Managing Digitalized Ecosystems – Perspectives on Identity, Diversity, and New Work Structures

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***Research paper 7: (Chapter 8)**

Görmar, L., Barwinski, R. W., Bouncken, R. B., Laudien, S. M. 2020. Co-Creation in Coworking Spaces: Boundary Conditions of Diversity. *Knowledge Management Research & Practice,* 19 (1), 53-64. Online at: https://www.tandfonline.com/14778238.2020.1740627

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Acknowledgements

The world is changing at a rapid pace. Globalization and digital technologies are changing how societies, organizations, and people function. Digital technologies enable firms to change their processes, products, services, and business models. While this trend enables collaborations within ecosystems that spread across the globe, it leaves people wondering how their personal ecosystems are affected by working with people from different cultures that they might have never met in person and struggle to define their personal ecosystem and realize their full potentials of performance and creativity. In these challenging times, I was lucky to find a place where I could benefit from both the openness to collaborate, work with scholars from all over the world, and find a home where I received help, guidance, support, counsel, and friendship. The Chair of Strategic Management and Organization at the University of Bayreuth truly has become my social community since joining in late 2017. It is my utmost concern to thank all the great people who have made and continue making the University of Bayreuth such a special place that I gladly call my second home.

Out of all the people who have made Bayreuth a special place, my deepest and sincere gratitude belongs to my supervisor and friend, Professor Dr. Ricarda Bouncken. By recruiting me and introducing me to the academic world, she helped me grow, develop, and become much more confident in my academic skills than I ever thought possible. She challenged me in many discussions, taught me to rethink and challenge my ideas, to be rigorous in my analysis, taught me academic stamina, enabled my participation in numerous academic conferences and trips all over the world, and finally gave me the opportunity to work on many outstanding research projects. Thank You! Furthermore, I would like to thank Professor Dr. Reinhard Meckl for acting as my second supervisor and reviewing my dissertation as well as Prof. Dr. Germelmann, who chaired my colloquium.

In this thesis I argue that while digital technologies, bring the world closer together, and also dissolve the previously clear structure of people and companies, community is becoming more and more important – especially in the times of Covid-19. I feel that the community at the chair was a pillar for my personal success - in terms of social and scientific support. I want to thank Angelika and Christine for managing our community, Viktor and Martin for their scientific support and discussions on all aspects of scientific life, Lars for showing me the ropes in scientific project management, Andreas for providing me with a lens into the practical side of my research topic, and all my colleagues and co-authors who are part of my community and contributed to many productive work hours and exhilarating discussions.

While the chair of Strategic Management and Organization has become my second home, I believe that it is my social environment that shaped my personality on my way to becoming the man I am today. Therefore, I want to thank my mother and father, who always gave me their unconditional support, raised me to become confident and independent to make my own way, and all my further family and friends who are the core of my community.

Abstract

Ecosystems are increasingly gaining in importance in both research and practice. Building on a wave of increasing digitalization and globalization, ecosystems are replacing traditional value chains. Firms are now focusing on a wide variety of partners and ways in which they can collectively create value for their customers. Ecosystems break down formerly existing barriers and create possibilities to integrate global partners to create innovative value propositions. This thesis introduces digitalized ecosystem as a phenomenon that creates an open and dynamic setting offering great potential for new and innovative value propositions and global business but simultaneously results in complex challenges for the firm management. Firms need to switch to operating in ecosystems, require managers with new skills to manage digital transformation and collaborations across borders, and manage the increasingly digital workforce.

Building on eight research articles, this thesis contributes to business research by (1) giving insights on how firms interact and strategically use ecosystems, (2) highlighting the firm-specific challenges of managing diversity and dynamics in digitalized ecosystems, and (3) giving perspectives on coworking spaces as local ecosystem hubs. The thesis is structured in three parts and covers the topics mentioned above at the ecosystem-level in part one and the firm-level in parts two and three. The first part includes one published research article and two conference articles that examine the characteristics of innovation ecosystems in the emerging 3D printing category, shows how a shared digital identity within the industry fuels open knowledge exchange, and introduces different collaboration strategies of ecosystem actors. Part two consists of two research articles investigating the managers' role in driving digital transformation and the complexity of managing an increasingly diverse workforce. Part three includes three published research articles covering coworking spaces as a new form to organize work in digitalized ecosystems. The research articles investigate the role of coworking spaces as an innovative setting for the digital workforce to generate innovations, co-create value, and empower its users.

This thesis shows that firms in increasingly open environments require some form of boundaries, which come at the ecosystem or category level. The findings point towards the need for dynamic managerial capabilities in dealing with the ongoing digital transformation. The thesis further highlights the need for further research on handling the increasing diversity in the workforce and within open-work structures.

Zusammenfassung

Ökosysteme gewinnen sowohl in der Forschung als auch in der Praxis zunehmend an Bedeutung. Aufbauend auf einer Welle der zunehmenden Digitalisierung und Globalisierung lösen Ökosysteme traditionelle Wertschöpfungsketten ab. Unternehmen konzentrieren sich nun auf eine Vielzahl von Partnern und Möglichkeiten, wie sie gemeinsam Werte für ihre Kunden schaffen können. Ökosysteme brechen dabei vormals bestehende Barrieren auf und schaffen Möglichkeiten globale Partner in die Entwicklung innovativer Angebote zu integrieren. In dieser Arbeit wird das digitalisierte Ökosystem als ein Phänomen diskutiert, das ein offenes und dynamisches Umfeld schafft, welches ein großes Potenzial für neue und innovative Angebote und globale Geschäfte bietet, aber gleichzeitig zu komplexen Herausforderungen für das Unternehmensmanagement führt. Unternehmen müssen sich auf offene Ökosysteme einstellen, benötigen Manager mit neuen Fähigkeiten, um die digitale Transformation und die Zusammenarbeit über Grenzen hinweg zu managen und die zunehmend digital arbeitende Belegschaft zu führen.

Aufbauend auf acht Forschungsbeiträgen leistet diese Arbeit einen Beitrag zur betriebswirtschaftlichen Forschung, indem sie (1) Einblicke in die Interaktion und strategische Nutzung von Ökosystemen gibt, (2) die firmenspezifischen Herausforderungen des Managements von Diversität und Dynamik in digitalisierten Ökosystemen aufzeigt und (3) Perspektiven für Coworking Spaces als lokale Ökosysteme aufzeigt. Die Arbeit ist in drei Teile gegliedert und behandelt die oben genannten Themen im ersten Teil auf der Ökosystem-Ebene und in den Teilen zwei und drei auf der Firmen-Ebene. Der erste Teil umfasst einen veröffentlichten Forschungsartikel und zwei Konferenzbeiträge, die die Charakteristika von Innovationsökosystemen in der Kategorie des 3D-Drucks untersuchen. Die Artikel zeigen wie eine gemeinsame digitale Identität innerhalb der Branche den offenen Wissensaustausch vorantreibt und erläutern unterschiedliche Kooperationsstrategien von Ökosystemakteuren. Teil zwei besteht aus zwei Forschungsartikeln, die die Rolle von Managern bei der Förderung der digitalen Transformation und die Komplexität des Managements einer zunehmend vielfältigen Belegschaft untersuchen. Teil drei umfasst drei veröffentlichte Forschungsartikel, die Coworking Spaces als neue Form der Arbeitsorganisation in digitalisierten Ökosystemen behandeln. Die Forschungsartikel untersuchen die Rolle von Coworking Spaces als innovatives Umfeld für die digital arbeitende Belegschaft, um Innovationen zu generieren, gemeinsam Werte zu schaffen und ihre Nutzer zu ermächtigen selbstständig zu arbeiten.

