objects play in facilitating cross-boundary knowledge work. This is motivated by the increasing pressure placed on companies to collaborate across organizational, functional and disciplinary boundaries in order to innovate more effectively. Specifically, I ask:

What role do spaces and objects (physical and digital) play within cross-boundary knowledge work?

The overarching research purpose is achieved by answering four research questions that are addressed in the individual papers included in this dissertation.

1.2.1 Boundary objects in spanning knowledge boundaries

The first paper in my dissertation builds the foundation for the study by exploring how boundary objects enable collaboration across social worlds (Carlile, 2002; Star & Griesemer, 1989). Recent studies of cross-boundary spanning have argued that the literature on boundary objects fails to illustrate actual practices afforded by the objects and fails to sufficiently problematize boundaries (Langley et al., 2019). In fact, boundary objects are primarily studied in relation to knowledge boundary spanning (Carlile, 2002; Hsiao, Tsai, & Lee, 2012; Swan, Bresnen, Newell, & Robertson, 2007). However, the existing literature suggests that boundary objects may play different roles. For instance, boundary objects used across organizations or departments may have a political role (Jarzabkowski & Kaplan, 2015), whereby the

objects become arenas in which different actors exert varying levels of influence (Courpasson, Dany, & Clegg, 2012). Another example involves temporal work through boundary objects, as such work often happens during project meetings where timelines and project charts are employed (Yakura, 2002). The emphasis on knowledge work is linked primarily to the original theorization of boundary objects developed by Star (1988) and Star and Griesemer (1989), who defined them as "objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star & Griesemer, 1989, p. 393). I maintain that the original theorization needs to be updated considering the advances in organization and management studies (OMS) since the work of these authors to provide a more complete analysis of the concept of boundary objects.

I use the three main components of boundary objects as a starting point: interpretive flexibility, the structure of information and work process needs and arrangements, and the dynamic between ill-structured and more tailored uses of the objects (Star & Griesemer, 1989). The review focuses on how the different roles of boundary objects and the practices they afford, as described in the recent literature, inform a research agenda that is grounded in the original theorization. Therefore, I summarize the objectives of the first paper by asking the following research question: **RQ1.** How do boundary objects support cross-boundary spanning among various domains?

1.2.2 Boundary objects as leverage to foster knowledge integration

Cross-boundary collaboration is motivated by different objectives, such as solving complex problems and creating innovative products. This diversity of objectives translates into differences in the type of knowledge dynamics present among collaborating actors. While in some cases, cross-boundary knowledge work involves *knowledge sharing* (Bechky, 2003; Nelson & Winter, 1982), in other cases, this is neither feasible nor needed (Edmondson & Harvey, 2017a; Majchrzak et al., 2012). In fact, knowledge sharing requires actors to engage in deep conversations until they establish a shared knowledge base (Carlile, 2002; Hsiao et al., 2012). This process is normally lengthy, especially when the involved parties come from distant domains. For this reason, *knowledge integration* is often most appropriate for solving complex problems in less time (Majchrzak et al., 2012). Knowledge integration focuses on overcoming knowledge differences among interdisciplinary actors and on leveraging individual specialized knowledge to produce a common knowledge outcome (Majchrzak et al., 2012). For instance, consider the interdisciplinary clinical teams that bring together different sources of expertise to produce a diagnosis on a patient case (DiBenigno & Kellogg, 2014).

Fostering interdisciplinary knowledge integration is especially important within collaborative innovation projects, which are often subject to time pressure. The literature on knowledge integration and cross-boundary teams suggests that artifacts might play a role in the process by complementing social practices (Edmondson & Harvey, 2017a; Majchrzak et al., 2012). However, existing research has not yet addressed the question of "how" boundary objects enable knowledge integration. To address this gap, I employ the concept of material scaffolding (Roberts & Beamish,

2017)—using objects to facilitate shared cognitive processes—to answer the following question:
RQ2. How does the design of boundary objects influence knowledge integration?

1.2.3 Boundary objects and space as leverage to foster collaborative innovation

Building on the importance of boundary objects to the cross-boundary knowledge spanning highlighted in the literature review, the third paper of this dissertation extends the focus on the role of space. Space is understood as both the physical and digital infrastructures that support cross-boundary work. These include the architectural characteristics of project rooms and the artifacts they contain as well as digital platforms and online documents in use by collaborating actors. The existing literature on cross-boundary knowledge spanning has traditionally focused on practices that enable collaboration across occupational groups, communities of experts and international actors (Brown & Duguid, 1991; Lave & Wenger, 1991; Wenger, 1998). However, our understanding of the role of space is still insufficient (Capdevila, Cohendet, & Simon, 2018). In particular, the affordance approach (Gibson, 1979) offers an interesting perspective for studying extended cognition in cross-boundary settings (Estany & Martínez, 2014). Affordances are possible actions signaled by the built environment and perceived by actors (Gibson, 1979). Therefore, affordances can influence the cross-boundary spanning process by suggesting that diverse actors engage in collaborative practices through space and objects.

Innovation is an especially suitable context in which to study the role of space. Innovation spaces, such as coworking hubs, studios and incubators, have gain increased popularity as a means to facilitate collaboration among heterogeneous actors (Vignoli, Mattarelli, & Mäkinen, 2018). In particular, the design perspective on collaborative innovation (Ollila & Ystrom, 2016) suggests that cross-boundary actors produce innovation by combining domain-specific knowledge and expertise and by developing new practices over time. However, existing research has not addressed how nonhuman factors enable or impair this dynamic process (Ollila & Ystrom, 2016). Therefore, in the third paper of this dissertation, I look at academic business studios to answer the following research question:
RQ3. How can innovation spaces foster collaborative innovation?

1.2.4 Space as leverage to foster knowledege communities

The study of cross-boundary knowledge work from a space and object perspective would be incomplete without a consideration of the ecosystem dimension. Knowledge dynamics depend on the knowledge available in the ecosystem where the space is situated and on its geographical outreach (Amin & Cohendet, 2004; Cohendet, Grandadam, Simon, & Capdevila, 2014). Knowledge communities emerged as an important concept for redefining the geography of innovation through cross-boundary work (Brown & Duguid, 1991, 2002; Lave & Wenger, 1991; Wenger, 1998). In this paper, I study the role of boundary space (Champenois & Etzkowitz, 2018) in fostering knowledge communities. The previous literature has referred to the concept of boundary space (Champenois & Etzkowitz, 2018) as the liminal process of the intersection of diverse institutional spheres and the resulting novel

organizational design. With this study, I focus on the materiality of boundary space, making its geographical scope and the physical and digital objects that it includes central.

Entrepreneurial ecosystems (Autio, Nambisan, Thomas, & Wright, 2018) are a suitable context in which to address the topic. Entrepreneurial ecosystems are ecosystems characterized by knowledge about the process of entrepreneurship (Autio et al., 2018). Within entrepreneurial ecosystems, several structural elements support the formation and scaling of startups (Autio et al., 2018). Among these elements are coworking spaces, incubators and science parks, which catalyze the efforts of future entrepreneurs, investors and advisors to boost economic activity. Startup accelerators are a structural element of entrepreneurial ecosystems that focus on providing knowledge services to local and international startups through three- to six-month programs (Battistella, De Toni, & Pessot, 2017; Cohen, 2013). Studying the role of space within startup accelerators is especially interesting since it is not a core element of their value proposition (Cohen, 2013). Space in the startup accelerator is mostly a feature and an enabler and can take several different forms and require different levels of investment depending on the needs of the participants in the program (Cohen, Fehder, Hochberg, & Murray, 2019). Thus, the fourth research question of my dissertation looks at the role of physical and digital space in relation to knowledge communities:

RQ4. How to leverage the design of boundary space to foster knowledge communities in startup accelerators?

1.3 Clarification of key concepts

Before diving into the single elements characterizing the overarching framework of the dissertation, this section clarifies some of the key concepts.

Affordances. Affordance is a concept that originated within ecological psychology (Gibson, 1966, 1977, 1986). Affordances describe possibilities for action suggested to the observer by the built environment (Gibson, 1977). The perceptual nature of affordances is context dependent (Bloomfield, Latham, & Vurdubakis, 2010; Faraj & Azad, 2012; Hutchby, 2001). Indeed, affordances are the result of culture, social environment and previous experience, all of which inform and shape individual perceptions (Norman, 1988).

Boundary. Boundaries are physical or mental delimitations that set specific areas apart based on a set of parameters, which include organizational, social and cultural characteristics (Hsiao et al., 2012). In this dissertation, I focus primarily on knowledge boundary crossing, which refers to collaboration among actors with different backgrounds and expertise. However, I touch on different typologies of boundaries that may impact knowledge work, such as symbolic, political and temporal boundaries.

Boundary objects. Boundary objects are "objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star & Griesemer, 1989, p. 393).

Boundary objects afford collaboration among different social worlds (Carlile, 2002; Star & Griesemer, 1989). Diverse actors attribute local uses to the objects while keeping their identity undefined within the interdisciplinary field (Star, 2010). Any object can potentially become a boundary object through its use in practice and in relation to other boundary objects (Carlile, 2002; Levina, 2005; Levina & Vaast, 2005; Nicolini et al., 2012; Scarbrough, Panourgias, & Nandhakumar, 2015).

Boundary space. The concept of boundary space is both procedural and organizational. It refers to the process of intersecting diverse institutional spheres and to the new organization that results from that intersection (Champenois & Etzkowitz, 2018). Boundary spaces are characterized by liminality, which means that they are in-between spaces (Champenois & Etzkowitz, 2018).

Collaborative innovation. Collaborative innovation is an innovation strategy based on cross-boundary work among interdisciplinary actors (Kodama, 2015). Collaborative innovation may involve actors belonging to the same organization or not (Kodama, 2015). In the latter case, we talk about open innovation (Chesbrough, 2003).

Cross-boundary knowledge work. Cross-boundary knowledge work refers to different types of knowledge dynamics occurring across boundaries (see the description of boundaries above).

Innovation. Innovation refers to new ways of creating value for customers and organizations by changing one or more elements of the business system (Nambisan & Sawhney, 2007), such as product, processes, and business models.

Innovation spaces. Innovation spaces are physical, digital or blended spaces that are set up to facilitate innovation activities across boundaries. Examples of innovation spaces include accelerators, crowdsourcing platforms, fab labs, and business studios, among others. Innovation spaces provide interdisciplinary actors with a shared workspace and shared equipment, a community of like-minded innovators (Schmidt & Brinks, 2017) and a creative climate (Cirella & Yström, 2018).

Knowledge community. The concept of knowledge communities originated within situated learning theory (Brown & Duguid, 1991; Lave & Wenger, 1991). Knowledge communities are characterized by a shared common knowledge objective, shared culture, norms and membership qualification requirements (Thompson, 2005). They describe independent units that do not necessarily rely on formal organizational structures. Different types of knowledge communities exist. The two main types of knowledge communities discussed in the literature are communities of practice and epistemic communities (Cohendet, Creplet, & Dupouët, 2001).

Knowledge integration. Knowledge integration refers to knowledge work across boundaries that does not require the involved actors to share a common knowledge base (Majchrzak et al., 2012). To integrate knowledge, the actors involved have to be

able to transcend knowledge differences (Majchrzak et al., 2012). Knowledge integration is observed in very diverse cross-boundary teams that need to solve problems in a short amount of time (Edmondson & Harvey, 2017a). For instance, large information technology projects require the expertise of several independent specialists (Mitchell, 2006).

Knowledge sharing. Knowledge sharing describes knowledge work among actors with the same knowledge base (Carlile, 2002) and same linguistic interpretation (Belmondo & Sargis-Roussel, 2015). Whenever knowledge sharing occurs across occupational or disciplinary domains, a process of knowledge translation is necessary (Carlile, 2002). Cross-boundary knowledge sharing requires time since the involved actors need to engage in deep conversations in order to establish the needed shared knowledge base (Majchrzak et al., 2012). A typical example of knowledge sharing is online expert communities (Hwang, Singh, & Argote, 2015).

Knowledge work. The concept of knowledge work is part of knowledge management theory. Knowledge work describes "knowledge-as-a-practice" rather than knowledge as a resource (Newell, 2015). The study of knowledge work marked a shift in which knowledge is no longer seen as a timeless body of truth but rather as part of evolving social infrastructures (Blackler, 1995).

Material scaffolding. The concept of scaffolding has its roots in education theories (Bruner, 1960; Vygotsky, 1978), where it is used to describe ways in which adults support the development of children's cognitive abilities. Its use was eventually extended to knowledge dynamics across different fields of practices (Kokkonen, 2014; Majchrzak et al., 2012; Roberts & Beamish, 2017). Different types of scaffolds exist: relational, cognitive, and material (Roberts & Beamish, 2017). In this dissertation, I use the concept of material scaffolding, which refers to objects and technologies that help structure the cognitive process of cross-boundary knowledge actors (Roberts & Beamish, 2017).

Material scaffolding and affordances. Although material scaffolding and affordances originated in different traditions outside to the study of cognition (Estany & Martínez, 2014), they have integrative valence. Affordances refer to the potential uses of objects, which depend on the observers' ability to perceive. Scaffolds are actualized affordances, which become permanent structures when observers share the same perception. Affordances and scaffolding can be used together to explain extended cognition (Estany & Martínez, 2014).

Sociomateriality. Sociomateriality is a theoretical perspective that originated in information systems (IS) research and has recently gained increasing popularity in management and organization studies (Jarzabkowski & Pinch, 2013; Leonardi & Barley, 2010). Sociomateriality sees social and material as constitutively entangled in the performance of everyday activities (Orlikowski, 2007). Materiality not only refers to the constitutive materials of a technology but also encompasses all physical

and digital enablers of human activity (Leonardi, 2012). Sociomateriality posits that social practices are shaped by material elements and vice versa.

1.4 Outline of the dissertation

The remainder of this part of the dissertation consists of four more chapters. Chapter 2 outlines the theoretical framework of the dissertation. Here, I elaborate on the main theory of knowledge management and introduce the additional theoretical lens of social practice theory and the socio-material perspective in particular. Chapter 3 presents the data and analytical approaches used in the four papers. Chapter 4 briefly summarizes the four papers. Chapter 5 discusses this dissertation's main contributions to theory and practice and addresses some of its limitations, turning them into avenues for future research. The four papers follow Chapter 5. Together, the papers contribute to a better understanding of cross-boundary knowledge work from the perspective of sociomateriality.

2 Theoretical framework

The theoretical framework describes the main theoretical perspectives and context in which this dissertation is grounded. In this section, I first introduce *cross-boundary knowledge management theory*, which shapes the main contribution of my dissertation. Second, I present *social practice theory* and dig deeper into the *sociomaterial perspective*. Third, I describe the context of *collaborative innovation* and justify why it is an appropriate setting for studying cross-boundary knowledge management. A brief integrative summary concludes the theoretical framework.

2.1 Cross-boundary knowledge management

The main theoretical perspective embraced by this dissertation is cross-boundary knowledge management. I refer to knowledge as a justified personal belief that translates into an entity's increased capability for effective action (Nonaka, 1994; Sabherwal & Becerra-Fernandez, 2003). Therefore, I adopt a subjective perspective on knowledge (Boland & Tenkasi, 1995; Nonaka, 1994). According to the subjective view of knowledge, knowledge depends on the human experience, and it develops through social interactions (Venzin, Von Krogh, & Roos, 1998). Knowledge management comprises a set of theories that proceed from the knowledge-based view of the firm (Conner & Prahalad, 1996; Kogut & Zander, 1992). Traditionally, knowledge management has been defined as "the process of continually managing knowledge of all kinds to meet existing and emerging needs, to identify and exploit existing and acquired knowledge assets, and to develop new opportunities" (Quintas, Lefrere, & Jones, 1997, p. 387). At the core of knowledge management is the idea that organizations are able to learn and to turn knowledge into a competitive advantage. Despite the height of its popularity dating back to the nineties, knowledge management has received renewed interest in the face of growing innovation needs. In particular, a specific focus on knowledge management within current discussions about boundary work (Langley et al., 2019) would be timely. Managing knowledge across boundaries is challenging since the actors involved have different professional and experiential backgrounds. This means that they have different subjective views on knowledge, which have to be managed in order to collectively produce knowledge outcomes.

2.1.1 Nature of knowledge boundaries and knowledge dynamics

Understanding different types of knowledge boundaries is of paramount importance in managing such boundaries. The most popular classification of knowledge boundaries was advanced by Paul Carlile (2002), who classified knowledge boundaries into three categories: syntactic, semantic, and pragmatic. Syntactic boundaries first appeared in communication theory. They emerge when interacting actors do not share the same language and cannot engage in knowledge work. Semantic boundaries exist when, in the presence of a common language, the interpretation among collaborating actors differs. Interpretive differences arise from differences in the cultural or occupational backgrounds of the interacting parties.

Finally, pragmatic boundaries are the hardest to cross, and they emerge when both language and interpretation across agents differ. To traverse pragmatic knowledge boundaries, knowledge needs to be transformed, and new knowledge has to be created.

Carlile's (2002) classification of knowledge boundaries has been employed by several influential papers that used it as a base to conceptualize knowledge boundary management practices. Building on Carlile (2002), Hsiao et al. (2012) distinguished three different perspectives about knowledge: *information processing, cognitive,* and *learning.* The information processing perspective (Galbraith, 1973) views knowledge as a tradable good that can be transferred between actors with a shared knowledge. This is the oldest theoretical perspective on knowledge boundary-crossing, and it has largely been employed in studies on information systems. The cognitive perspective considers knowledge to be cognition, and it has largely been applied in the study of collaboration among interdisciplinary actors (Hsiao et al., 2012). This perspective has achieved great popularity within innovation studies and in relation to strategic knowledge management (Alexander, Neyer, & Huizingh, 2016). Among the topics that are most relevant to the cognitive perspective are practices and objects that facilitate knowledge sharing and knowledge transfer through deep conversations among strategic partners. To conclude, the learning perspective focuses on knowledge as a process of collaborative learning (Hsiao et al., 2012). This perspective is tangentially related to the theoretical stream of "situated learning" (Brown & Duguid, 1991; Cohendet et al., 2014), which stresses the creation of new knowledge among informal communities connected by the shared objective to advance knowledge of specific practices or create new knowledge by integrating members' independent expertise (Cohendet et al., 2014).

Knowledge boundaries are not fixed. They are traversed by different types of knowledge dynamics. The study of knowledge dynamics across boundaries has focused on how the circulation of tacit knowledge can be enabled (Nonaka & Takeuchi, 1995). The focus on tacit knowledge stands in contrast to traditional studies on knowledge management, which focused on explicit knowledge. The classification of different types of knowledge boundaries aids in understanding knowledge dynamics. In fact, cross-boundary knowledge management looks at the following three main groups of knowledge dynamics: knowledge sharing, knowledge creation, and knowledge integration. These three groups correspond to the three typologies of knowledge boundaries introduced previously. Knowledge sharing is an in-depth form of knowledge work that presupposes that collaborating actors engage in sustained interactions conducive to mutual learning (Majchrzak et al., 2012). Examples of knowledge sharing are expert forums and conferences and online specialist communities. In knowledge sharing, everybody shares a common knowledge base, which is expanded through expert discussions and feedback (Cabrera & Cabrera, 2002; Quinn, Anderson, & Finkelstein, 1996). In this sense, knowledge sharing often leads to the creation of new knowledge. In fact, knowledge creation happens when pragmatic boundaries are crossed and collaborating actors engage in the practice of "knowing" (Hsiao et al., 2012). Knowledge creation is most frequent when collaborating actors are in close enough geographical proximity to facilitate the emergence of strong ties. Examples of knowledge creation include new artistic and

culinary movements. Finally, knowledge integration refers to knowledge work across knowledge boundaries (Majchrzak et al., 2012). In this case, collaborating actors do not share a common knowledge base, but they are able to contribute their individual knowledge and expertise to a common endeavor (Tell et al, 2017). For instance, complex medical diagnoses rely on the joint efforts of different experts. Knowledge integration is also a main source of combinatorial innovation, which succeeds whenever different technologies or ideas are successfully integrated into new products or experiences (Strambach & Klement, 2012). Knowledge integration plays a central role in this dissertation.

Although the focus of this dissertation is on knowledge boundaries, nonknowledge boundaries, such as organizational and cultural boundaries, are often mentioned. In fact, acknowledging the existence of nonknowledge boundaries leads to a more nuanced view of cross-boundary spanning and of the challenges it entails. Knowledge boundary work happens in contexts characterized by liminality and indeterminacy. The diversity among knowledge actors generates complexity (Edmondson & Harvey, 2017a). This complexity translates in differences at the boundary among actors and it requires different types of boundary work in order to be managed (Langley et al., 2019). For instance, team dynamics is a recurrent theme within cross-boundary knowledge management literature (Edmondson & Harvey, 2017a; Enberg, Lindkvist, Tell, 2010).

2.1.2 Knowledge communities

Cross-boundary knowledge management is tightly related to situated learning theory (Brown & Duguid, 1991; Wenger, 1998). According to situated learning theory, knowledge dynamics are always situated within knowledge communities (Brown & Duguid, 1991; Wenger, 1998). Knowledge communities are informal associations that can exist within or across organizations (Thompson, 2005). They can be described according to the following set of common structural elements: joint enterprise, mutual engagement, and common identity (Wenger, 1998). Joint enterprise refers to the knowledge objective pursued by the community (Thompson, 2005). Mutual engagement relates to the modality of interaction among members of the community (Wenger, 1998). Common identity describes the culture, symbols and routines that set specific communities apart from others (Wenger, 1998).

Knowledge communities have been studied from two perspectives: analytical and instrumental (Omidvar & Kislov, 2014). From an analytical perspective, knowledge communities emerge from the spontaneous self-organization of individuals involved in knowledge work (Omidvar & Kislov, 2014; Thompson, 2005). In turn, the structural characteristics of independent communities result from a process of negotiation among their members (Amin & Roberts, 2008). In contrast, the instrumental perspective views knowledge communities as a type of organizational leverage that stimulates knowledge work across boundaries and supports organizational objectives (Omidvar & Kislov, 2014).

Different types of knowledge communities exist (Cohendet et al., 2014). However, the existing literature has devoted special attention to two main types: communities of practice and epistemic communities. Communities of practice are typical of professional associations and online communities. Their main objective is to share

knowledge that is relevant to a common practice. In fact, the boundaries set by practice embed community actors in an informal organization (Granovetter, 1985). Brown and Duguid (1991) view communities of practice as independent entities that are hostile to institutional theory and have their own organizational identity. Communities of practice enhance individual competencies through the construction and sharing of common resources (Cohendet et al., 2004). The term epistemic communities originally pertained to the domain of international relations (Haas, 1989, 1992; Adler, 1992). In Haas's (1989) theorization, such communities are national or international networks of members sharing the common objective of developing knowledge in a defined area. They aim to influence policy making through the provision of cause and effect relationships in relation to complex problems (Dobusch & Quack, 2010). These communities are generally small in size (Cowan et al., 2000; Dobusch & Quack, 2010), and they share a set of principal and causal beliefs, validity notions and common enterprise policies (Dobusch & Quack, 2010). Amin & Roberts (2008) characterize them as coalitions of professionals that can exist within organizations, offsite or as part of an interorganizational network. Epistemic communities can be scientific, technological, or artistic in nature (Cohendet, 2014). They are able to turn uncertain conditions in new knowledge creation thanks to their diversity (Amin & Roberts, 2008). They recognize the need for a procedural authority to enable collective action (Cowan et al., 2000). Bonds in epistemic communities are built around common projects and shared problems (Amin & Roberts, 2008).

Knowledge space in communities of practice and epistemic communities differs significantly. Communities of practice are often virtual, since there is no need for closed geographical proximity, given the high degree of cognitive proximity shared by their members (Capdevila et al., 2018). In contrast, epistemic communities mostly require the colocation of their members. Despite that fact, epistemic communities do engage in knowledge work in a broader geographical space: "The cognitive building of an epistemic movement will continue to be organized by the epistemic community anchored in the initial localized milieu" (Cohendet et al., 2014, p. 937). The main reason to reach out to distant geographical milieu is to avoid cognitive lock in, which can ultimately lead to the failure of the community (Capdevila et al., 2018). Although space has been widely acknowledged in knowledge community research, existing research has paid little attention to the microlevel origins of knowledge dynamics (Capdevila et al., 2018). This could be due to its origin in economic geography, which is mainly concerned with a macro definition of space and of its constituencies.

2.2 Social practice theory

2.2.1 Social practice theory: an introduction

The growing focus on practices in organizational life is referred to as the practice turn in organization studies (Cetina, Schatzki, & Von Savigny, 2005; Feldman & Orlikowski, 2011). The practice turn happened in reaction to an overly narrow focus on the structural elements of organizations rather than on the way organizations were actually navigated from an agential standpoint (Feldman & Orlikowski, 2011). Cook and Brown (1999, p. 60) call practices "the coordinated activities of individuals and

groups in doing their 'real work' as it is informed by a particular organization or group context". Despite the existence of multiple perspectives in the study of practice, practice approaches share a set of assumptions that can be boiled down to the following three principles: "(1) situated actions are consequential to the production of social life; (2) dualisms are rejected as a way of theorizing; [and] (3) relations are mutually constitutive" (Feldman & Orlikowski, 2011, p. 1241). Common to the different social practice theory (SPT) approaches is the notion that social reality is continuously produced by people's repetitive acts (Feldman & Orlikowski, 2011). Practices are more than simple accounts of people's activity during the day (Nicolini, 2011). They carry deeper value as enablers of connected processes such as meaning making, identity work and the production of social order (Nicolini, 2011). In this sense, repetition is a way to institutionalize practice (Berger & Luckmann, 1967), which contributes to providing stability for the concerned social group (Brown & Duguid, 1991; Lave & Wenger, 1991). The boundaries set by practice let the embedding conditions of the organization emerge (Granovetter, 1985) and foster knowledge acquisition within the community. The knowledge-acquisition process may take both an individual and a collective form (Cook & Brown, 1999; Swan et al. 2007). Even though learning practices are an individual effort, "acceptable" practices emerge from interactions in social groups (Cook & Brown, 1999; Swan et al. 2007). The latter implies that practices are never completely stable but that they evolve based on the negotiations and learnings that take place among the individuals who are part of the community. Knowledge is localized within the community (Cook & Brown, 1999; Swan et al., 2007), meaning that it is produced within social contexts that share the same practice(s). At the same time, there is not a fixed amount of knowledge, as it is constantly expanding through the interactions that strive to improve common practice through discussion and peer learning (Brown & Duguid, 1991; Lave & Wenger, 1991). The localized nature of knowledge makes it difficult to transfer it to other contexts, which results in the creation of practice-based boundaries (Swan et al., 2007). We may thus say that practices are instrumental to both the generation of knowledge and its transfer (Cook & Brown, 1999). This is an important characteristic since it potentially extends the function of practices from "creating boundaries" to "spanning boundaries" through their existence between, rather than within, independent social groups (Swan et al., 2007). Despite the commonalities of assumptions, differences exist in the perspective from which practices are studied. I will present some of the existing perspectives based on the relationship between knowledge and practice in the following section.

SPT is instrumental for addressing gaps in cross-boundary knowledge management. As previously stated, SPT encompasses a broad range of perspectives on the study of practices. An important distinction needs to be made regarding the relationship between knowledge and practice in these perspectives (Gherardi, 2006; Gherardi & Perrotta, 2014; Nicolini, 2011). Gherardi (2006) identified three relationships between knowledge and practice: *containment, mutual constitution* and e*quivalence*. From a *containment* perspective, knowledge is situated in the relationships among people who share (and participate in) the same practices (Gherardi, 2006). Studies that adopt this perspective often mention communities of practice or networks of practice (Brown & Duguid, 1991, 2002; Lave & Wenger,

1991; Wenger, 1998) in order to circumscribe relationships to identifiable entities. According to the *mutual constitution* perspective, knowledge and knowing are two separate, yet interrelated, concepts (Gherardi, 2006). The distinction between knowing-as-process and knowledge-as-product is influenced by the work of Giddens (1984) relative to structuration theory and by American pragmatists (Cook & Brown, 1999). In a nutshell, "knowledge is a tool that we use in our daily activity, whereas knowing describes competent interaction with the world" (Nicolini, 2011, p. 604). Last, knowing can be ontologically *equated* to practicing (Gherardi, 2006). This perspective does not allow for the existence of knowledge prior to or independently from the practice itself. Practices become "sites" (Nicolini, 2011; Schatzki, 2002) that provide the context for the "existence and performance" of knowledge. The latter entails that specific constellations of actors, locations and objects are fundamental and indissolubly related to the emergence of specific forms of knowledge (Nicolini, 2011). The necessary engagement of independent actors with their surroundings to access and implement knowledge supports the sociomaterial approach to practice (Orlikowski, 2002) that this dissertation is grounded in and that will be the focus of the next theoretical section.