Diese Arbeit zeigt, dass Unternehmen in offenen Umgebungen eine Form von Grenzen benötigen, die auf der Ebene von Ökosystemen oder Kategorien liegen können. Die Ergebnisse weisen auf den Bedarf an dynamischen Managementfähigkeiten im Umgang mit der laufenden digitalen Transformation hin. Die Arbeit unterstreicht weiterhin den Bedarf an weiterer Forschung zum Umgang mit der zunehmenden Diversität in der Belegschaft und innerhalb offener Arbeitsstrukturen.

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Chapter 1: Introduction

1.1 Motivation and Research Context

Over the past century the traditional value chain has been the most dominant design of collaboration and was mainly focused on regional actors (Porter, 1985). Control over the value chain used to increase a firm's overall market power and allowed them to earn the benefits of economies of scale (Porter, 1985). The introduction of digital technologies and the increasing globalization has significantly changed this picture. Firms are now operating and creating value in a much more open and dynamic setting (Henfridsson et al., 2018), resulting in highly complex problems regarding their management and collaboration structures (Kapoor, 2018; Peppard & Rylander, 2006; Rong et al., 2010). These complex problems involve the demand for new skills in management and labor, increasing work and collaborations across borders (McWilliam et al., 2019), switching from a value chain to an ecosystem perspective (Bogers, Sims, & West, 2019; Denicolai, Magnani, & Vidal, 2020), and managing new forms of work organization (Bouncken & Reuschl, 2018).

Digital technologies are increasingly transforming the world we live in. Communities, organizations, personal and working environments are rapidly changing (Colbert, Yee, & George, 2016; Soluk & Kammerlander, 2021; Vial, 2019). This digital transformation of organizations, defined as the activities through which a company *"fundamentally transform[s] business strategies, business processes, firm capabilities, products and services, and key interfirm relationships in extended business networks"* with digital technologies (Bharadwaj et al., 2013, p. 471), has changed the way companies are organized and need to be managed (Pavlou & El Sawy, 2006; Pavlou & El Sawy, 2011; Karimi & Walter, 2016). Digital technologies require new skills and expertise to keep ahead of competition and keep customers with digital expectations satisfied (Verhoef et al., 2021; Vial, 2019). At the same time, managers may need new and dynamic managerial capabilities in order to keep up to date with the constant digital change (Helfat & Martin, 2015; Li et al., 2018). Dynamic capabilities (Teece, Pisano, & Shuen, 1997) at the firm and management level (Soluk & Kammerlander, 2021) might further be necessary to coordinate and manage the open ecosystem environment.

The ecosystem as new organizational form has started to gain significance among researchers (Adner, 2017; Adner & Kapoor, 2016; Jacobides, Cennamo, & Gawer, 2018) and practitioners (Atluri, Dietz, & Henke, 2017; Jacobides, Sundararajan, & Van Alstyne, 2019). The concept of

an ‘ecosystem’ describes collectives of heterogeneous, but complementary, actors who collectively generate an output at the ecosystem-level (Seppelt et al., 2011). This output extends beyond what any actor could produce individually (Adner, 2017; Autio et al., 2018; Järvi, 2018). Ecosystems are distinguished from other types of collectives (supply chains, networks) by their governance systems. Distinct from, e.g., conventional supply chains, ecosystems are not defined by contractual relationships alone (Jacobides et al., 2018). Ecosystems offer a route to include external partners in their innovation strategy (Adner, 2017; Bogers et al., 2017; Frishammar et al., 2019; West, 2014), and become part of globally operating innovation ecosystems (Nambisan, Zahra, & Luo, 2019; Li & Garnsey, 2014). This approach is getting increasingly important with platform-based business models increasing the modularization of work (Adner & Kapoor, 2016; Jacobides et al., 2018; Kenney & Zysman, 2016; Thomas & Autio, 2020). These changes are forcing firms to rethink the ways in which they do business and how they organize as they are no longer restricted by spatial boundaries (Kohli & Melville, 2019). Digital technologies allow for fast exchange of different forms of knowledge among dispersed locations around the world (Lyytinen, Yoo, & Boland Jr, 2016), opening up the potential for global collaborations (Manyika et al., 2016). While working in global ecosystems offers many advantages (Manyika et al., 2016), the current literature lacks information on how to best manage global ecosystems in connection with digital technologies. Further research has not considered how to best work on knowledge-based innovations if there is no special connection and therefor limited trust.

While digital technologies enable new business models (Matt, Hess, & Benlian, 2015), strategies (Bharadwaj et al., 2013; Nylén & Holmström, 2015; Vial, 2019), and global ecosystems (Manyika et al., 2016), they also come with numerous behavioral and organizational challenges for firms: Digital technologies and the internet have promoted the growth of the digital workforce (Colbert et al., 2016; Legner et al., 2017) and virtual work has become the new normal: Staff members work from dispersed locations and interact through their smart phones or other mobile devices (Fitzgerald et al., 2014; Raghuram et al., 2019). The current Covid-19 pandemic is amplifying this trend with increasing numbers of firms offering remote work and not planning to return to full on-site work structures once the pandemic is over (Kniffin et al., 2021; Wang et al., 2021). As Bouncken and Reuschl (2018) show, coworking spaces offer a solution to connect remote workers in a flexible and social environment, thereby creating the possibility for entrepreneurial ecosystems to arise (Spigel, 2015). Coworking spaces have the potential to become a valuable tool in the management of

digitalized ecosystems, as they offer flexible structures, a personal and professional ecosystem and network structures along with a community of coworkers (Reuschl & Bouncken, 2017). Coworking spaces are a phenomenon based on the digitalization and transformation of society. On the one hand current literature highlights how coworking spaces connect heterogenous individuals and organizations to form new teams, connect with peers and improve work performance (Bouncken & Aslam, 2019; Bouncken & Reuschl, 2018; Cabral & Winden, 2016; Parrino, 2015; Spinuzzi, 2012; Garrett, Spreitzer, & Bacevice, 2017, Vidaillet & Bousalham, 2020) generate a "sense of community" among coworkers (Blagoev, Costas, & Karreman, 2019; Bouncken et al., 2020; Castilho & Quandt, 2017; Garrett et al., 2017), and boost entrepreneurship, and creativity (Capdevila, 2014; King, 2017; Marchegiani & Arcese, 2018; Rese, Görmar, & Herbig, 2021; Rese, Kopplin, & Nielebock, 2020). On the other hand, research stays silent on other important factors: Can coworking function as individual ecosystems and facilitate the co-creation of value among users? What is the effect of the coworking space environment on the empowerment of the individual users? How can firms best facilitate the community and creative atmosphere to generate innovations?

This thesis aims to investigate the challenges of managing digitalized ecosystems. While ecosystems have received increasing scholarly attention, there remain many open research areas (Bogers et al., 2019). This thesis is divided into three major parts: The first part focusses on the ecosystem level to investigate how digital technologies affect firms operating in emerging innovation ecosystems. The second and third parts focus on the firm level to investigate firm specific challenges and opportunities arising from digitalized ecosystems. Part two does so by investigating how firms are affected by the turn to globalized digital ecosystems (Manyika et al., 2016) and which managerial capabilities are required to deal with the inherent dynamics and diversity. The third part investigates coworking spaces as local ecosystem hubs for innovation and empowerment that enhance productivity, empowerment, and innovation at the individual and firm level.