2.2.2 The sociomateriality perspective

The practice turn in organization studies has brought along a rising interest in the role of materiality within organizational life (Jarzabkowski & Pinch, 2013; Nicolini et al., 2012). Materiality and sociomateriality have become increasingly popular terms in management and organization theory (Jarzabkowski & Pinch, 2013). Orlikowski (20007) defined sociomateriality as "the constitutive entanglement of the social and the material in everyday organizational life" (Orlikowski, 2007, p. 1438). Therefore, it is a fundamental aspect from a practice theory perspective (Nicolini et al., 2012). Sociomateriality research took its premises from the field of information systems (IS). Orlikowski and Scott (2008) and Leonardi and Barley (2010) called attention to the poor representation of information systems (IS) in the main management outlets. Their reviews on the Academy of Management Annals paved the way for an upsurge of studies embracing sociomateriality as a theoretical foundation. Orlikowski's adoption of the term "sociomateriality" was not an accident (Leonardi, 2013). By dropping the linguistic focus on "technology", Orlikowski brought into the discussion of the technical enablers of organizational practices a number of scholars who would not have considered it otherwise (Leonardi, 2013). At the same time, the sociomateriality label brought the study of technology and organizations closer to other studies that had previously looked at materiality from other perspectives. Leonardi (2012) stresses the difference between "materiality" and "physicality". Materiality not only refers to the constitutive materials of a technology but also encompasses all physical and digital enablers of human activity. Nevertheless, when shifting focus from the physical world to the digital one, the concept of materiality may appear less straightforward (Leonardi, 2012).

Orlikowski's (2006) exploration of "*material knowing*" rests on the assumption that practice views of knowledge should go beyond *emergent* (in the making), *embodied* (tacit, experiential) and *embedded* (affected by the sociocultural context) cognition. Knowing can, in fact, be *material* thanks to the *scaffolding* role of

boundary objects. Scaffolding refers to an engagement technique aimed at involving individuals in activities from which they are normally excluded by providing infrastructure for collaboration (Majchrzak et al., 2012; Roberts & Beamish, 2017). Boundary objects are material artifacts that emerge in the collaboration process among actors with different knowledge bases (Star & Griesemer, 1989). Boundary objects catalyze the diverse knowledge of the collaborating actors and make it explicit in a shared representation that can be discussed and contested. In fact, Orlikowski (2006) refers to objects as enablers of cognitive exchange: "In this sense of augmenting human activity, scaffolds include physical objects, linguistic systems, technological artefacts, spatial contexts, and institutional rules—all of which structure human activity by supporting and guiding it, while at the same time configuring and disciplining it" (Orlikowski, 2006, p. 462). The latter enables collaborating actors to engage in "productive dialogues" (Tsoukas, 2009, p. 942)—dialogues emerging out of a shared commitment to knowledge work. Research on sociomateriality has faced several challenges throughout the years. One of the key hurdles has been to separate material determinism and voluntarism (Leonardi & Barley, 2008). On the one hand, boundary objects have material properties that determine their use by preventing a set of actions. On the other hand, actors may decide how to make use of the objects within the possibilities allowed by their material properties. The concept of affordances introduced in the following section helps to reconcile this seemingly irreconcilable paradox.

2.2.3 The affordance approach

Jarzabkowski and Pinch (2013) distinguish between an *affordances* approach and a *scripts* approach to sociomateriality. According to the traditional literature on cognitive processes, external representations are fundamental to the emergence of affordances, invariant characteristics of material objects that enable action (Gibson, 1977). Therefore, the affordance approach is concerned with the "specific properties that materials bring to social interactions" (Jarzabkowski & Pinch, 2013, p.585). Affordance theory has its roots within ecological psychology. The term affordances was originally coined by Gibson (1966), who claimed that physical objects have properties that transcend their physicality. These properties "point both ways to the environment and to the observer" (Gibson, 1979, p. 271). Due to the appearance of specific contextual elements, affordances are considered relational (Bloomfield et al., 2010; Faraj & Azad, 2012; Hutchby, 2001). According to Gibson, every environment provides stimuli, which leads to individual perceptions of the possible course of actions. For instance, a chair signals to men the possibility of sitting on it, which consequently affords the action of "sitting". The same chair might be perceived differently by monkeys, who could instead see the possibility of climbing on it. The emergence of affordances depends on one's cultural background and life experiences, which shape one's perception of the world (Norman, 1988). Affordances further result from the act of socializing with one's peers, which blends individual experiences with learned behaviors (Gibson, 1979). At the same time, affordances trigger socialization processes among interacting individuals, who progressively learn to share the same (social) practices (Gibson, 1979).

Don Norman (1988) extended the concept of affordances to the domain of human machine interaction (HMI). Norman's studies on technology maintain that affordances are a built-in feature of objects. An object's design becomes a way to guide users' experience with the object itself. Despite the possibility of suggesting affordances by design, not all designed affordances are perceived by users as the designer intends (Faraj & Azad, 2012; Jarzabkowski & Pinch, 2013). By being repurposed in multiple situations that require human interaction, the same object may provide different affordances (David & Pinch, 2006; Jarzabkowski & Pinch, 2013). Creative repurposing opens up a broad range of new possibilities of action that may have not been foreseen; at the same time, repurposing is limited by the physical and technological constraints set by the object's original design (David & Pinch, 2006; Hutchby, 2001; Jarzabkowski & Pinch, 2013). This reminds us that while we can strive to select objects that provide just-right affordances to reach a set goal, the perceptual nature of affordances does not guarantee that our intentions will match the expectations of the user group. By separating the physical and psychical side of objects, we are left with technical considerations regarding what can be (physically) done or not done with the object and with the object's situated enactment.

Following the last point above, Jarzabkowski and Pinch (2013) warn against substituting the concept of affordances with the possible functions of the object. Using the latter risks producing a "laundry list" of the object's functions and individual intentions (Jarzabkowski & Pinch, 2013, p. 582) and thus failing to grasp the object's co-construction. To avoid this pitfall, Leonardi and Barley (2008) suggest embracing the idea that materiality and perceptions may take turns in steering practices. As anticipated in the former section about sociomateriality, affordances bridge the gap between determinism and voluntarism by considering individual perceptions of the material world as complementary to material constraints (Leonardi & Barley, 2008). The concept of affordances further complements scaffolding (Estany & Martínez, 2014). In fact, when boundary objects' affordances become crystallized in a shared perception by collaborating actors, the objects become material scaffolds (Estany & Martínez, 2014).

In my dissertation, I embrace the concept of the emergence of objects' affordances, as well as their crystallization in scaffolds. Given the context-dependency of this approach, my dissertation focuses on three different "subcontexts" within the same broader context of collaborative innovation; I will introduce these subcontexts in the following section.

2.3 Collaborative innovation

This dissertation addresses existing gaps in cross-boundary knowledge management theory by looking at different collaborative innovation contexts. Collaborative innovation is a suitable context because it is a strategy based on involving internal and external interdisciplinary actors in an organization to create business improvements and sustained learning (Kodama, 2015). In particular, I study three "subcontexts": business studios, corporate hackathons, and startup accelerators.

2.3.1 Business studios

The first collaborative innovation context studied in this dissertation is the "business studio". Business studios are "places of inquiry into the pernicious problems of business and society, and for creatively expressing the results of the inquiry process" (Barry & Meisiek, 2014, p. 154). Grounded in the tradition of design (Alexander, 1964; Barrett, 2005), the term studio denotes both a physical innovation space and a problem-solving process leveraging creative and design-inspired techniques (Barry & Meisiek, 2014). The need to collaborate across boundaries, which characterizes the design profession, requires an environment that enables "productive dialogues" (Tsoukas, 2009, p. 942). Tsoukas (2009, p. 942) maintains that "dialogues become productive when the modality of interaction between participants is that of relational engagement". Relational engagement in a design-based context is embodied and afforded by the studio.

Design problems are "usually among the most complex and ill-structured kinds of problems that are encountered in practice" (Jonassen, 2000, p. 80), and they are core to several professional practices such as architecture and engineering (Cennamo et al., 2011). It is no surprise that these professions have increasingly become objects of study in the innovation and management community in the attempt to learn more about a "design method" of innovating and to adopt its best practices to other fields (Boland Jr, Collopy, Lyytinen, & Yoo, 2008; Yoo, Boland Jr, & Lyytinen, 2006). For this reason, many companies and universities have set up business studios at their premises. For instance, the Ericsson Studio in Stockholm welcomes employees and customers to collaborate in creating new experiences using their cutting-edge technologies. Likewise, Copenhagen Business School and Sydney Business School leverage their studios for a joint course meant to teach collaborative innovation methods in a studio context.

Work in a studio is always project based, and it has physicality at core (Kimbell, 2011). Every project entails the representation of its elements in the space through a series of visualizations. From the ideation phase to the production of the final product, the space progressively acquires cues that materialize the elements of the project, including the parts of a building, the characters of a story, sketches of figures or flyers for a show. The constant display of artifacts and the culture of openness and mutual respect in the studio afford the practice of critique towards the development of a final product (Barry & Meisiek, 2014). The emphasis on space and objects as mediators among interdisciplinary actors makes studios a relevant context in which to study cross-boundary knowledge work from a sociomaterial perspective.

2.3.2 Corporate hackathons

Second, I look at corporate hackathons. Hackathons are time-limited events during which participants work on innovation challenges (Komssi, Pichlis, Raatikainen, Kindström, & Järvinen, 2015). The challenges can be proposed by different stakeholders. Depending on the stakeholders involved, hackathons can mainly be categorized as corporate or noncorporate events. Noncorporate hackathons are competitions independently organized by public entities or private associations. The challenges addressed during these types of events vary broadly. Some noncorporate hackathons mainly aim to provide a "hands-on" opportunity to meet those who are

enthusiastic about specific technologies or issues. Other noncorporate hackathons pursue specific objectives, such as solving local problems or widespread challenges. In contrast, corporate hackathons are an open innovation tool aimed at producing commercial value for the sponsoring enterprises (Komssi et al., 2015).

The origin of hackathons is in software development (Briscoe & Mulligan, 2014; Komssi et al., 2015). However, today, many such events involve participants from different backgrounds leveraging interdisciplinary knowledge to solve complex innovation problems. Interdisciplinary corporate hackathons are especially interesting for the research aims of this dissertation, since they involve significant cross-boundary work. In fact, hackathon participants join teams directly at the event without having a significant history of collaboration. Moreover, they work under time pressure and with no real possibility to engage in in-depth knowledge work. The characteristics of hackathon teams reflect those of cross-boundary teams theorized by the literature (Edmondson & Harvey, 2017a). Likewise, the question of how these teams can be supported in integrating knowledge is highly relevant. Another aspect that makes hackathons a relevant context to study is the fact that hackathon teams tend to run in an agile way or with methods inspired by the lean startup method (Blank, 2013). These methods give centrality to the production of artifacts to advance product development through repetitive feedback and prototype iterations (Blank, 2013).

2.3.3 Startup accelerators

Finally, I look at the context of startup accelerators (hereafter referred to as accelerators). Accelerators are a rising incubation model aimed at supporting startups as they prepare to solicit funding. (Cohen, 2013) Startups need to apply to be considered for membership, and they join accelerator programs in batches of 6 to 125 (Cohen, Bingham, & Hallen, 2018). Different types of accelerators exist (Hochberg, 2016; Pauwels, Clarysse, Wright, & Van Hove, 2016). Some accelerators focus on specific industry verticals or technologies, whereas others are industry agnostic; some require startups to give up equity in order to be part of the program, while others do not; some invest in pre-seed stage startups, while others target more mature ventures; and finally, some are residential, while others run remotely.

Compared to the rent-seeking orientation of traditional incubation models (Hansen, Chesbrough, Nohria, & Sull, 2000), the accelerator business model relies on providing knowledge and financial resources to startups to sustain their scaling process (Battistella et al., 2017; Cohen et al., 2018). Accelerators provide space and infrastructure as a means to support startups, rather than a paid service. This makes accelerators a suitable context in which to study the role of space as leverage to foster critical knowledge dynamics. The high heterogeneity among accelerators (Hochberg, 2016; Pauwels et al., 2016) prompts a reflection about the influence of space to pursue different knowledge objectives. To understand more about this issue, the fourth paper of this dissertation digs deeper into the implications of geography, (physical and digital) infrastructures, and the function of accelerators' space within the knowledge communities they foster.

2.4 Synthesis of the theoretical framework

The theoretical framework can be synthetized with a general focus on knowledge boundary work, which is addressed from the perspective of sociomateriality. However, the four papers included in the dissertation tackle different aspects of the theme at different levels of analysis. In particular, Paper 1 and Paper 2 have a strong focus on boundary objects. The objective is to understand how boundary objects relate to cross-boundary knowledge work and what the most salient properties they display are. Paper 3 expands the analytical focus to the physical and digital space in which boundary objects are contained. In Paper 3, I place boundary objects in a material context to understand how their roles and properties are influenced by the physical and digital space. Finally, Paper 4 expands the definition of space to include the dimension of geography. Including an ecosystem perspective in the study of spaces is important because it adds a layer of information about the knowledge communities who engage with the space, the resources available to those designing the space, and the external identity that is projected onto the space. We may say that there is a progression from micro to macro, which has implications for the contributions of the dissertation. In fact, the theoretical focus moves from the nature of knowledge boundaries (Paper 1) to the phenomenon of knowledge integration occurring at boundaries (Papers 2 and 3) and then to the creation of diverse knowledge dynamics within knowledge communities (Paper 4).

Table 1. Theoretical focus of the four papers

	Paper 1	**Paper 2**	**Paper 3**	**Paper 4**
Title	*Boundary objects in cross-boundary spanning: A systematic literature review*	*From idea to prototype in 48 hours: Designing boundary objects for knowledge integration*	*Leveraging innovation spaces to foster collaborative innovation*	*Leveraging accelerators' space to foster knowledge communities*
Main focus	Role of boundary objects	Knowledge integration	Knowledge integration	Knowledge communities
Level of analysis	Boundary objects	Boundary objects	- Physical/Digital space - Boundary objects	- Ecosystem - Physical/ Digital space - Boundary objects

3. Research method

3.1 My philosophical stance

Before choosing a research method, researchers should clarify what their philosophical stance is. A philosophical stance reflects the researcher's assumptions about the nature of the world and ways one can investigate it. While ontology describes the individual perception of what is real, epistemology describes how such reality is accessed and divulged (Burrell & Morgan, 1979). The research questions and the philosophical stance of the researcher determine the selected method of inquiry (Morgan & Smircich, 1980). Therefore, in this section, I will argue for a critical realist approach (Mutch, 2013) to the study of cross-boundary knowledge work from the perspective of sociomateriality. A critical realist ontology considers the world to be real "but only imperfectly and probabilistically apprehendable" (Guba & Lincoln, 1994, p. 109). It leans towards an objective view of reality, and it can be classified as a "postpositivist" stance (Guba & Lincoln, 1994). On the one hand, it maintains that a "regulatory ideal" (Guba & Lincoln, 1994, p. 110) exists; on the other hand, it allows for new discoveries driven by exploration.

Organizational scholars have applied two main philosophical perspectives to the study of sociomateriality: agential realism and critical realism. Both agential realism and critical realism claim the reality of matter against its representation for instrumental purposes (Mutch, 2013). Barad (2003, p. 810) describes agential realism as an "account of techno-scientific and other practices" grounded in feminism, antiracism, poststructuralism, queer studies and Marxism. Similarly, critical realism offers a philosophical backing for other disciplines by enquiring about the reality of the world as an enabler of scientific practice (Bhaskar, 1979). However, the two perspectives stand on separate ontologies. While agential realism rejects the duality of structures central to structuration theory (Giddens, 1984), critical realism maintains that the social and the material need to be kept separate to discover more about their interplay (Mutch, 2003).

Historically speaking, sociomateriality appeared as a response to critiques about the structuration process implicit in the use of a practice lens to study technology in organizations (Leonardi, 2013). Such research focuses on technology in use, practice and interpretation, all of which are social processes that only reflect the existence of a technology, paradoxically overshadowing the technology itself (Leonardi, 2013). In fact, from the point of view of structuration theory, technologies and actions continuously interact, but they are considered separate entities (Leonardi, 2013). Orlikowski (2007) foundational theorization of sociomateriality was influenced by Latour's actor network theory (ANT) and Barad's (2003) agential realism. ANT argues that there is no difference between social and material. Partly building on ANT, agential realism addresses such differences on an epistemological level rather than an ontological level (Leonardi, 2013). Barad (2013) contends that knowledge about the world is constructed through the interactions of scientists and machines with the objects of study. According to agential realism, objects or phenomena receive agency as a consequence of knowers' observation through equipment and

other devices (Leonardi, 2013); therefore, the social and material are "inextricably related"(Orlikowski, 2007, p. 1437).

Recently, the suitability of agential realism as a philosophical stance for the study of sociomateriality has come under question. *Information and Organization* hosted a debate on the topic in 2013. Mutch (2013) contrasted Barad's (2003) perspective with one based on critical realism. Critical realism violates one of the shared principles of practice theories, namely, the rejection of the duality of structures (Feldman & Orlikowski, 2011). Although adopting a critical realist stance on sociomateriality might seem incongruent, it can also be a way to overcome the practical issues naturally occurring in the process of studying sociomateriality with an agential perspective. Mutch (2013) emphasizes the difficulties of other scholars in striking a balance between the appreciation of the material and the appreciation of the agentic realm (Wagner, Newell, & Piccoli, 2010) and in identifying key material components of the phenomenon under observation (Nyberg, 2009). The emphasis on the human aspect of the intra-actions between people and objects (Barad, 2007), as well as the underappreciation of contextual variables, lead to obstacles in the study of sociomateriality (Mutch, 2013). Mutch's (2013) criticism of the application of agential realism to sociomateriality rests primarily on the neglect of emergence as a fundamental property of the social world. The latter refers to a stratified view of the world, where social structures lay the foundation for future actions (Mutch, 2013).

I believe that there is a good fit between my philosophical stance and my research design. As a critical realist, I am interested in the underlying mechanisms of phenomena—mechanisms that are independent from the action of individuals. This also supports my choice to select instrumental theories that allow us to go deeper in the study of knowledge management. I began this study starting with a review of the existing literature and with a clear theoretical framework (Burrell & Morgan, 1979; Gioia & Pitre, 1990). In fact, my main scientific aim is to advance existing theory rather than build a new theory from scratch. The first paper in my dissertation is indeed a systematic literature review, which lays the groundwork for my empirical work following the process of evidence-based research. Methodologically, I use research techniques, such as ethnography, that are also used in interpretivist research, but I am using them to expand existing theory rather than to derive new interpretations of phenomena (Morgan & Smircich, 1980). The final reason I am convinced about the value of critical realism and the functionalist paradigm is linked to the practical relevance of my studies. All of the papers included in the dissertation strongly emphasize the practical implications of the findings. Therefore, I am mainly concerned with establishing relationships, causal links and generalizable evidence that can "speak" to the academic as well as to the business context (Gioia & Pitre, 1990).

3.2 General approach to research

This dissertation consists of four papers. Each paper addresses a separate research question. The first paper is a systematic review of the boundary object literature, which serves as a foundation block of my dissertation. The remaining papers are empirical. To answer the three empirical research questions, I adopt a fully qualitative approach. However, the papers included in my dissertation adopt different qualitative

techniques. Specifically, I address Q2 with action research (Baskerville & Wood-Harper, 1996; Susman & Evered, 1978), Q3 with ethnographic methods, and Q4 with multiple case studies (Eisenhardt, 1989).

The empirical data for this dissertation primarily consist of ethnographic data and case studies. The data collection for Papers 2 and 3 partially overlap, whereas the data for Paper 4 are completely independent. Although different, the three methodologies are all consistent with the critical realist paradigm. I apply the logic of retroduction, or abductive inference (Peirce, 1883), moving from real world observations to "inference to the best explanation" (Harman, 1965). In this section, I summarize the data collection and data analysis approaches employed to address the three empirical questions. Two of the papers (Papers 2 and 4) are coauthored, which had implications for the research process. The roles of each of my coauthors are specified below.

Table 2. Data collection overview

	Paper 2	**Paper 3**	**Paper 4**
Title	*From idea to prototype in 48 hours: Designing boundary objects for knowledge integration*	*Leveraging innovation spaces to foster collaborative innovation*	*Leveraging accelerators' space to foster knowledge communities*
Research technique	Action research	Ethnography	Multiple case studies
Primary data	- Observations of six 48-hour events (288 hours) - Feedback sessions (12 hours) - Templates (459) - Pitch decks (51) - Idea prototypes (85) - Learning documents shared with organizers (4) - Participant reflections (58 papers)	- Observations of three studio-based courses (65 hours) - Observations of three 48-hour events (144 hours) - Course participant reflections (115 papers) - Online course blog (1737 entries) - Post-event surveys (38)	- Interviews with members of accelerator teams (21) - Interviews with accelerated startups (27)
Complementary data	- Interviews with experts (7)	- Interviews with experts (6) - Practitioner reports about studio pedagogy	- Interviews with experts (8) - Online reports - Video content

3.2.1 Q2 – Action research

Action research is an interventionist methodology aimed at generating knowledge that is relevant to both theory and practice (Baskerville & Wood-Harper, 1996; Susman & Evered, 1978). Researchers contend that action research is suitable for studying technology and human interactions (Baskerville & Wood-Harper, 1996; Lindgren, Henfridsson, & Schultze, 2004). Moreover, it allows us to study potential improvements to existing methodologies (Baskerville & Wood-Harper, 1996). Action research is particularly useful to face the ever changing and complex landscape of innovation management (Ollila & Yström, 2020).

I chose action research to answer question 2 because the research question had clear practical and theoretical objectives. On the one hand, I wanted to improve the hackathon process through the design of technological scaffolds. On the other hand, I wanted to shed light on the role of material scaffolds in cross-boundary teams. I worked on this paper with a coauthor. While my coauthor was primarily active on the front-line running interventions, I mainly took care of the data collection and analysis.

In line with prior contributions in the social sciences (Lindgren et al., 2004), we employed canonical action research (Susman & Evered, 1978). Canonical action research is an action research approach based on the following five steps: *diagnosing, planning action, taking action, evaluating,* and *specifying learning*. This paper involved two action research cycles, each following the five steps listed above. Because the action research process was repeated twice, the data collection and data analysis were also doubled.

Data about corporate hackathons were gathered during the InnoDays (ID) event. We focused on a recent set of events and employed rich data sources. To kick off the project, we used observations and feedback sessions from ID Innsbruck 2017 and ID Jönköping 2018, as well as in-depth interviews with organizers of other hackathons. This helped us to define the hypothesis, which guided our initial study. Specifically, we set out to design physical wall showcasing templates representing different steps of the ID process and a digital platform for documentation, instructions and communication with mentors and team members.

After developing our intervention, we planned to implement it during two events: ID San Francisco 2018 and ID Innsbruck 2018. To evaluate the intervention, we collected data from several sources, which we divided into two main groups: (a) templates on the Idea Wall, pitch decks and documents on the Innovation Platform, and idea prototypes; and (b) written reflections by participants, an online survey sent to participants, focus groups with participants, mentors and corporate partners, and learning documents shared with the organizers. Data collection was repeated four times, once per event. Our own evaluation of the first action research cycle also provided data to kick off the second cycle.

Data belonging to group (a) were analyzed through ratings and comparisons across events. The objective was to assess whether our intervention led to an improvement in the quality and documentation of ideas produced by the ID teams. Therefore, we involved external parties and ID organizers in the rating process. Data belonging to group b were analyzed through ethnomethodology and coding to identify design principles supporting the initial design dimensions (*instrumentality, symbolism,* and *temporality*) and to add a new dimension (*engagement*).

3.2.2 Q3 – Ethnography

I chose an ethnographic approach for answering Q2 because the affordance lens (Gibson, 2014) that I adopt suggests that every individual has a different experience with the surrounding built environment. Therefore, this approach was appropriate for capturing how space can be leveraged to foster collaborative innovation from the perspective of the users of the space. Ethnography starts from a position of complete theoretical agnosticism with respect to the situation under observation (Van Maanen, 1988). The accounts and interpretations of the individuals involved provide a starting

point for the researcher's analysis. My objective was to provide a deeper understanding of how collaborative innovation, intended as a social activity, is carried out within its performance settings. Therefore, I employed interpretive coding to develop an explanation based on data.

Data collection. The data collected to answer Q3 focused on business studios (Barry & Meisiek, 2014). Specifically, data were gathered within two independent settings: the course on entrepreneurial creativity that I teach at Jönköping International Business School and InnoDays, a student-based corporate hackathon that I am involved in running. Primary data collection involved two editions of the entrepreneurial creativity course (2017 and 2018) and three InnoDays events (January 2018, April 2018 and June 2018). In total, I collected over 100 reflection papers, approximately 1700 entries on online channels and 40 survey responses. These accounts primarily discussed the studio experience of the participants, with a specific focus on the use they made of physical and digital infrastructures. Moreover, I engaged in over 200 hours of participatory observation. Finally, I conducted 6 interviews with colleagues who run academic business studios at other institutions to use as secondary data.

Data analysis. Data analysis for this paper consisted of four steps (Friesl, Larty, & Jacobs, 2018). First, I listed all of the boundary objects in use by the studio participants, and I categorized them into three groups: materials, workspace elements and artifacts. Second, I created descriptions of how the identified boundary objects were used in specific situations. Third, I coded the reflections, entries and survey answers using four affordances introduced in the theoretical framework of the paper (convergence, generativity, socialization and collaborative learning). Finally, I conducted a thematic analysis of the coded materials (Miles & Huberman, 1994), aggregating them into two dimensions: the "combination of specific knowledge and expertise" and the "development of new practices". The two aggregate dimensions matched the two sides of collaborative innovation (Ollila & Ystrom, 2016). The objective of the analysis was to portray the emergence of affordances from boundary objects and their contribution to collaborative innovation.

3.2.3 Q4 – Multiple case studies

To answer Q4, I employed a multiple case study design (Eisenhardt, 1989; Yin, 1984). The objective of the study was to identify how different spatial configurations of startup accelerators fostered different types of knowledge communities. Therefore, a larger number of case studies was necessary to grasp a diverse range of scenarios. The use of multiple case studies stems from replication logic, providing a strong base for theorizing through cross-case comparisons (Eisenhardt & Graebner, 2007). The same approach has previously been utilized by researchers to compare different accelerator programs along a series of shared design dimensions (Pauwels et al., 2016). I conducted this research with a coauthor. My coauthor supported me during the data collection process by securing access to interviewees, and she was involved in the analysis and writing process.

Data collection. The last data collection field for this dissertation was in the Bay Area, one of the most thriving entrepreneurial ecosystems in the world (Engel, 2015). Consistent with the multiple case study design, we compiled a list of seventeen startup

accelerators. Data collection for the fourth paper involved three stages. Initially, we ran informal interviews with local experts, such as venture capital investors and local innovation scholars, to become familiar with the context and obtain feedback on the interview guidelines. The second stage was dedicated to case selection through maximum variation sampling (Flyvbjerg, 2006). During this stage, we interviewed managers of diverse startup accelerators (21), conducted site visits, and collected secondary material, such as online documents, videos and podcasts. Finally, we interviewed startup founders who had participated in the selected accelerator programs. To identify potential interviewees, we ran a search on LinkedIn. Again, we employed maximum variation sampling (Flyvbjerg, 2006) looking for startups from the US and abroad, working on different issues in diverse industries. Ultimately we interviewed 27 of the contacted startups that were available to meet with us.

Data analysis. Data analysis involved three steps. First, we conducted a thematic coding of the case studies using concepts described in the theoretical framework of the paper (*community members' characteristics, structural elements of the communities,* and *boundary space).* Second, we performed a cross-case analysis (Eisenhardt, 1989) of the case studies to clarify the relationships between theoretical constructs. During this stage, we mapped the process that each accelerator followed to determine the location and infrastructure provided to the startups. The outcome was a theoretical model that we iterated based on expert feedback to improve its explanatory power. Finally, we opted for a star-based model of organizational design showcasing the interdependency among all elements. Third, we performed a further cross-case analysis (Eisenhardt, 1989) based on the *community knowledge objective.* The objective was to show how accelerators' decisions about space differ depending on the knowledge community the accelerator seeks to attract. This allowed us to identify three archetypes with distinct spatial characteristics. We labeled the three archetypes "knowledge spoke hub", "knowledge center", and "knowledge network".