1.2 Thesis Structure and Results

This thesis consists of eight research articles that investigate the effects of digitalizing ecosystems on identity, diversity, and new work structures. Every research paper addresses its own research question. Together they provide a fundament to understand three major aspects of managing digitalized ecosystems in the modern business environment. The eight research articles consist of six journal publications and two conference papers and thus address

independent research questions with a separate research design. Figure 1.1 presents the structure of the overall thesis and provides an overview of the major findings of each article. Research papers one, two, and three explore the characteristics of innovation ecosystems in the emerging 3D printing category. They further focus on how a shared digital identity fuels open knowledge exchange in a global setting and which collaborative strategies firms apply. Applying a firm centric view, in part two, research papers four and five focus on managing the dynamics of digital transformation and a diverse workforce. Research papers six, seven, and eight investigate the role of coworking spaces. Research paper six refines our understanding of how ventures can make use of coworking spaces to foster innovation. Research paper seven focusses on coworking spaces as service ecosystems which provide the setting for value co-creation and research paper eight identifies how coworking spaces can influence work satisfaction and empower users to increase innovative and entrepreneurial performance.

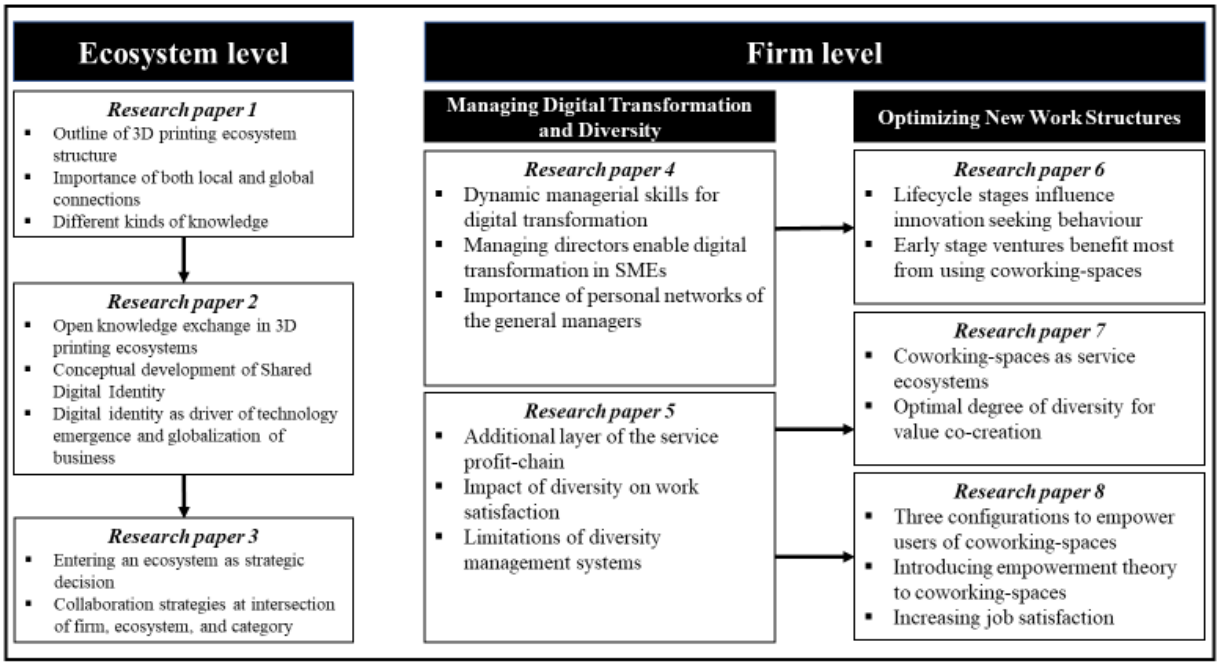

Figure 1. 1 Structure of this thesis

The first research article, "*Linkages in 3D Printing Ecosystems*", was presented at the *Portland international Conference on Management of Engineering and Technology* and published in the conference proceedings. This research paper explores 3D printing ecosystems, focusing on how the required knowledge to drive the emerging technology forward is created and exchanged. As the complexity of innovation processes increases, knowledge exchange between actors becomes increasingly important for learning and innovation (Powell, Koput, & Smith-Doerr, 1996), leading to the involvement of interconnected and heterogeneous groups of actors in the

innovation process (Corsaro, Cantù, & Tunisini, 2012), that can go beyond traditional clusters (Awate & Mudambi, 2018; Mudambi, 2008). This paper shows the importance of local and global connections in creating a common innovation and offers a first perspective on how different forms of knowledge are exchanged.

This research paper is authored by Ricarda Bouncken, Roman Barwinski, and Jochen Pampel. Roman Barwinski especially contributed to conducting the empirical analysis and systematizing the results.

The second research article, "*Shared Digital Identity and Rich Knowledge Ties in Global 3D Printing – A Drizzle in the Clouds?*", was published in the *Global Strategy Journal*. This paper builds on the first research paper and intensifies the investigation of knowledge exchanges in the 3D printing ecosystem. Building on a qualitative analysis and applying the innovative, flexible pattern matching approach (Bouncken et al., 2021a; Bouncken, Qiu, & García, 2021b), the paper challenges the current understanding that tacit knowledge is only shared in close proximity and in strong ties (Mudambi et al., 2018; Schotter et al., 2017). The study shows that in the nascent 3D printing industry, firms digitally exchange and share explicit and tacit knowledge globally, even in weak ties. The paper offers the new perspective of a shared digital identity conceptualized as collective self-concept(s) of an in-group towards the creation, emergence, application, and development of digital technology built on a sense of community, enthusiasm, being part of something special, as well as common values and norms. The study further specifies how the shared digital identity drives technology emergence and the globalization of business.

This research paper is authored by Ricarda Bouncken and Roman Barwinski. The authors contributed equally to all parts of the paper.

The third research article, "*Collaboration strategies of ecosystem actors in emerging categories*", was accepted for the *40th Strategic Management Society Annual Meeting 2020*. This article builds on insights from the first research article and dives deeper to investigate the collaborative aspects at the intersections of the firm-, ecosystem-, and category-level. Drawing on cultural entrepreneurship theory (Lounsbury & Glynn, 2019; Lounsbury, Gehman, & Ann Glynn, 2019), the article shows the entering of an ecosystem as a strategic decision and specifies

three distinctive strategies used by firms to establish themselves and the ecosystem within the category.

This research paper is authored by Ricarda Bouncken, Roman Barwinski, and Jeffrey Covin. The authors contributed equally to all parts of the paper.

The fourth research article "*GeschäftsführerInnen als Enabler digitaler Transformation in KMU"*, is currently under revision at *Zeitschrift für KMU und Entrepreneurship*. This research paper draws on the theory of dynamic managerial capabilities (Helfat & Martin, 2015) to explain how the managing directors of small firms are crucial to enable a digital transformation. While the digital transformation of big and mittelstand firms has received extensive scholarly attention (e.g., Soluk & Kammerlander, 2021; Verhoef et al., 2021), not much was known about the challenges to small firms. Based on qualitative interviews, the paper shows how general managers of small firms use their own social capital and network, renew their own managerial cognition, and develop organizational digitalization skills to go through a digital transformation. The study further introduces the idea that small firms with a focus on direct customer interaction do not have to undergo a total digital transformation, instead, they can use the interaction as a unique advantage.

This research paper is authored by Roman Barwinski, Ricarda Bouncken, and Lukas Henkelmann. The authors contributed equally to all parts of the paper. The paper is written in German and was translated to English for this thesis.

The fifth research article, "*Cross-cultural diversity management in service firms*", was published in *European Journal of International Management*. This article investigates the effects of increasing workforce diversity in service firms. The article builds on social identity theory (Ashforth & Mael, 1989; Tajfel & Turner, 1986) to investigate how increasing diversity in the workforce can lead to issues with individuals' job satisfaction. The article uses a modified version of the service-profit chain to analyze the relationship of diversity and work satisfaction quantitatively. We find that increasing diversity influences work satisfaction in the workforce and perceived hospital outcomes. The article adds an additional aspect to the model of the service-profit chain and shows that superficially implemented diversity management is not capable of effectively managing increasing diversity.

This research paper is authored by Ricarda Bouncken, Andreas Reuschl, Roman Barwinski, and Celine Viala. The core of the paper was written by Ricarda Bouncken and Andreas Reuschl. Roman Barwinski especially contributed to the revision and finalization of the paper. Celine Viala contributed to the finalization of the paper.

The sixth research article, "*Changing with the Time: New Ventures' Quest for Innovation.*", was published in the *Journal of Small Business Strategy*. This paper seeks to advance our understanding of how firms can utilize coworking spaces to improve their innovation search (Dahlander, O'Mahony, & Gann, 2016). The article draws on a qualitative study applying participative observation and qualitative interviews to show that firms have different angles to using coworking spaces. The paper shows that firms differ and can completely switch between their innovation search according to their lifecycle stage. The study explicitly shows that coworking spaces offer rich opportunities for social interactions, information exchange, and collaboration, leading to new ideas and business opportunities, especially for firms in their early stages.

T*his research paper is authored by Roman Barwinski, Yixin Qiu, Mahmood Aslam, and Thomas Clauss. Roman Barwinski crafted the basic structure of the paper. All authors contributed to the finalization of the paper.*

The seventh research article, "*Co-Creation in Coworking Spaces: Boundary Conditions of Diversity*", was published in *Knowledge Management Research & Practice*. This is the first of three research articles to focus on coworking spaces as a phenomenon driven by the digital transformation of society and organizations. This article builds on service management literature to introduce the idea of coworking spaces as service ecosystems (Vargo & Lusch, 2011; 2016), which can become a hub for value-cocreation (Vargo & Lusch, 2004). The qualitative analysis indicates that there is an optimal degree of diversity of coworking space users. The results show that while coworking spaces can be hubs for value co-creation, this only occurs when coworkers share the same work ethos and have a certain degree of diversity regarding their background and knowledge basis.

This research paper is authored by Lars Görmar, Roman Barwinski, Ricarda Bouncken, and Sven Laudien. Roman Barwinski especially contributed to the development of the theoretical background and discussion sections.

Finally, the eighth research article, "*Coworking Spaces: Empowerment for Entrepreneurship and Innovation in the Digital and Sharing Economy",* was published in the *Journal of Business Research.* The paper shifts the focus to the perspective of employees and coworking space users. The study applies a two-step mixed methods approach with an explorative qualitative approach setting the stage for a fuzzy set qualitative comparative analysis (Kallmuenzer et al., 2019; Woodside, 2014). The introduces empowerment theory (Spreitzer, 1995; Zhang & Begley, 2011; Matthews, 2003) to the coworking context. The results show how different configurations of coworking spaces can enable high work satisfaction and empower innovation and entrepreneurial performance.

This research paper is authored by Ricarda Bouncken, Martin Ratzmann, Roman Barwinski, and Sascha Kraus. Roman Barwinski crafted the basic structure of the paper. All authors contributed to the finalization of the paper.

A brief conclusion provides directions for further research on digitalized ecosystems, their management, legitimation practices, required capabilities for successful digital transformation, the phenomenon of coworking spaces, and potential impacts of the Covid-19 related changes to working environments

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Part 1: Digitalization in Innovation Ecosystems

Chapter 2: Linkages in 3D Printing Ecosystems

With Ricarda B. Bouncken and Jochen R. Pampel (2018).

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2.1 Abstract

3D printing technologies offer rich opportunities for product, service, and organizational innovation to firms in diverse sectors. Additionally, the 3D printing field includes diverse firms in sectors of manufacturing, services, software and design. Knowledge of 3D printing is dispersed among firms in the field. Innovation in the still emerging 3D printing field is strongly based upon the creation and exchange of knowledge among firms that work in business or knowledge ecosystems. While there is huge research about knowledge creation in firms and in dyad alliances, little is known about it in ecosystems. Our qualitative research explores the characteristics of ecosystems in 3D printing and focusses on how knowledge creation and exchange occur among firms in 3D printing ecosystems. We find that local and trans-local connections play an important role for knowledge exchange of two different key forms of knowledge in 3D printing: operational process knowledge and technology potential knowledge.

2.2 Introduction

Innovation strongly builds upon connections between organizations and their acting individuals allowing to share, combine and generate knowledge from diverse and dispersed sources (Mudambi, 2008; Awate & Mudambi, 2018; Turkina, Van Assche, & Kali, 2016). Studies on emerging technologies and industries argue that local connections in industry clusters drive innovation (Nooteboom, Van Haverbeke, Duysters, Gilsing, & van den Oord, 2007). The spatial proximity between actors opens opportunities for formal and informal exchanges (Cohen & Levinthal, 1990). Silicon Valley prominently shows that innovation around digital technologies can take strong advantage from agglomeration effects and proximity (Bresnahan, Gambardella, & Saxenian, 2001). Clusters assist innovation when the actors have different forms and degrees of proximity. For example, when geographic proximity occurs with cognitive distance that can lessen cognitive lock-ins while allowing learning out of diverse, but complementary, knowledge and technological fields (Boschma, 2005). However, clusters not

only provide benefits from proximity and agglomeration, but they also have inherent risks of unintended spill-overs and competition costs (Alcácer, 2006, Mudambi et al., 2018).

Firms in clusters are not limited to the use of local connections, they also reach out for more remote connections 'trans-local pipelines' complementing their knowledge sources, resources, and market potentials (Turkina et al., 2016 p., 1213; Dunning, 1988). These trans-local pipelines allow them to access internationally dispersed knowledge bases (Mudambi et al., 2018). Modern communication technologies make distance less relevant for knowledge sharing among firms (Bell & Zaheer, 2007). Mudambi (2008) presumes that information and communication technologies allow disaggregating the firm's business processes into finer slices. The question of local and trans-local linkages becomes particularly interesting for industries with strong use of digital technologies, developing into ecosystems (Adner, 2006). These ecosystems consist of a multilaterally set of partners who interact in order to create a focal value proposition (Adner, 2017). Digital technologies allow augmented digital transfers e.g. by video communication, virtual reality, digital prototypes, even digital products and technologies itself. However, trust-building and learning might be easier in direct personal exchanges. Therefore, our study aims to answer the following research question: What roles do proximity and trans-local connections play for knowledge exchange and innovation in highly digitalized ecosystems? Our study explores this question in the ecosystems of 3D printing.

In 3D printing, we find a complex structure of relationships between actors, which are more than bilateral and show critical interactions across these relationships. Therefore, we chose to apply an ecosystem approach which is best suited to study complex multilateral relationships focused on a common value creation (Adner, 2017). As typical for innovation ecosystems (Adner, 2006; Adner & Kapoor, 2010, 2016), the 3D printing field consists of different players who depend on the success of each other. In order to innovate, actors require fellow actors in their ecosystem to understand the requirements, share knowledge and push for innovations on all ends. For example, 3D printing is highly dependent on the printable material. As the number of printable materials is increasing so are the possibilities of using the technology (Rindfleisch et al., 2017). The different technological foci, but also the connections between actors change the typical linear and firm centered approach to innovation (Rindfleisch et al., 2017; Ben-Ner & Siemsen, 2017).

To address our research question, we use a two-step qualitative inductive research approach. We conduct 20 interviews with middle and upper managers of companies engaged in 3D

printing to generate a clear picture of the industry itself and also focus on connections and learning among industry players.