3.3 Ethics and quality

My entire dissertation adopts a qualitative approach. Brinkmann and Kvale (2005) retrace the history of qualitative research, pointing to the fact that it was initially considered an "inherently ethical" (Brinkmann & Kvale, 2005, p. 162) type of research. Because they allowed for long-term relationships between researchers and their research subjects, qualitative studies were presented as a democratizing force (Denzin & Lincoln, 2000). In time, this began to be questioned. Despite the benefits of letting research subjects take an active part in the research process, doing so presents potential ethical issues as well (Brinkmann & Kvale, 2005). One of the main challenges related to qualitative work is maintaining trustworthiness during data collection and analysis. In fact, qualitative researchers may unwillingly impose their own biases in order to lead the study towards the expected results. I employed different methods and practices to enhance the dissertation's quality. To demonstrate the trustworthiness of the study, I chose to adhere to the criteria developed by Lincoln and Guba (1985). I will briefly introduce each criterium and then explain my attempts to increase the trustworthiness of the study.

Credibility. Credibility refers to the "fit" between the views of the participants in the study and the researchers' representation of those views. In assessing credibility,

it is important to triangulate data during the data collection process and to present and discuss the results after data analysis. In fact, member-checking is a common procedure to ensure the credibility of the results. As previously mentioned, the data for this dissertation largely consist of ethnographic material. Ethnography emerged out of cultural anthropology studies and can take many forms. I strive for objectivity in my research; therefore, I have chosen a realist approach to ethnographic work (Van Maanen, 1988). From a realist standpoint, researchers are obligated to report facts as they unfold and to present data with no judgment. However, they have the right to direct the final interpretation. The findings of Papers 2 and 3 were discussed with some of the members who had participated in the study, since a secondary objective of both papers was to enhance practice. Paper 2 in particular strived for the constant involvement of the client organization in the data collection and data analysis process in accordance with principles for quality in canonical action research (Davison, Martinsons, & Ou, 2012). In the case of Paper 4, data triangulation ensured credibility. In fact, each case study was summarized in case wrap-ups that incorporated secondary sources and the perspectives of multiple interviewees. Moreover, experts in the field of startups and innovation were presented with the findings to ascertain whether the resulting archetypes from the study seemed to fit the reality experienced by practitioners.

Transferability. Transferability relates to the generalizability of the findings. Transferability is not always possible in qualitative studies. At best, it is possible to obtain generalizable "theoretical concepts". However, it is the researcher's responsibility to provide thick descriptions to help readers evaluate whether the findings of a study can be transferred to their particular context. This dissertation placed substantial emphasis on the identification of transferable theoretical concepts yet provided ample evidence grounded in the specific context of collaborative innovation. The findings of the three empirical studies led to the development of theoretical frameworks and principles that can be generally assessed using different knowledge boundary crossing contexts. Future studies might enquire into the actual transferability of the findings, or part of them, outside of a collaborative innovation context.

Dependability. Dependability involves the traceability and documentation of the research process. The most common way to ensure dependability is having experts audit the research process (Koch, 2006). In the case of this dissertation, all of the papers have been presented at international academic conferences, and Paper 3 has been accepted for publication. The peer-review process was especially useful for verifying whether the reporting of the study met academic standards. To increase the dependability of the study, I used the coding software Nvivo for organizing documents and keeping track of the coding procedure.

Confirmability. Confirmability is concerned with the transparency of the methodological and theoretical choices of the researcher during the research process. Confirmability is achieved when the criteria of credibility, transferability, and dependability are met (Guba & Lincoln, 1989). Based on the above, this dissertation meets confirmability requirements. A further explanation of the methodological and theoretical choices of the dissertation is provided by the kappa. The kappa is an overarching document that explains the rationale for the study, its philosophical

positioning, and the connections among the four papers based on theoretical contributions and methodological approaches.

Audit trails. Audit trails are evidence of the research steps taken by the researchers and are available to the readers of the study. A well-executed audit trail should make it possible for other researchers to obtain comparable results by analyzing the same data (Koch, 2006). One fundamental element of conducting successful audit trails is reflexivity. In this dissertation, practical reflexivity principles have been applied (Gorli, Nicolini, & Scaratti, 2015). Practical reflexivity involves the constant questioning of taken-for-granted habits (Gorli et al., 2015). It involves both the researchers and the research subjects, who are encouraged to embrace practical reflexivity as a way to enhance and develop their practice. Particularly, Papers 2 and 3 employed "at-home ethnography" and "writing" as important activities for fostering practical reflexivity. Data for both papers largely consisted of written reflections by the research subjects and were complemented by my own notes. "Learning through reflection" is also one of the five main criteria for quality in canonical action research (Davison et al., 2012), which I applied to Paper 2. In the case of Paper 4, notes and debriefing during the data collection process were helpful in establishing an audit trail, prompting reflexivity and enhancing the confirmability of the study.

To conclude, I conducted data collection for the entire dissertation in compliance with the GDPR requirements. Before conducting interviews, I explained my research and got consent from the interviewees to be recorded and quoted. Moreover, I fully anonymized the sources in each of the three empiric paper and stored the original files on a secure private storage space.

4. Summary of the papers

This dissertation is composed of four papers. The four papers are linked by the overarching research purpose: understanding what role spaces and objects (physical and digital) play within knowledge work. Collaborative innovation offers a context for the study. In this section, I briefly summarize the papers and explain the links.

4.1 Paper 1: Boundary objects in boundary spanning: A systematic literature review

This paper addresses research question 1: "How do boundary objects support cross-boundary spanning among various domains?" To answer the research question, I employ a systematic literature review based on a protocol-driven methodology. The literature review shows that boundary objects afford four main types of boundary work: *knowledge, temporal, political,* and *identity* (themes). These types of boundary work correspond to the following practices: *trading, sharing, knowing, retrieving, prospecting, manipulating, ignoring, indexing, and socializing* (subthemes). After explaining the types of boundary work and their associated practices, I perform a critical analysis using the three components of the original theorization as a baseline (interpretive flexibility, the structure of information and work process needs and arrangements, and the dynamic between ill-structured and more tailored use of the objects). The analysis reviews the components in light of the development of the boundary object scholarship. For instance, I challenge the assumption of knowledge work centrality in the use of the notion of boundary objects. Instead, I maintain that components such as interpretive flexibility may relate to temporal, political, or identity work depending on the use context.

This study enhances the understanding of the concept of boundary objects by summarizing and integrating twenty-five years of scholarship. The critical analysis translates the findings into questions for future inquiry. The research agenda lays the groundwork for further boundary object studies that reveal new insights without overlooking their theoretical origins. Potential contributions to broader theorizing and practical implications for the design of boundary objects are highlighted.

4.2 Paper 2: From idea to prototype in 48 hours: Designing boundary objects for knowledge integration

This paper addresses research question 2: "How does the design of boundary objects influence knowledge integration?". The research question is based on the observation that material scaffolds—physical objects, space, and technology—may support cross-boundary knowledge integration. I maintain that material scaffolding can be achieved through the design of boundary objects. Therefore, I set out to explore effectively scaffolded design dimensions for boundary object through an 18-month action research project. Corporate hackathons provided the context for the study. The choice of corporate hackathons was suitable for addressing the research question because they involve cross-boundary teams that need to integrate knowledge to address

innovation challenges in a short time. The study uses cross-boundary knowledge integration as the main theoretical perspective and boundary objects as an additional lens. Four dimensions and ten principles for the design of scaffolds for knowledge integration are identified and illustrated by practical examples.

This paper has three important contributions: first, it contributes to the existing scholarship on cross-boundary knowledge integration by suggesting that such integration depends on having a shared purpose, identity and time horizon, all of which can be supported by boundary objects. Second, it extends the study of boundary object qualities by explaining why engagement is an important quality for enhancing the relevance of boundary objects within collaborative settings. Third, it advances cross-boundary knowledge work as a possible theoretical lens to be applied to the study of open innovation contexts such as corporate hackathons. Finally, practitioners will find advice on how to run effective corporate hackathons.

4.3 Paper 3: Leveraging innovation spaces to foster collaborative innovation

This paper addresses research question 3: "How can innovation spaces foster collaborative innovation?" I adopt an ethnographic approach to uncover the role of space and objects in the collaborative innovation context of academic business studios. This paper shows how the four affordances of convergence, generativity, socialization, and collaborative learning play out in innovation spaces. Moreover, it presents a model linking the four affordances to key elements that are conducive to collaboration innovation from a design perspective. Specifically, I find that convergence and generativity make the "combination of domain-specific knowledge and expertise" possible, while socialization and collaborative learning support "the development of new practices", which together lead to collaborative innovation. The combination of domain-specific knowledge and expertise links to the topic of knowledge integration, which is central to this dissertation. Although the model developed in the paper splits the four affordances into two groups, I maintain that the two groups reinforce each other. To clarify, while convergence and generativity underpin knowledge integration, socialization and collaborative learning are necessary to sublimate knowledge integration into a tangible outcome—in the case of this paper, collaborative innovation.

This paper contributes to the design perspective on collaborative innovation by problematizing the role of space and objects. Additionally, it provides managers of innovation spaces with recommendations on how to leverage the built environment to stimulate collaboration among users of their spaces.

4.4 Paper 4: Leveraging accelerators' space to foster knowledge communities

This paper addresses research question 4: "How to leverage the design of boundary space to foster knowledge communities in startup accelerators?". I focus on the materiality of boundary space—geography and physical/digital infrastructure. A multiple case study of startup accelerators in the Bay Area is used to theorize about the effects of decisions about space on knowledge communities. A theoretical

framework based on the star model of organizational design represents the interconnectedness among structural elements of knowledge communities and boundary space. Moreover, the paper shows that different spatial configurations may lead to the emergence of knowledge communities characterized by different knowledge objectives. The empirical findings of the paper are summarized by the following three startup accelerator archetypes: a knowledge spoke hub, knowledge center, and knowledge network.

This paper contributes to the literature about knowledge communities and incubation models. In both contexts, the role of spatial arrangements has been acknowledged but was downplayed until only recently. With this study, that role becomes central. Finally, the paper contributes to practice. On the one hand, managers who are planning to set up accelerators receive guidance on how to optimize space for results; on the other hand, startups can use the three archetypes as a decision-making tool to judge what type of accelerator best caters to their needs; finally, policy makers can learn more about the relationship between space and entrepreneurship.

4.5 Linking the four papers

As noted in section 2.4, the four papers build on each other and show a progression from the micro to the macro. Paper 1 addresses research question 1: "How do boundary objects support cross-boundary spanning among various domains?" The increasing popularity of the concept of boundary objects in management and organization studies is what motivates this paper, which takes a systematic literature review approach. In Paper 1, I look at boundary objects as a means to cross knowledge boundaries and focus on the roles they take on. The literature review provides the building blocks for the whole dissertation. In fact, I rely on the identified roles of boundary objects in the three empiric papers.

Paper 2 addresses research question 2, "How does the design of boundary objects influence knowledge integration?", and it presents boundary objects as leverage for fostering knowledge integration. Paper 2 operationalizes the instrumental, symbolic, and temporal role of boundary objects as a basis for an action research intervention. Moreover, it complements the findings of the literature review by adding engagement as a further role played by boundary objects to foster knowledge integration.

Paper 3 addresses research question 3: "How can innovation spaces foster collaborative innovation?" This question is based on the observation that cross-boundary knowledge integration requires material scaffolds. In this paper, I reveal how to use boundary objects and space to foster collaborative innovation. Paper 3 studies boundary objects in the physical space of business studios. In this paper, objects and space produce affordances that lead to collaborative innovation. The affordances point to the instrumental and symbolic role identified in the review.

Finally, Paper 4 addresses research question 4: "How to leverage the design of boundary space to foster knowledge communities in startup accelerators?" Paper 4 considers space to be leverage for fostering knowledge communities, and it extends the definition of space to the geographical scope of cross-boundary knowledge work. In Paper 4, I show how boundary objects and space enable knowledge dynamics that are conducive to fostering specific types of knowledge communities. Again, the instrumental and symbolic role of boundary objects appears throughout the paper. In

fact, I discuss how geography and (physical and digital) infrastructures support knowledge work among community members, at the same time supporting the creation of a common identity.

The links among the independent contributions of the four papers inform a more general reflection. I discuss the overarching theoretical contributions and practical implications of the dissertation in section 5.

Table 3. Key contributions of the four papers

	Paper 1	**Paper 2**	**Paper 3**	**Paper 4**
Title	*Boundary objects in cross-boundary spanning: A systematic literature review*	*From idea to prototype in 48 hours: Designing boundary objects for knowledge integration*	*Leveraging innovation spaces to foster collaborative innovation*	*Leveraging accelerators' space to foster knowledge communities*
Guiding Research Question	How do boundary objects support cross-boundary spanning among various domains?	How does the design of boundary objects influence knowledge integration?	How can innovation spaces foster collaborative innovation?	How to leverage the design of boundary space to foster knowledge communities in startup accelerators?
Theoretical Contribution	*Boundary objects and knowledge management* → - Provides an integrated framework of the existing literature about boundary objects in cross-boundary spanning based on three knowledge-management perspectives - Advances a research agenda	*Knowledge integration* → Illustrates the role of material scaffolds to support knowledge integration *Boundary objects*→ Shows the importance of boundary objects' engagement quality to provide effective scaffolding	*Knowledge integration*→ Describes the role of sociomaterial space in enabling four affordances that lead to knowledge integration *Collaborative innovation*→ Shows how the affordances enable collaborative innovation	*Knowledge communities*→ Present a theoretical model showing the role of space in enabling knowledge communities to achieve their objectives *Incubation models*→ Illustrates three knowledge-based startup accelerator archetypes
Managerial implications	Guidance for designing boundary objects	- Design dimensions and principles of effective boundary objects for knowledge integration - Insights into organizing successful corporate hackathons	Step-by-step framework for fostering collaborative innovation	- Decision-making toolkit for designing accelerator spaces - Interplay of space and entrepreneurial activity

5. Conclusions

5.1 Contributions to theory

This dissertation has several important theoretical implications. First, it contributes to cross-boundary knowledge management. Second, it contributes to the sociomaterial perspective within social practice theory. Third, it deepens the understanding of relevant theoretical topics within collaborative innovation. This section is structured into three areas of theoretical contributions, and it concludes with a brief summary that ties the contributions together.