The findings of our study show that firms require dynamic inter-firm knowledge exchanges in order to cope with the high uncertainties and dynamics. These knowledge exchanges and learning processes among firms take advantage of proximity, especially of co-location to exchange and to develop explicit and implicit knowledge. In particular, we find local ad-hoc meetings between firms and co-located trans-versional teams between firms. Additionally, we identify trans-local pipelines using digitalized technology to transfer knowledge and temporary training and learning events by personnel transfer between partners. We further categorize two forms of knowledge, operational process knowledge, and technological potential knowledge which show different exchange directions, formal vs. informal forms and require different amounts of feedback. Finally, we show risks that are highest when both exchanges occur parallel.

2.3 Conceptual Background

Diverse and dispersed sources of knowledge are a key source for innovations in organizations as their individuals interact, share, combine and generate new knowledge (Mudambi, 2008; Awate & Mudambi, 2018). From a Schumpeterian view, innovation is defined as the implementation of new combinations or the combination of factors in a novel way (Schumpeter, 1942). It includes the creation of advanced or novel products, processes or services which are new and desirable to the market (Cepeda-Carrión et al., 2012; Van de Ven, 1986; Woodside & Biemans, 2005). Porter and Stern (1999) define innovation as the transformation of knowledge into new products, processes, and services. As the complexity of the innovation process continues to increase, knowledge exchange between actors has become a prerequisite for learning and innovation (Powell et al., 1996). Corsaro et al. (2012) show that innovation activities become increasingly interconnected involving heterogenous groups of inputs and actors. Innovation ecosystems capture the idea that innovations are often not only dependent upon one single firm but on a whole group of actors who are directly and indirectly influencing or prohibiting the success of an innovation (Adner & Kapoor, 2010). Innovation ecosystems consist of different players who depend on the success of each other, often one innovation does not function without a proceeding technology which lays the groundwork (Adner, 2006). Innovation ecosystems enable the creation and capture of value from new and complex value propositions (Dattée et al., 2018).

While related to the innovation and ecosystem literature the current study pursues a different approach by examining the effects of proximity as well as trans-local connections on knowledge exchange and innovation in highly digitalized ecosystems.

2.3.1 *Innovation ecosystems and actor location*

Most innovation ecosystems exist in clusters of local proximity. This is due to the fact, that local connections within industry clusters are known to drive innovation (Nooteboom et al., 2007). Porter, 1990) first highlighted the competitive advantage of firms acting at the regional level. As knowledge interactions are not limited to the firm, innovation does not only happen within the boundaries of a firm but also with diverse actors outside its boundaries and is facilitated by geographical and other proximities (Gilly & Torre, 2000; Boschma, 2005), they take place by collaborating with other firms, research organizations or universities. The basic idea of clusters is that close proximity between actors enables formal and informal exchanges and as such fast and flexible knowledge sharing (Cohen & Levinthal, 1990), thereby enhancing innovation at the local level. Accordingly, the literature on innovation ecosystems enhances the idea of fostering growth and interaction around knowledge hubs (Engel & del-Palacio, 2011). Bresnahan et al. (2001) give Silicon Valley as an example of the benefits of proximity regarding innovations around digital technologies.

Although knowledge flows are not limited to geographic proximity (Moodysson, 2008; Fitjar, Huber, & Rodríguez-Pose, 2016) the region is often viewed as a very important area for knowledge exchange (Malmberg, 1996; Asheim & Gertler, 2005). The possibility of firms sourcing local knowledge depends on the available regional knowledge base, therefore firms are often located in specialized clusters such as the Silicon Valley. Grillitsch, Martin, & Srholec, 2017) show that a balanced knowledge base at close proximity fosters innovation. Clusters and close proximity do not only provide benefits to a firm, besides all positive effects proximity always goes hand in hand with high competition costs and the risk of unintended knowledge spill-over to competitors (Alcácer, 2006, Mudambi et al., 2018). A recent study by Maskell and Lorenzen (2004) has shown, that geographical proximity does not guarantee knowledge exchange and spill-over effects.

As actors access knowledge across organizational boundaries, they increasingly use digital technologies, which improve communication to remote locations. Bell and Zaheer (2007) show, that digital technologies make distance less relevant for the exchange of knowledge among firms. They also find that personal relationships and friendships play an important role for the

success of knowledge exchange over long distances. In addition to this a study by Sturgeon, Van Biesebroeck, and Gereffi (2008) shows, that firms set up formal ties with firms outside their local cluster to join the global innovation system. These firms establish partnerships to access knowledge that is not available at the local cluster (Bathelt, Malmberg, & Maskell, 2004). The success of a firm, therefore, depends not only on its local cluster but also the management of trans-local knowledge sources (Lorenzen & Mudambi, 2012). These trans-local connections become increasingly interesting because of the depth of digital technologies which improve communication and enable a constant flow of information.

Innovation ecosystems, where actors are dependent on the development of other innovations in order to generate a common value proposition, face challenges when working with actors at close proximity as well as in remote locations. Although firms are able to tap into various knowledge sources, they need to be aware of certain differences, as geographical distance also has challenges for knowledge exchange at the firm level (Bell & Zaheer, 2007). Currently, the effects of proximity and trans-local connections on knowledge exchange and innovation in highly digitalized ecosystems have not been studied. The high degree of digitalization within an ecosystem allows for the actors to become more remote as we find in the additive manufacturing industry. Different technological foci and connections between actors change the approach to innovation (Rindfleisch et al., 2017; Ben-Ner & Siemsen, 2017). This underlines the importance of better understanding the local and trans-local knowledge exchanges for innovation in highly digitalized 3D printing ecosystems.

2.3.2 *3D Printing*

The additive manufacturing field consists of different players who depend on the success of each other. Innovation typically does not function without a preceding technology. Additive manufacturing, often referred to as 3D printing, centers on technologies of layering of thin slices of material in an additive process (Weller et al., 2015). The layering can use a wide and increasing set of materials. The 3D printing technology transfers digital designs into physical goods (Rindfleisch et al., 2017). Even analog objects can be scanned or designed digitally and then be improved or changed digitally before being printed. The 3D printing ecosystems consist of manufacturers of 3D printing devices (e.g. for 3D printing using plastic, metal, proteins), industrial clients (e.g. for rapid prototyping, rapid tooling, and digital manufacturing) suppliers of materials, software developers, scientists and labs, designers of the printed objects, and end-customers (Berman, 2012). Products can be printed at any location in the world by a 3D printer

with the required specifications, giving a lot of flexibility to printing firms (Bogue, 2013; Kietzmann et al., 2015; Rayna & Striukova, 2016). On the contrary, 3D printing is highly dependent on the print material. Not all materials qualify for printing or depend on specific printers. As the number of printable materials is increasing, so are the possibilities of using technology (Rindfleisch et al., 2017). The software to design 3D printable designs is increasingly important in the emergence of 3D printing because the creation and modification of design require in-depth technical knowledge of CAD programs, usually limited to experts (Rindfleisch et al., 2017). The progress in the surrounding ecosystem has a major influence on technology acceptance and thereby substitution of old technology in general and particularly in the 3D printing field where different technologies emerge and are related to different different actors (Adner & Kapoor, 2016). The 3D printing ecosystem continuously gains importance as costs are decreasing, material variety is growing, and the requirement for professional skills is decreasing. The new technology offers huge potentials for cost reductions in production and logistics and also in transferring new product concepts into real objects (Lipson & Kurman, 2013). 3D printing may change business models, value chains and supply chains (Rayna & Striukova, 2016; Piller, Weller, & Kleer, 2015; Teece & Linden, 2017). Shane (2000) shows that different information and experiences of firms influence the seizing of 3D printing opportunities.

2.4 Methodology

The emerging field of geographical location within ecosystems and its effects on knowledge exchange and innovation is at an early stage in management research. Due to this newness of the field, we decided to apply an inductive qualitative research approach (Yin, 2014). A qualitative-empirical research approach is well suited to explore rather new research fields, as it enables the researcher to uncover causalities and allows for contextualization and helps to communicate theory (Welch, Piekkari, Plakoyiannaki, & Paavilainen-Mäntymäki, 2011). We chose a two-step research approach starting with open interviews with managers of companies applying 3D printing. The aim of this first step was to generate a general understanding and leave room for the research design to evolve while being well acquainted with the problem but not being committed to a certain study plan (Stake, 1981). This first approach enabled us to continuously reduce the breadth of our enquiry and concentrate on emerging topics (Parlett & Hamilton, 1972). The Information gathered during this first round of open interviews was enriched by secondary data collected prior to the interviews. In an iterative process of comparison and analysis, two key topics emerged, which were then explored more deeply in

the second step of the research process. For the second step, we chose semi-structured interviews on the prioritized topics which are likely to provide valuable theoretical insights (Eisenhardt & Graebner, 2007), gather in-depth data (Anteby et al., 2015; Yin, 2014). The organizational aspects of collaboration and knowledge exchange in highly digitalized ecosystems are a relatively new phenomenon which has not yet been thoroughly studied. As there is already literature on innovation ecosystems, our aim is to advance from existing knowledge and theory to better understand the specifics of the phenomenon instead of developing completely new theory. Therefore, we decided to use systematic combining (Dubois & Gadde, 2002), which focusses on theory development, instead of grounded theory (Glaser, 1992; Glaser & Strauss, 2009), which focusses on data collection and theory discovery without considering prior research (Eisenhardt & Graebner, 2007; Langley, 1999). Systematic combining is characterized by the matching of empirical data with literature (Dubois & Gadde, 2002) and allows for the integration of existing literature with new insights drawn from empirical data. Systematic combining is applied by various studies in a novel setting (Edvardsson et al., 2008; Harryson et al., 2008), we, therefore, are confident, that this approach is sufficient for our research goal.

2.4.1 *Sampling Strategy*

To address our research question in a first step we used a sample of companies involved in 3D printing. The companies were considered to be suitable when the companies were either fully involved and built their complete business model on 3D printing or were still at an early stage and started additive manufacturing while maintaining alternative revenue streams. We purposefully sampled these companies to generate a sample that represented different cases of 3D printing use and depth to cover our areas of theoretical interest (Seawright & Gerring, 2008). Once collaboration and knowledge exchange in the ecosystem emerged as our central research topic, we selected companies that pursued different approaches in this regard. Assuming that collaboration and knowledge exchange in ecosystems would vary regarding size and number of partners as well as the location of these partners, we included diverse and heterogenous firms in our sample.

2.4.2 *Data collection*

We started the first step of our data collection process by gathering archival material and conducting open interviews with middle and upper managers of companies using or offering products and/or services related to 3D printing. The aim of these interviews was to generate a

general understanding of the industry, its opportunities, challenges, and involved players. 6 interviews were carried out at different locations in Europe between June and November 2017. Two interviewers conducted interviews (average: 60 minutes duration). Interviews were carefully transcribed and sent to the interviewees for approval. The primary data was supplemented by secondary data about the firms. The data was analyzed independently by the two researchers. In an iterative process of comparison and analysis, two new key topics emerged that we explored more deeply in the following step.

Table 2. 1 Interview partners

Interview	Industry	Position	Employees
R1	Additive Manufacturing Services	Technology Manager	17
R2	Construction Office	Engineer	1
R3	Instrumentation/Control Engineering	CEO	5
R4	Aviation	Project Manager R&D	45.000
R5	Manufacturer of Access control and time recording devices	CEO	4
R6	Design and 3D Print	CEO	3
R7	3D Printer Manufacturer	Head of Marketing	300
R8	3D Printer Manufacturer	CEO	11-50
R9	Manufacturer of Laser Systems	Sales Manager	90
R10	Manufacturer of Cutting Machine tools	Product Manager 3D	7.236
R11	Manufacturer of Metals & Ceramics	Marketing Manager	2.600
R12	Full-Service Additive Manufacturing	VP Marketing	2.400
R13	Additive Manufacturing Methods	Sales Manager	200
R14	Additive Manufacturing Service	CEO	30
R15	Logistics	Head of Innovations	72.000
R16	R&D	Network Manager	1.000
R17	Software Development	CEO	10
R18	3D Printer Manufacturer	CTO	41
R19	Additive Manufacturing Services	Engineer	80
R20	3D Printer Manufacturer	CEO	11-50

The topics of collaboration and knowledge exchanges among local and trans-local partners in the ecosystem emerged as core topics of our study. In the second step of our research process, we explored these topics more deeply by developing an interview guideline specifically for the topic of collaboration and knowledge exchanges among local and trans-local partners in the ecosystem.

Our main data source are 20 semi-structured interviews within 6 ecosystems. We started by interviewing one key-informant for each ecosystem building on archival data to identify the person to interview first. From then on, we used a snowballing technique to identify informants

within the ecosystem who could provide information and talk about collaboration and knowledge exchange with different partners in the ecosystem. To make sure informants were suitable and we covered many different perspectives, our sample of interviewees consists of different hierarchical levels and functional positions. Our sample consists of a total of 20 interviews representing the ecosystems main actors. After 20 interviews we had reached a point of saturation, where any further interview did not generate a significant amount of additional information (Eisenhardt, 1989b). The 20 interviews were carried out between December 2017 and February 2018. A description of our sample is shown in Table 2. 1.

2.4.3 *Analysis*

Our analysis progressed from a content analysis of the first 6 open interviews which resulted in two main topics of collaboration and knowledge exchanges among local and trans-local partners in the ecosystem, which we explored more

deeply in the proceeding 20 semi-structured interviews using an interview guideline. Our main data analysis of the 20 interviews is based on a two-step coding process suggested by Gioia et al. (2012), in which we synthesized interview data with archival data which was triangulated to increase the trustworthiness of our findings (Fusch & Ness, 2015). We first used an open coding technique (Charmaz, 2014), we coded each sentence marking interesting passages within the empirical data to capture ideas or concepts using *"in-vivo"* coding. We tried to stay as close to the informants' words as possible, if necessary summarizing informant phrases in a descriptive fashion (Strauss & Corbin, 1998b; Van Maanen, 1979b). The interview transcripts were coded independently, and we met on a regular basis to discuss our coding so that we reached a common set of codes. This process ensured that the data was interpreted in the same fashion and no relevant information was missed. The initial codes showed differences in length ranging from full sentences to only a couple of words. Through coding meetings and discussions to resolve emerging issues in the data we arrived at a final set of codes with sufficient relevance for our research topic.