Despite there being a great number of studies that focus on *cross-boundary knowledge management*, this topic still appears to be very relevant for explaining current phenomena in business administration. Starting with Paper 1, the dissertation shows that knowledge boundaries are intertwined with other types of boundaries. The multifaceted concept of boundary objects (Carlile, 2002; Star & Griesemer, 1989) is used to reconcile different types of boundary crossing. The review emphasizes the need to reflect on the theoretical assumptions about knowledge in the study of boundary crossing (Hsiao et al., 2012). For instance, if knowledge is seen as information, temporal boundaries might become relevant to its retrieval. Building on this insight, this dissertation joins the current debate on the problematization of boundaries (Langley et al., 2019). The ancillary dimensions of objects and space design that contribute to knowledge boundary crossing are presented as critical to effective knowledge work. To give an example, Paper 4 stresses that identity is a fundamental dimension to consider when designing spatial arrangements to foster specific knowledge communities.

The two central papers of the dissertation add to the existing work on knowledge integration within cross-boundary teams (Edmondson & Harvey, 2017a; Majchrzak et al., 2012) by discussing the design of boundary objects and space. Paper 2 translates the four typologies of boundary crossing identified by the literature review into the design dimensions of material scaffolds for knowledge integration (Majchrzak et al., 2012; Roberts & Beamish, 2017). Moreover, the paper details actual design principles that can be implemented by the facilitators and project managers of collaborative innovation initiatives. Paper 3 addresses the challenge of knowledge integration through the concept of the affordances of the built environment within business studios. Together, these two papers show the importance of key affordances, confirming that a space and the boundary objects emanating from that space are necessary to enable knowledge integration. Interestingly, both papers emphasize the need to consider the esthetic dimensions of objects and spaces (Endrissat, Islam, & Noppeney, 2016; Islam, Endrissat, & Noppeney, 2016), not only as knowledge conveyance but also as leverage to attract the attention of collaborating actors.

Regarding the *sociomaterial perspective*, this dissertation allows us to deepen our understanding of the role of artifacts and spaces within collaborative settings and to combine existing concepts in new ways. Scholarly interest in sociomateriality within management and organization theory is on the rise (Jarzabkowski & Pinch, 2013;

Zeiss & Groenewegen, 2009). However, the number of empirical studies that center the sociomaterial dimension of organizational life are still limited. To this point, a recent review of boundary work published in the *Academy of Management Annals* by Langley et al. (2019) lamented that the boundary objects literature falls short in providing an account of the actual practices afforded by such objects. I argue that this might be attributed to two main reasons: first, the absence of integrating taxonomies that help consolidate the labels used to describe practices afforded by boundary objects by different authors, and second, the difficulty of obtaining in-depth data that shows how collaborating actors use objects and spaces. To address this gap in the literature, Paper 1 lists a series of practices discussed in the existing boundary objects literature. Papers 2 and 3 portray the interplay of users and objects in tackling the challenges of cross-boundary knowledge work. A further contribution to the sociomateriality literature is the study of interactions within systems of boundary objects (Nandhakumar, Panourgias, & Scarbrough, 2013; Scarbrough et al., 2015). For instance, paper 3 shows how knowledge integration among hackathon team members, company partners, and mentors happened through different boundary objects. This stands in contrast to the traditional scholarship on boundary objects, which has a tendency to focus on one object at a time (Nandhakumar et al., 2013; Scarbrough et al., 2015).

The theoretical contributions of this dissertation extend to the study of *collaborative innovation*. In this respect, the contributions are generic to the dissertation and specific to each paper. First, the three collaborative innovation contexts that ground my study are growing in popularity among practitioners, opening up several research opportunities. Collaboration between established organizations and external innovators is fundamental to the success of every open innovation initiative (Chesbrough, 2003; Huizingh, 2011). This collaborative process requires crossing several boundaries. Through this dissertation, I offer a relevant theoretical perspective that can illuminate the process of collaborative innovation across boundaries, at the same time showing how material infrastructures can help organize and consolidate knowledge outcomes on a long-term basis. In terms of the specific papers, Paper 3 builds on the design perspective on collaborative innovation (Ollila & Ystrom, 2016). According to the design perspective, collaborative innovation is a dynamic process that emerges from the relationships among human actors (Ollila & Ystrom, 2016). By discussing the role of boundary objects' affordances in facilitating this emergent process, Paper 3 complements and extends prior studies, adding the important dimension of sociomateriality. The focus of Paper 2 on corporate hackathons is also unique. With few notable exceptions, the existing scholarship about corporate hackathons is limited and dispersed across numerous fields of research. Paper 2 not only suggests a promising theoretical lens through which to address the challenges faced by corporate hackathon organizers but also provides recommendations on how to design infrastructures for knowledge integration in this specific context. Finally, paper 4 discusses the phenomenon of startup accelerators from the perspective of space. While scholarly attention to the design of startup accelerators is on the rise, existing contributions are not specific to individual design dimensions (Cohen et al., 2019; Pauwels et al., 2016). Paper 4 advances the knowledge on startup accelerators by proposing three archetypes based

on spatial characteristics in terms of the geography, infrastructure, and function of the space. Most importantly, the three archetypes lead to the emergence of diverse knowledge communities, which may help diversify startup accelerators on the basis of their knowledge objectives rather than performance outcomes.

In summary, during the research process of this dissertation, my comprehension of the role of sociomateriality within cross-boundary knowledge work increased as the data unfolded. The papers show a progression from the micro to the macro effects of sociomateriality in cross-boundary knowledge work, thus showing its multilevel nature. Moreover, the interconnectedness among the different levels appears to be an interesting finding with great potential. This dissertation shows that boundary objects, spaces, and ecosystems present very similar characteristics in relation to cross-boundary knowledge work. All of them catalyze knowledge by offering a shared platform to diverse actors, and they are successful when the interaction among the collaborating actors is productive. While these three elements are typically studied separately, their integration in the context of this study is promising. Collaborative innovation is a case in point. The closer we look at companies' efforts to engage in collaborative innovation, the more likely we are to see the involvement of space at different levels. Boundary objects, such as prototypes and project charts, enable collaborative practices among cross-boundary innovation teams. Cross-boundary innovation teams collaborate in ad hoc physical or digital workspaces. Physical or digital workspaces are anchored to ecosystems, which provide specific resources. To give an example, the three spatial archetypes identified through the analysis of startup accelerators in Paper 4 suggest that space has a performative role in collaborating actors engaging with each other to pursue a common knowledge objective. Whether space is effective is not merely a matter of whether it has the best infrastructure. It comes down to having a space strategy in place that capitalizes on the resources available in the ecosystem and addresses the unfolding needs of cross-boundary innovation teams by providing suitable boundary objects.

In conclusion, this dissertation offers several new insights that together extend our understanding of cross-boundary knowledge management. The use of multiple research techniques is effective in gaining deeper and more comprehensive insight into how such a complex phenomenon can be addressed. Hopefully, this research can provide an impetus for other studies in the realms of cross-boundary knowledge work, sociomateriality and collaborative innovation, building on the contributions presented here. The following section highlights the limitations of the study and suggests avenues for future research.

5.2 Limitations and future studies

This research has some limitations, which suggest opportunities for future research. Some of the limitations apply to all three empirical papers, whereas others are specific to a single paper.

The choice of knowledge management as a main theoretical perspective on cross-boundary spanning leaves ample room for future studies to combine other theoretical perspectives. While adopting a knowledge management lens helps to explain the knowledge and innovation outcomes of cross-boundary work, it fails to explain equally critical social dynamics. Paper 1 offers several suggestions on potential

research questions that may be addressed in the future. In particular, identity theory might be fitting to address a number of challenges related to knowledge boundary spanning. The identity perspective has already been applied to the study of boundary work (Lifshitz-Assaf, 2018; Robinson & Baum, 2019). However, the combination of identity theory and sociomateriality has thus far been underexplored. The latter offers ample room to explore the role of cultural representations as enactments of collaborative endeavors in depth. This is particularly relevant to the innovation field, whereby tensions between established and emerging cultures coexist in longer time spans.

Time is an important dimension that was not explored in-depth in the dissertation. The papers included in this dissertation only limitedly discuss the evolution and decline of boundary objects over time. Process studies could address this limitation by extending the data collection to cover a long-term horizon and by tracking how the boundary objects in use change in terms of their role and their centrality as the collaborative relationship among their users progresses. Connected to this, boundary objects' "repurposing" (David & Pinch, 2006; Hutchby, 2001; Jarzabkowski & Pinch, 2013) throughout the collaborative process is an area that certainly deserves space and attention in scholarly dialogue.

Another limitation of the dissertation is the focus on knowledge integration in Papers 2 and 3. Sociomateriality is a relevant lens through which to study other typologies of knowledge dynamics, such as knowledge creation and knowledge sharing. While Paper 4 acknowledges the role of space in supporting alternative types of knowledge dynamics in the context of knowledge communities, future studies could examine sociomaterial practices for knowledge creation and sharing in greater detail. The latter entails longer engagement with and within collaboration teams in order to more closely observe the interactions among collaborating actors at a deeper level. Possible suitable contexts for such a study include but are not limited to health-care organizations, scientific discoveries and creative movements.

This study is further limited by the fact that the role of boundary spanners (Hawkins & Rezazade, 2012; Levina & Vaast, 2005) that support the introduction and design of boundary objects is downplayed. All three empirical papers mention that the role of boundary spanners, such as facilitators and managers, is pivotal to the effective setup of the space; the design, selection, and introduction of boundary objects; and the support of the collaborating actors as they engage with the physical and digital environment. In particular, facilitation in the collaborative innovation context is a topic that has not yet been extensively studied. Other researchers could extend the scope of this dissertation to include a focus on the practices and behaviors that facilitators may adopt to enhance boundary objects' effectiveness in specific contexts.

Finally, my research approach is entirely qualitative. The qualitative nature of my study is not a limitation per se, but it may make generalizability a concern. One major advantage of qualitative studies is that they allow contextual appreciation. At the same time, they do not allow us to uncover relationships of causality among variables to be considered universally valid. At most, qualitative research makes it possible to argue for the generalizability of "theoretical concepts" or "local theories". Hence, the focus on collaborative, open innovation contexts can be viewed as a limitation. While

the affordances, design principles, and archetypes identified in this study are not necessarily context specific, future studies might seek further validation in other contexts that experience similar levels of cross-boundary knowledge work. For instance, they could look into companies that pursue internal collaborative work across organizational functions. Alternatively, they could focus on nontraditional management settings, such as performing arts and team sports. By researching the role of space and objects in diverse cross-boundary knowledge contexts, it will be possible to more firmly establish common themes across contexts and to highlight context-specific variations. In doing so, the very notion of "collaboration", which is a grounding concept of my study, might be challenged by other logics at the organizational edges, such as competition and organizational configuring (Langley et al., 2019).

Moreover, different methods could be used to deepen our understanding of using objects within organizational settings. For instance, heat maps and tracking devices might help generate fine-grained data on how the physical environment is used. Finally, the last paper in the dissertation shows specific spatial arrangements in relation to the attributes of knowledge community members. The main findings of the study could lay the groundwork for future work that would expand our knowledge of specific features that space and objects ought to display in order to enable collaborative processes.

5.3 Contributions to practice

Cross-boundary knowledge management has attracted much attention in recent years, given its strong practical implications for organizations as well as civil society. In particular, the topic is relevant to the growing innovation community, which is need to provide constant support to collaborating actors as they engage in cross-boundary work. My direct experience in running corporate hackathons and business studios helped to guarantee the relevance of the key findings for innovation practitioners who are daily confronted with the challenges of running innovation spaces.

This dissertation suggests to managers of innovation spaces that physical and digital objects and spaces can be leveraged to stimulate effective collaboration among diverse actors involved in innovation initiatives. While there are contrasting opinions regarding whether it is worth investing in innovation spaces, my dissertation makes a strong argument for considering space as an enabler rather than a magic bullet. The four papers provide recommendations on dimensions to consider when designing and selecting objects and spaces to be part of the collaborative process. Innovation practitioners, such as hackathon organizers and studio facilitators, benefit from in-depth accounts. My data mainly consist of direct observations of and reflections from actors involved in collaborative innovation. The data were gathered over several years and from different geographical areas. Thus, they constitute a rich source for examples of use-case scenarios. The multiple perspectives included in my dissertation offer benchmarking opportunities, as well as the possibility to identify trends and recommendations for the design of environments conducive to successful collaborative innovation across disciplinary and organizational boundaries. The practical implications of this dissertation extend to potential users and financers of innovation spaces, such as entrepreneurs and startups, as well as companies and

policy makers. The findings of the empirical papers shed light on different types of innovation spaces and can therefore be informative for startups and innovators in their decision to engage with specific types over others. The practical recommendations of this dissertation can be summarized by the following types of fit that innovation spaces need to provide:

Space-ecosystem fit. The design of innovation spaces should start with a deep reflection on the knowledge objectives expected from the space. A clear positioning helps with recruiting collaborating actors and attracting resources. This dissertation gives examples of different types of knowledge objectives, including knowledge sharing, integration, and creation. Managers of innovation spaces should ask themselves the following question: What do we want to achieve with the setup of the space? Obtaining familiarity with the context is a fundamental step in determining whether the defined knowledge objective is in line with available resources. Studying the context includes considerations about geography and available resources. Once the objective has been defined and the ecosystem studied, the infrastructure should be designed to reflect the identity of the ecosystem and best leverage the available resources.

Space-stakeholder fit. Innovation spaces typically have several stakeholders. Stakeholders can be divided into two main groups: direct and indirect users of the space. Direct users of innovation spaces involve collaborating actors, as well as managers and facilitators. Indirect users of the space include financers and external partners. Each of these stakeholders has different expectations from the space in terms of functionality, identity and communication. Functionality is a core dimension for direct users who engage with the space on a regular basis. On the other hand, it is less relevant to financers and external partners, who seldom engage with the space. Identity is important to all of the stakeholders, yet in different ways. Direct users want to be allowed to shape their own project culture. Financers care about shaping the space to reflect the values and image of their own institution. External partners and communities care about representation. The communication aspects of the space range from the "work needs" of direct users to the "readability needs" of indirect users. Direct users expect the space to document the work of the different actors involved and aggregate it in a shared workspace. Financers and external partners expect to be able to understand the work done in the space, including what type of projects are undertaken there, how the projects are progressing and what their historical development has been. The design of the infrastructure should align and balance the expectations of the multiple stakeholders involved.

Space-project fit. The design of innovation spaces has parallels to the design of innovative products and services. It is not possible to foresee all the needs of direct users. The dynamic nature of innovation work requires flexible arrangements and continuous adjustments. Therefore, it is important to observe how the behavior of the users evolves over time and to modify the space accordingly. Moreover, users should be engaged in the process of repurposing the original design to fit their current uses and identity. Two concepts are important for fulfilling innovation workers' needs through design: scenarios and tasks. Scenarios are based on different numbers of users being involved throughout the project—for instance, project team interactions versus open feedback sessions and one-person phone calls versus conference calls.

Tasks are actual "jobs to be done", which emerge and evolve over time. For instance, in the initial stages of a project, most tasks are related to ideation, hence empty spaces and inspirational materials will be needed. As the project progresses, the tasks will become increasingly specific, often requiring new investments in technology. Given the emerging and changing nature of project needs, it is wise to keep initial investments in specialized equipment to a minimum and consult project teams about what is needed along the way.

In a world where the availability and variety of innovation spaces is growing steadily, identifying the best fit to fulfil individual needs and objectives is hard. At the same time, policy makers and companies are willing to invest in innovation, but they are not necessarily able to evaluate the most effective way to do so. I hope that this dissertation provides valuable guidance on discerning and leveraging the opportunities that a mindful, user-centric approach to the design of innovation spaces can bring.

References

Adner, R. (2012). The wide lens: A new strategy for innovation: Penguin UK.

Alexander, A. T., Neyer, A. K., & Huizingh, K. (2016). Introduction to the special issue: transferring knowledge for innovation. *R&D Management, 4*6(2), 305-311.

Alexander, C. (1964). *Notes on the synthesis of form (Vol. 5)*: Harvard University Press.

Amin, A., & Cohendet, P. (2004). *Architectures of knowledge: Firms, capabilities, and communities*: OUP Oxford.

Amin, A., & Roberts, J. (2008). Knowing in action: Beyond communities of practice. *Research Policy, 37*(2), 353-369.

Autio, E., Nambisan, S., Thomas, L. D., & Wright, M. (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. S*trategic Entrepreneurship Journal, 12*(1), 72-95.

Barad, K. (2003). Posthumanist performativity: Toward an understanding of how matter comes to matter. *Journal of women in culture and societ*y, 28(3), 801-831.

Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning:* Duke University Press.

Barrett, E. (2005). Creative arts practice, creative industries: method and process as cultural capital. *Paper presented at the Speculation and Innovation: applying practice led research in the creative industries*.

Barry, D., & Meisiek, S. (2014). Discovering the business studio. *Journal of Management Education, 39*(1), 153–175.

Baskerville, R. L., & Wood-Harper, A. T. (1996). A critical perspective on action research as a method for information systems research. *Journal of Information Technology, 11*(3), 235-246.

Battistella, C., De Toni, A. F., & Pessot, E. (2017). Open accelerators for start-ups success: a case study. *European Journal of Innovation Management, 20*(1), 80-111.

Bechky, B. A. (2003). Sharing meaning across occupational communities: The transformation of understanding on a production floor. *Organization Science, 14*(3), 312-330.

Belmondo, C., & Sargis-Roussel, C. (2015). Negotiating language, meaning and intention: Strategy infrastructure as the outcome of using a strategy tool through transforming strategy objects. *British Journal of Management, 26*, S90-S104.

Bengtsson, M., Enberg, C., & Tell, F. (2020). Foolishness without consequence? From physical to virtual modeling in the history of military aircraft development at Saab. *Industrial and Corporate Change*, *29*(1), 163-181.

Berger, P., & Luckmann, T. (1967). T*he social construction of reality*. London: Allen Lane.

Bhaskar, R. (1979). *Philosophy and the human sciences: The possibility of naturalism: a philosophical critique of the contemporary human sciences*: Harvester Press.

Blackler, F. (1995). Knowledge, knowledge work and organizations: An overview and interpretation. *Organization Studies, 16*(6), 1021-1046.

Blank, S. (2013). Why the lean start-up changes everything. *Harvard Business Review, 91*(5), 63-72.

Bloomfield, B. P., Latham, Y., & Vurdubakis, T. (2010). Bodies, technologies and action possibilities: When is an affordance? *Sociology, 44*(3), 415-433.

Boland Jr, R. J., Collopy, F., Lyytinen, K., & Yoo, Y. (2008). Managing as designing: Lessons for organization leaders from the design practice of Frank O. Gehry. *Design issues, 24*(1), 10-25.

Boland, R. J., & Tenkasi, R. V. (1995). Perspective making and perspective taking in communities of knowing. *Organization Science, 6*(4), 350-372.

Brinkmann, S., & Kvale, S. (2005). Confronting the ethics of qualitative research. J*ournal of constructivist psychology, 18*(2), 157-181.

Briscoe, G., & Mulligan, C. (2014). *Digital innovation: The hackathon phenomenon*. Creativeworks London Working Paper N.6

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

Brown, J. S., & Duguid, P. (2002). Local knowledge: Innovation in the networked age. *Management Learning, 33*(4), 427-437.

Bruner, J. (1960). *The Process of Education:* Harvard University Press Cambridge.

Burrell, G., & Morgan, G. (1979). *Sociology paradigm and organisational analysis: Elements of the sociology of corporate life*. In: Portsmouth: Heinemann.

Cabrera, A., & Cabrera, E. F. (2002). Knowledge-sharing dilemmas. *Organization Studies, 23*(5), 687-710.

Capdevila, I., Cohendet, P., & Simon, L. (2018). From a local community to a global influence. How elBulli restaurant created a new epistemic movement in the world of haute cuisine. *Industry and Innovation, 25*(5), 526-549.

Carlile, P. R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization Science, 13*(4), 442-455.

Cennamo, K., Brandt, C., Scott, B., Douglas, S., McGrath, M., Reimer, Y., & Vernon, M. (2011). Managing the complexity of design problems through studio-based learning. *Interdisciplinary Journal of Problem-Based Learning, 5*(2), 5.

Cetina, K. K., Schatzki, T. R., & Von Savigny, E. (2005). *The practice turn in contemporary theory.* Routledge.

Champenois, C., & Etzkowitz, H. (2018). From boundary line to boundary space: The creation of hybrid organizations as a Triple Helix micro-foundation. *Technovation, 76*, 28-39.

Chesbrough, H. (2003). *Open innovation*. In: Boston: Harvard Business School Press.

Chesbrough, H. (2019). *Open innovation results: Going beyond the hype and getting down to business.* Oxford University Press.

Christensen, C. M., Raynor, M. E., & McDonald, R. (2015). What is disruptive innovation. *Harvard Business Review*, *93*(12), 44-53.

Cirella, S., & Yström, A. (2018). Creativity and science parks: more than just a physical platform? *CERN IdeaSquare* J*ournal of Experimental Innovation, 2*(1), 8-13.

Cohen, S. (2013). What do accelerators do? Insights from incubators and angels. Innovations: *Technology, Governance, Globalization, 8*(3-4), 19-25.

Cohen, S., Fehder, D. C., Hochberg, Y. V., & Murray, F. (2019). The design of startup accelerators. *Research Policy, 48*(7), 1781-1797.

Cohen, S. L., Bingham, C. B., & Hallen, B. L. (2018). The role of accelerator designs in mitigating bounded rationality in new ventures. *Administrative Science Quarterly*.

Cohendet, P., Creplet, F., & Dupouët, O. (2001). Communities of practice and epistemic communities: a renewed approach of organisational learning within the firm. P*aper presented at the Workshop on Economics and Heterogeneous Interacting Agents.*

Cohendet, P., Grandadam, D., Simon, L., & Capdevila, I. (2014). Epistemic communities, localization and the dynamics of knowledge creation. *Journal of Economic Geography, 14*(5), 929-954.

Conner, K. R., & Prahalad, C. K. (1996). A resource-based theory of the firm: Knowledge versus opportunism. *Organization Science, 7*(5), 477-501.

Cook, S. D., & Brown, J. S. (1999). Bridging epistemologies: The generative dance between organizational knowledge and organizational knowing. *Organization Science, 10*(4), 381-400.

Courpasson, D., Dany, F., & Clegg, S. (2012). Resisters at work: Generating productive resistance in the workplace. *Organization Science, 23*(3), 801-819.

Cross, R., Rebele, R., & Grant, A. (2016). Collaborative overload. *Harvard Business Review, 94*(1), 74-79.

David, S., & Pinch, T. J. (2006). Six degrees of reputation: The use and abuse of online review and recommendation systems. *First Monday, 11*(3).

Davison, R. M., Martinsons, M. G., & Ou, C. X. J. (2012). The roles of theory in canonical action research. *Mis Quarterly, 36*(3), 763-786.

Denzin, N. K., & Lincoln, Y. S. (2000). *Handbook of qualitative inquiry*. Thousand Oaks, CA: Sage.

Di Fiore, A., & Vetter, J. (2016). Why B2B Companies Struggle with Collaborative Innovation. *Harvard Business Review*.

DiBenigno, J., & Kellogg, K. C. (2014). Beyond occupational differences: The importance of crosscutting demographics and dyadic toolkits for collaboration in a US hospital. *Administrative Science Quarterly, 59*(3), 375-408.

Edmondson, A. C., & Harvey, J.-F. (2017a). Cross-boundary teaming for innovation: Integrating research on teams and knowledge in organizations. *Human Resource Management Review, 28*(4), 347-360.

Edmondson, A. C., & Harvey, J.-F. (2017b). *Extreme teaming: Lessons in complex, cross-sector leadership:* Emerald Publishing Limited.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review, 14*(4), 532-550.

Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal, 50*(1), 25-32.

Enberg, C., Lindkvist, L., & Tell, F. (2010). Knowledge integration at the edge of technology: On teamwork and complexity in new turbine development. *International Journal of Project Management*, *28*(8), 756-765.

Endrissat, N., Islam, G., & Noppeney, C. (2016). Visual organizing: Balancing coordination and creative freedom via mood boards. J*ournal of Business Research, 69*(7), 2353-2362.

Engel, J. S. (2015). Global clusters of innovation: Lessons from Silicon Valley. *California Management Review, 57*(2), 36-65.

Estany, A., & Martínez, S. (2014). "Scaffolding" and "affordance" as integrative concepts in the cognitive sciences. *Philosophical Psychology, 27*(1), 98-111.

Faraj, S., & Azad, B. (2012). The materiality of technology: An affordance perspective. *Materiality and organizing: Social interaction in a technological world*, 237-258.

Feldman, M. S., & Orlikowski, W. J. (2011). Theorizing practice and practicing theory. *Organization Science, 22*(5), 1240-1253.

Fixson, S. K., Seidel, V. P., & Bailey, J. (2015). Creating space for innovation: The role of a "design zone" within a business school. *Evolving Entrepreneurial Education: Innovation in the Babson Classroom*, 217.

Flyvbjerg, B. (2006). Five misunderstandings about case-study research. *Qualitative inquiry, 12*(2), 219-245.

Friesl, M., Larty, J., & Jacobs, C. (2018). Putting strategy into action - The role of artefacts for business format replication. *European Management Review, 15*(2), 221-235.

Galbraith, J. (1973). *Designing complex organizations*. Addison-Wesley Publishing Company London.

Gherardi, S. (2006). *Organizational knowledge: The texture of organizing*. London: Blackwells.

Gherardi, S., & Perrotta, M. (2014). Between the hand and the head: How things get done, and how in doing the ways of doing are discovered. *Qualitative Research in Organizations and Management: An International Journal, 9(*2), 134-150.

Gibson, J. J. (1966). *The senses considered as perceptual systems.* Houghton Mifflin.

Gibson, J. J. (1977). Perceiving, acting, and knowing: Toward an ecological psychology. *The Theory of Affordances*, 67-82.

Gibson, J. J. (1979). The theory of affordance*s. The People, Place, and Space Reader*, 56-60.

Gibson, J. J. (1986). *The ecological approach to visual perception.* Houghton Mifflin.

Giddens, A. (1984). The constitution of society: Outline oft he theory of structuration. Berkeley: University of California Press.

Gioia, D. A., & Pitre, E. (1990). Multiparadigm perspectives on theory building. *Academy of Management Review, 15*(4), 584-602.

Gorli, M., Nicolini, D., & Scaratti, G. (2015). Reflexivity in practice: Tools and conditions for developing organizational authorship. *Human Relations, 68*(8), 1347-1375.

Granovetter, M. (1985). Economic action and social structure: The problem of embeddedness. *American journal of sociology, 91*(3), 481-510.

Gryszkiewicz, L., Lykourentzou, I., & Toivonen, T. (2016). Innovation labs: Leveraging openness for radical innovation? *Journal of Innovation Management, 4*(4), 68-97.

Guba, E. G., & Lincoln, Y. S. (1989). *Fourth generation evaluation*. Sage.

Guba, E. G., & Lincoln, Y. S. (1994). Competing paradigms in qualitative research. *Handbook of qualitative research, 2*(163-194), 105.

Hansen, M. T., Chesbrough, H. W., Nohria, N., & Sull, D. N. (2000). Networked incubators - Hothouses of the new economy. *Harvard Business Review, 78*(5),

Harman, G. H. (1965). The inference to the best explanation. *The philosophical review, 74*(1), 88-95.

Hawkins, M. A., & Rezazade, M. H. (2012). Knowledge boundary spanning process: synthesizing four spanning mechanisms. *Management Decision, 50*(10), 1800-1815.

Hochberg, Y. V. (2016). Accelerating entrepreneurs and ecosystems: The seed accelerator model. *Innovation Policy and the Economy, 16*(1), 25-51.

Hsiao, R. L., Tsai, D. H., & Lee, C. F. (2012). Collaborative Knowing: The Adaptive Nature of Cross-Boundary Spanning. *Journal of Management Studies, 49*(3), 463-491.

Huizingh, E. (2011). Open innovation: State of the art and future perspectives. *Technovation, 31*(1), 2-9.