Table 2. 2 Coding table

Exemplary Quote	1st order concept	2nd order theme	Aggregate dimension
"Often the customer tells us what he wants exactly for a customer and then we develop it" (R11)	Technology/innovation pull	Vertical connections	Ecosystem links

"Actors who also play along are, of course, design offices, which might enter between customers and us as a service provider." (R1)	Involvement of new actors		
"Pre-development try to arouse interest in programs." (R4)	Technology push		
"here are a lot of competitors at the table Siemens and the Deutsche Bahn are in parts competitors when it comes to applying for maintenance of trains." (R15)	Companies engage in research with competitors	Horizontal connections	
"At the moment these are all more pioneers who work together what want to enforce the idea. (…) everyone is aware that if they do not take care of certain topics together, the progress will be slow" (R15)	Focus on the greater good		
"Our research and development team is still relatively small, but of course, they then work in research teams together with the external partners" (R13)	Collaborative research		
"Making contacts with other people who are not necessarily in 3D printing and exploring whether there are opportunities for new development, which can be adapted with a filament or otherwise with 3D printing."(R20)	Evaluating distant business opportunities	Lateral connections	
"The network is very good, because there are all sorts of partners and potential partners, which might be needed for all sorts of 3D printing applications." (R15)	Consideration of all players even without current necessity		
Exemplary Quote	**1st order concept**	**2nd order theme**	**Aggregate dimension**
"We do not have to hold the whole available technology as that is an extreme dynamic range. It changes every year, with new developments coming to market" (R19)	Uncertain technological developments	Changing technology	Changes
"We always have to adapt or we switch to another software" (R6)	Evolutionary change versus revolutionary change		
"We do not know how the technology will develop, what sort of machines will exist, what happens on the powder box and and and ..." (R14)	Actors seeking information on technology developments		
"I believe, none of us sitting here at the table knows what the market will look like in two or three years." (R14)	Unclear market development	Changing market	
"I think the general challenge is that the market is growing very fast." (R7)	The rapid market size increase		
"More materials, faster machines, more automation, etc., this young technology is demanding a lot from the market, where it is probably difficult to keep pace with all developments because the developments are much more complicated than expected." (R14)	Technologies demand a lot from the markets		
"if you only see it from the point of procurement, there is the possibility that you want to order somewhere and suddenly the supplying company doesn't exist anymore. … It may well be that a supplier or manufacturer goes bankrupt and you have to order elsewhere."(R2)	High fluctuation of players due to different reasons	Changing actors	

“There are always new collaborations, corporations, and mergers between different market players and also new competitors” (R11)	New mergers and collaborations, new competition arises		
Exemplary Quote	**1st order concept**	**2nd order theme**	**Aggregate dimension**
„Research-projects with different partners. To test new materials and their usability for the market“ (R12)	Explorative nature	Business critical	technology potential knowledge
„We need to always develop, qualify new materials which help our customers (...) improve our offering and competences“ (R13)	Basis for new business models		
„When we are looking for partners, we are looking for complementary competencies“ (R16)	Complementarity between actors	Complex knowledge	
„The partner always needs to know the current standing, we need a very close communication“ (R12)	Open communication		
“Then a team is formed by the project partner and they then meet regularly in meetings to exchange ideas” (R1)	Interorganizational team formation		
“Telephone conferences and Skype are used (when not meeting in person).” (R1)	Diverse methods of communication		
“We then deliver the machines and software plus all the training and we do it all the time we always support the customer because they also have to learn” (R20)	Instructional	Operational knowledge	Operational process knowledge
“We also offer training for our software. So, for example, our 3D express software, you have to do a week of training to understand it” (R12)	Improving capabilities		
“Training is an important point because we can pass on our knowledge within a short time” (R12)	One directional information flow	Process improvement	
“There are all these problems, we learn how to prevent them, they describe and you can learn so much there” (R7)	Incremental innovations		
Exemplary Quote	**1st order concept**	**2nd order theme**	**Aggregate dimension**
“The partner gets in touch with us and says: I need help from your application engineers because that's very technical and I do not have the technical know-how. The application engineer comes to him and helps the partner to define and declinate the technical requirements in order to be supported by our side” (R12)	Ad-hoc meetings	Close proximity	Location characteristics
“There is also this transversal group (…), which deals with the basics and the process chain” (R3)	Trans-versional groups		
“We offer a complete package, yes, the customer has the full support, because we also give him some kind of the whole service and we help the customer also” (R5)	Knowledge provision	Long distance	
„There wasn’t any (regional aspect). We have partners in the UK that are looking at components and doing all kinds of studies and testing …We have either e-mail or telephone conferences“ (R18)	Sourcing global competencies with digital technologies		
“…(sales manager) tours all the customers(in one region and they) are being trained. Training is an important point because they say again, they can pass on their knowledge within a short time” (R20)	Planned & scheduled training		

In the next step, we started to group the codes into first order concepts according to basic concepts emerging from the data. Next, we scanned the concepts for similarities and differences using axial coding in order to condense these into second order themes. Based on these second order themes we started analyzing the archival data and conducted a literature analysis going back and forth between the literature and emergent theory, thereby supporting confidence in our findings [59]. In the final step, we used selective coding to aggregate the second order themes to final dimensions.

2.5 Results

The results of the coding process are displayed in table 2. We decided to separate the table for the different findings, improving readability.

2.5.1 *Diverse links between actors in the ecosystem*

Our results point to the insight that companies involved with 3D printing are acting in an ecosystem with varying links between involved players. We find a high number of vertical connections. R1 informed us that while their customers were a valuable source for input regarding product developments, they also saw tendencies of a growing vertical chain: *"Actors who also play along are, of course, design offices, which might enter between customers and us as a service provider"*. R4 gave further proof of vertical connections describing a technology push "Predevelopment try to arouse interest in programs.". We further found many hints for horizontal connections between competitors who engaged in collaborative research: R15: *"At the moment these are all more like pioneers who work together and want to enforce the idea. (…) everyone is aware that if they do not take care of certain topics together, the progress will be slow"*. R13 stated: *"Our research and development team is still relatively small, but of course, they then work in research teams together with the external partners"*. Additional to the direct vertical and horizontal links between actors within the ecosystem wo found proof for a trend towards more lateral and distant connections in order to evaluate new business opportunities. These connections were not as established as the direct ones and R20 stated that *"making contacts with other people who are not necessarily in 3D printing and exploring whether there are opportunities for new development, which can be adapted with a filament or otherwise with 3D printing"*. This shows the active development of opportunities and the ecosystem.

The 3D printing ecosystem consists of a rich variety of connections, collaborations, and networks with the purpose of research and the bundling of competences and resources to push 3D printing in general. Partners form contracts (Interviews R7, R9, R13, and R15) but also base their collaboration on trust and the willingness to share knowledge and team up with partners to form a strong front to establish 3D printing as a valid industrial production technology. We learned this from many different interviewees, for example, R10*: "if we all individually work on these topics, (...), then it will take a very long time. So, I can imagine that you are so (.) Although you may work in different industries, there is a higher level of collaboration and partnership. (.)between machine designer, end customer, OEM, Tier-one supplier"*, or R14: *"So if one party in a cooperation just tries to take and give nothing, then the cooperation is quickly over. you have to look for partners with a realistic expectation to create a win-win situation for both".*

R15 was very clear about this: *"I can only state that the companies are exchanging massive amounts of information and perhaps one could imagine that the companies approach the matter quite selfishly. But no, it's just the opposite, information is openly shared, maybe not in detail, or the exact concept, but it's exchanged a lot between companies. That's what our network is all about. There are presentations by Airbus, who print aircraft parts themselves with own machines, 3D printers, responsible people, they are also present in person in the network and answer questions. Exactly that is the strength to also exchange with other companies and then to consider whether this is interesting for your own company. These collaborations are not necessarily at the project level, but also at the "exchange level".*

Research is often driven and funded by labs, universities, and governmental institutions who see the potential of 3D printing and want to push research and development, and later making the knowledge public to enable all companies to participate in 3D printing (R16). 3D printing is in a situation where not the printers, but the printable materials and the design possibilities are driving the change and development of the market (R17). Approval by government institutions as for protein printing or in the medical sector, in general, is very time-consuming and complicates the standard approach. Materials are often the limitation. R4 told us: *"Simply because every time in 3D printing a new material with a new microstructure is created. This means that the effort to generate and qualify new materials and to certify them is very high. So you will try to limit this to a few materials"*. Contrary to this R13 stated *"We just keep on developing, qualifying new materials that will then help our end users (.) Precisely, just to expand our offer, our expertise".*

These last two statements by R4 and R 13 show a very different approach regarding the challenges and opportunities coming from uncertainty and change.