Hutchby, I. (2001). Technologies, texts and affordances. *Sociology, 35*(2), 441-456.

Hwang, E. H., Singh, P. V., & Argote, L. (2015). Knowledge sharing in online communities: Learning to cross geographic and hierarchical boundaries. *Organization Science, 26*(6), 1593-1611.

Islam, G., Endrissat, N., & Noppeney, C. (2016). Beyond 'the Eye' of the beholder: Scent innovation through analogical reconfiguration. *Organization Studies, 37*(6), 769-795.

Jarzabkowski, P., & Kaplan, S. (2015). Strategy tools-in-use: A framework for understanding "technologies of rationality" in practice. *Strategic Management Journal, 36*(4), 537-558.

Jarzabkowski, P., & Pinch, T. (2013). Sociomateriality is 'the New Black': accomplishing repurposing, reinscripting and repairing in context. *M@ n@ gement, 16*(5), 579-592.

Jonassen, D. H. (2000). Toward a design theory of problem solving. *Educational technology research and development, 48*(4), 63-85.

Ketchen, D. J., Ireland, R. D., & Snow, C. C. (2007). Strategic entrepreneurship, collaborative innovation, and wealth creation. *Strategic Entrepreneurship Journal, 1*(3-4), 371-385.

Koch, T. (2006). Establishing rigour in qualitative research: the decision trail. *Journal of advanced nursing, 53*(1), 91-100.

Kodama, M. (2015). *Collaborative Innovation: Developing Health Support Ecosystems.* Routledge.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science, 3*(3), 383-397.

Kokkonen, J. (2014). Stepping into the emptiness: Scaffolding in organizational transition. The *Learning Organization, 21*(3), 193-205.

Komssi, M., Pichlis, D., Raatikainen, M., Kindström, K., & Järvinen, J. (2015). What are hackathons for? *IEEE Software, 32*(5), 60-67.

Langley, A., Lindberg, K., Mørk, B. E., Nicolini, D., Raviola, E., & Walter, L. (2019). Boundary work among groups, occupations, and organizations: From cartography to process. *Academy of Management Annals, 13*(2), 704-736.

Lave, J., & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation*: Cambridge University Press.

Leonardi, & Barley, S. R. (2008). Materiality and change: Challenges to building better theory about technology and organizing. *Information and Organization, 18*(3), 159-176.

Leonardi, P. M. (2012). Materiality, sociomateriality, and socio-technical systems: what do these terms mean? How are they related? Do we need them? In P. M. Leonardi, B. A. Nardi, & J. Kallinikos (Eds.), *Materiality and Organizing: Social Interaction in a Technological World* (25-48). Oxford: Oxford University Press.

Leonardi, P. M. (2013). Theoretical foundations for the study of sociomateriality. *Information and Organization, 23*(2), 59-76.

Leonardi, P. M., & Barley, S. R. (2010). What's under construction here? Social action, materiality, and power in constructivist studies of technology and organizing. *Academy of Management Annals, 4*(1), 1-51.

Levina, N. (2005). Collaborating on multiparty information systems development projects: A collective reflection-in-action view. *Information Systems Research, 16*(2), 109-130.

Levina, N., & Vaast, E. (2005). The emergence of boundary spanning competence in practice. implications for implementation and use of information systems. *Mis Quarterly, 29*(2), 335-363.

Lifshitz-Assaf, H. (2018). Dismantling knowledge boundaries at NASA: The critical role of professional identity in open innovation. *Administrative Science Quarterly, 63*(4), 746-782.

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newberry Park. In: CA: Sage.

Lindgren, R., Henfridsson, O., & Schultze, U. (2004). Design principles for competence management systems: A synthesis of an action research study. *Mis Quarterly, 28*(3), 435-472.

Maas, J.-B., van Fenema, P. C., & Soeters, J. (2016). ERP as an organizational innovation: key users and cross-boundary knowledge management. *Journal of Knowledge Management, 20*(3).

Magadley, W., & Birdi, K. (2009). Innovation labs: An examination into the use of physical spaces to enhance organizational creativity. *Creativity and Innovation Management, 18*(4), 315-325.

Majchrzak, More, P. H. B., & Faraj, S. (2012). Transcending knowledge differences in cross-functional teams. *Organization Science, 23*(4), 951-970.

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook*. Sage.

Mitchell, V. L. (2006). Knowledge integration and information technology project performance. *Mis Quarterly*, *30*(4) 919-939.

Morgan, G., & Smircich, L. (1980). The case for qualitative research. *Academy of Management Review, 5*(4), 491-500.

Mutch, A. (2013). Sociomateriality—Taking the wrong turning? *Information and Organization, 23(*1), 28-40.

Nambisan, S., & Sawhney, M. (2007). A buyer's guide to the innovation bazaar. *Harvard Business Review*, 85(6), 109.

Nandhakumar, J., Panourgias, N. S., & Scarbrough, H. (2013). From Knowing It to "Getting It": Envisioning Practices in Computer Games Development. *Information Systems Research, 24*(4), 933-955.

Narsalay, R., Kavathekar, J., & Light, D. (2016). A Hands-Off Approach to Open Innovation Doesn't Work. Harvard Business Review. Retrieved from https://hbr.org/2016/05/a-hands-off-approach-to-open-innovation-doesnt-work

Nelson, R. R., & Winter, S. G. (1982). The Schumpeterian tradeoff revisited. The American Economic Review, 72(1), 114-132.

Newell, S. (2015). Managing knowledge and managing knowledge work: what we know and what the future holds. *Journal of Information Technology, 30*(1), 1-17.

Nicolini. (2011). Practice as the Site of Knowing: Insights from the Field of Telemedicine. *Organization Science, 22*(3), 602-620.

Nicolini, D., Mengis, J., & Swan, J. (2012). Understanding the role of objects in cross-disciplinary collaboration. *Organization Science, 23*(3), 612-629.

Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. Organization Science, 5(1), 14-37.

Nonaka, I., & Takeuchi, H. (1995). *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford university press.

Norman, D. A. (1988). *The psychology of everyday things.* Basic books.

Nyberg, D. (2009). Computers, customer service operatives and cyborgs: Intra-actions in call centres. *Organization Studies, 30*(11), 1181-1199.

Ollila, S., & Ystrom, A. (2016). Exploring Design Principles of Organizing for Collaborative Innovation: The Case of an Open Innovation Initiative. *Creativity and Innovation Management, 25*(3), 363-377.

Ollila, S., & Yström, A. (2020). Action research for innovation management: three benefits, three challenges, and three spaces. *R&D Management*, *50*(3), 396-411.

Omidvar, O., & Kislov, R. (2014). The evolution of the communities of practice approach: Toward knowledgeability in a landscape of practice—An interview with Etienne Wenger-Trayner. *Journal of Management Inquiry, 23*(3), 266-275.

Orlikowski, W. J. (2002). Knowing in practice: Enacting a collective capability in distributed organizing. *Organization Science, 13*(3), 249-273.

Orlikowski, W. J. (2006). Material knowing: The scaffolding of human knowledgeability. *European Journal of Information Systems, 15*(5), 460-466.

Orlikowski, W. J. (2007). Sociomaterial practices: Exploring technology at work. *Organization Studies, 28*(9), 1435-1448.

Orlikowski, W. J., & Scott, S. V. (2008). 10 sociomateriality: challenging the separation of technology, work and organization. *Academy of Management Annals, 2*(1), 433-474.

Pauwels, C., Clarysse, B., Wright, M., & Van Hove, J. (2016). Understanding a new generation incubation model: The accelerator. *Technovation, 50-51,* 13-24.

Peirce, C. S. (1883). *Studies in logic* (Vol. 1): John Benjamins Publishing.

Powell, W. W., & Snellman, K. (2004). The knowledge economy. *Annual Review of Sociology, 30*, 199-220.

Quinn, J. B., Anderson, P., & Finkelstein, S. (1996). Leveraging intellect. *Academy of Management Perspectives, 10*(3), 7-27.

Quintas, P., Lefrere, P., & Jones, G. (1997). Knowledge management: a strategic agenda. *Long Range Planning, 30*(3), 385-391.

Roberts, M. J., & Beamish, P. W. (2017). The scaffolding activities of international returnee executives: A learning based perspective of global boundary spanning. *Journal of Management Studies, 54*(4), 511-539.

Robinson, R. N., & Baum, T. (2019). Work (ing) artefacts: Tools of the trade, totems or trophies? *Human Relations, 73*(2), 165-189.

Sabherwal, R., & Becerra-Fernandez, I. (2003). An empirical study of the effect of knowledge management processes at individual, group, and organizational levels. *Decision sciences, 34*(2), 225-260.

Scarbrough, H., Panourgias, N. S., & Nandhakumar, J. (2015). Developing a relational view of the organizing role of objects: A study of the innovation process in computer games. *Organization Studies, 36(*2), 197-220.

Schatzki, T. R. (2002). *The site of the social: A philosophical account of the constitution of social life and change*. Penn State Press.

Schmidt, S., & Brinks, V. (2017). Open creative labs: Spatial settings at the intersection of communities and organizations. *Creativity and Innovation Management, 26*(3), 291-299.

Star, S. (1988). The structure of ill-structured solutions: Boundary objects and heterogeneous distributed problem solving. In: San Mateo: Morgan Kaufman. *Strateginen kaupunkiseutu.*

Star, S. L. (2010). This is Not a Boundary Object: Reflections on the Origin of a Concept. Science *Technology & Human Values, 35*(5), 601-617.

Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, translations and boundary objects - Amateurs and professionals in Berkeley's museum of vertebrate zoology. *Social Studies of Science, 19*(3), 387-420.

Strambach, S., & Klement, B. (2012). Cumulative and combinatorial micro-dynamics of knowledge: The role of space and place in knowledge integration. *European Planning Studies, 20*(11), 1843-1866.

Susman, G. I., & Evered, R. D. (1978). Assessment of scientific merits of action research. *Administrative Science Quarterly, 23*(4), 582-603.

Swan, J., Bresnen, M., Newell, S., & Robertson, M. (2007). The object of knowledge: The role of objects in biomedical innovation. *Human Relations, 6*0(12), 1809-1837.

Swink, M. (2006). Building collaborative innovation capability. *Research-Technology Management, 49*(2), 37-47.

Tell, F., Berggren, C., Brusoni, S., & Van de Ven, A. (2017). *Managing knowledge integration across boundaries*. Oxford University Press.

Thompson, M. (2005). Structural and epistemic parameters in communities of practice. *Organization Science*, 16(2), 151-164.

Tortoriello, M., & Krackhardt, D. (2010). Activating cross-boundary knowledge: The role of Simmelian ties in the generation of innovations. *Academy of Management Journal, 53*(1), 167-181.

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

Tucci, C. L., Chesbrough, H., Piller, F., & West, J. (2016). When do firms undertake open, collaborative activities? Introduction to the special section on open innovation and open business models. *Industrial and Corporate Change, 25*(2), 283-288.

Usman, M., & Vanhaverbeke, W. (2017). How start-ups successfully organize and manage open innovation with large companies. *European Journal of Innovation Management, 20*(1), 171-186.

Van Maanen, J. (1988). *Tales of the field: on writing ethnography*. Chicago, IL: University of.

Venzin, M., Von Krogh, G., & Roos, J. (1998). Future research into knowledge management. *Knowing in firms: Understanding, managing and measuring knowledg*e, 26-66.

Vignoli, M., Mattarelli, E., & Mäkinen, S. J. (2018). Experimenting with innovation in creative spaces. *CERN IdeaSquare Journal of Experimental Innovation, 2*(1)., 1-2

Viki, T. (2016). Five reasons your boss was right to shut down your innovation lab. Forbes.

Vygotsky, L. S. (1978). *Mind in society.* Harvard University Press.

Wagner, E. L., Newell, S., & Piccoli, G. (2010). Understanding project survival in an ES environment: a sociomaterial practice perspective. *Journal of the Association for Information Systems, 11*(5), 276.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*: Cambridge University Press.

World Economic Forum. (2015). *Collaborative Innovation Transforming Business, Driving Growth*. Regional Agenda.

Yakura, E. K. (2002). Charting time: Timelines as temporal boundary objects. *Academy of Management Journal, 45*(5), 956-970.

Yin, R. (1984). Case study research. Beverly Hills. In: ca: Sage.

Yoo, T. (2017). Big corporates should just ditch innovation labs — because they don't work. *Business Insider.* Retrieved from https://www.businessinsider.com.au/big-corporates-should-just-ditch-innovation-labs-because-they-dont-work-2017-11

Yoo, Y., Boland Jr, R. J., & Lyytinen, K. (2006). From organization design to organization designing. *Organization Science, 17*(2), 215-229.

Yoon, E., & Hughes, S. (2016). Big companies should collaborate with startups. *Harvard Business Review*. Retrieved from https://hbr. org/2016/02/big-companies-shouldcollaborate-with-startups.

Zeiss, R., & Groenewegen, P. (2009). Engaging boundary objects in OMS and STS? Exploring the subtleties of layered engagement. *Organization, 16*(1), 81-100.

Cross-boundary knowledge work in innovation

Understanding the role of space and objects

This dissertation applies the perspective of sociomateriality to the study of cross-boundary knowledge work – work across organizational and social boundaries - in the context of collaborative innovation. Cross-boundary knowledge work is an important topic given the emergence of novel challenges that require collaboration across disciplines and organizations. To address the increasing need for cross-boundary knowledge work, this dissertation turns to the design of objects and spaces as a defining aspect of organizational life. The overarching goal is to understand what role spaces and objects (physical and digital) play within cross-boundary knowledge work.

The dissertation is structured into four papers. The four papers make important contributions to the fields of cross-boundary knowledge work, sociomateriality, and collaborative innovation. Each paper strives to provide an in-depth account of how individual objects, systems of objects, and spaces support knowledge work in diverse collaborative innovation contexts including business studios, corporate hackathons, and startup accelerators. In addition, innovation managers find relevant advice on how to leverage the built environment to enhance their practice.

MARTA CACCAMO is a doctoral candidate in Business Administration at Jönköping International Business School. Her research explores the design of spaces and objects within collaborative innovation settings. Marta's research work builds mainly on her practical experience as facilitator of diverse innovation program formats, and on her passion for entrepreneurship.

ISSN 1403-0470
ISBN 978-91-7914-005-2