2.5.2 *Changes, uncertainty and high dynamics*

Secondly, our results further show that firms involved in 3D printing are facing multi-facetted changes. Our data shows that actors within the ecosystem are in constant need of technology and market information, see R19: *"We do not have to hold the whole available technology as that is an extreme dynamic range. It changes every year, with new developments coming to market"*. The constant technological developments lead to new products, markets, and business models. The described high technologic and high market uncertainties and dynamics bring opportunities but also necessities to work with new and changing actors. Companies react quickly to new developments and players entering or leaving the market as R6 informed us *"We always have to adapt, or we switch to another software. Or we take another printer, or we can improve that with the manufacturer(…)all the companies that supply us with printers or material are also new companies(…) they also have their starting difficulties and that's often a chain reaction"*. R2 also shared information on this *topic "if you only see it from the point of procurement, there is the possibility that you want to order somewhere and suddenly the supplying company doesn't exist anymore. (…) It may well be that a supplier or manufacturer goes bankrupt and you have to order elsewhere"*. Interviewees R11, R14 and R7 told us the following regarding market uncertainty, clearly stating, that change is daily business in the 3D printing ecosystem:

R11: *"Of course, we also notice that the market is changing very fast. There are always new collaborations, corporations, and mergers between different market players and also new competitors. And of course, we have to make sure that we are always there when things happen and keep an eye on the market"*.

R14: *"We are in a market segment that is just starting to grow. And I believe, none of us sitting here at the table knows what the market will look like in two or three years. We do not know how the technology will develop, what sort of machines will exist, what happens on the powder box and and and (...)"*.

R7: *"I think the general challenge is that the market is growing very fast (.) and is very, very, very close and very demanding. More materials, faster machines, more automation, etc., this young technology is demanding a lot from the market, where it is probably difficult to keep*

pace with all developments because the developments are much more complicated than expected."

Firms are taking even more different roles in the industry and searching for more technological possibilities and business models. As technologies in the area of 3D printing change frequently there is a continuing demand for information among many players involved (in the ecosystem). This information demand is increasingly covered by digital platforms such as video platforms or online forums. Recently suppliers provide current and potential customers with information regarding printers, materials and design possibilities on internet platforms.

R5: *"You first buy the device, are happy that you have it and then find that the parts that come out at the end are rubbish. Until you research the mistakes you made on the Internet. I mean, thanks to google, you can get information on almost everything out these days. Video Platform Youtube is a very large knowledge library in the area of 3D printing. All these problems are described, and you can learn so much".*

R6: *"That's just for all printers. There are enough printer problems that can be found on the internet and also their solutions. There are many people who have printers and then have problems. This is something you already find ... That's a community, a network - or 3D printing scene. People are already exchanging ideas about materials, what is cool and what printers are good, etc."*

2.5.3 *Global and local aspects*

Our results further show that both local as well as global aspects play an important role for actors involved in a 3D printing ecosystem. We found that companies' knowledge exchanges in the ecosystem consist of many local but also trans-local connections. We find that firms collaborating in close proximity benefit from the possibility of ad-hoc meetings, built trans-versional groups while geographical distance leads to the sourcing of specific competences using digital technologies. We also find the use of planned and scheduled meetings between actors with geographic distance.

3D printing is a fairly new technology that requires constant learning but also ad-hoc learning between firms. Incumbent firms often maintain their traditional businesses and many employees do not have 3D printing expertise. R3: *"what was learned over decades and understood by all now must be slowly understood for the 3D printing and make its way into the heads".* Players in the 3D printing ecosystem know about internal and external knowledge and technology deficits. Once problems occur actors search for solutions internally and by ad-hoc

contacting other firms in the ecosystem. R12 told us the following: *"The partner gets in touch with us and says: I need help from your application engineers because that's very technical and I do not have the technical know-how. The application engineer comes to him and helps the partner to define and declinate the technical requirements in order to be supported by our side".* Different players develop different technologies. Standards or a dominant design for printers, materials or software have not emerged, so questions often emerge suddenly and require ad-hoc solutions in the firm or supported by partners.

Older employees, who are often stuck with the ideas of former production processes have difficulties adapting to 3D printing. Customers can be hesitant, R2 *"The customer is so far apart from understanding the technology itself that he cannot identify with it. That may be a conflict. He wants to have tooling from the 1990s."* To conquer these challenges R15 has built up a "consulting area and also a kind of training and development area". The transfer of knowledge appears as a key topic for many actors involved in the 3D printing industry. The ecosystem uses strong knowledge exchanges on an ad-hoc basis but also by trans-versional groups (e.g. of engineers, designers, builders). R3 informed us, that *"There is also this transversal group (…), which deals with the basics and the process chain"*. The trans-versional groups work on merging diverse and sticky knowledge. These groups also require a sense of community. R10: *"community guides for the construction of additive, additively manufactured parts, building a knowledge pool".*

We find that ecosystems and networks are often local/regional in nature but remain open for international partners with specific knowledge. R18 told us that they search for specific expertise not only for regional partners and *"have partners in the UK (…) doing all kinds of studies and testing"*, that they are looking for competences in their partners independent of the location. Our interviews suggest that trans-local learning occurs through digitally supported technology transfer and by temporary co-location. In the latter case, teams travel for training and learning events to the other firm site. R7 told us that they mainly use emails and Skype in their communication with overseas partners, but also mentions that one of their supplier's sales managers from the United States visits them on a regular basis in Germany. He then *"tours all the customers"* in Europe where customers *"are being trained. Training is an important point because they say again, they can pass on their knowledge within a short time".* R7 further stated that he recently attended a seminar with people from several different countries to learn, brainstorm, and to be trained. We find temporary co-location especially for time-sensitive matters and when complex know-how requires extensive training. Our interviews clearly show

that remote forms of communication are not sufficient and cannot replace face-to-face meetings. Co-location offers the possibility to build a common mind-set and trust in collaborations (R8).

2.5.4 *Different characteristics of knowledge*

Our results show differences regarding the knowledge exchanged between actors within the ecosystems. We find two different categories of knowledge exchanges, both on the local and on the trans-local dimension. One centers on the learning of operational processes, particularly how to operate a 3D printer. The manufacturer and users of 3D printers improve the diffusion of the technology and the processes in rapid prototyping, digital products and services as R20 describes: *"we then deliver the machines and software plus all the training and we do it all the time we always support the customer because they also have to learn"* R12 also told us the following: *"we also offer training for our software. So, for example, our 3D express software, you have to do a week of training to understand it"*. More training allows better and faster use of the printers and software and to try out new solutions. We refer to this as operational process learning. The other category of knowledge exchange centers on understanding and developing technology opportunities. The knowledge exchanges ease the understanding and further development of what a specific product/technology can/might do and how this allows developing new technological potential of products. New materials might lead to new products. We find both forms among co-located actors and in trans-local pipelines. The operational process learning might be assisted by digital exchanges (videos etc.) as stated by R5 and R6 but seems best achieved in planned but temporary direct personal exchanges such as visits and training events as stated early by R7. R1 also informed us about their process of working on new products and technologies with their partners: when the project starts to become interesting *"then a team is formed by the project partner and they then meet regularly in meetings to exchange ideas"* in order to establish frequent communication *"telephone conferences and Skype"* are used. The operational process learning might include feedback slopes for process improvement but is mainly one directional. Instead, the technology potential learning is strongly feedback orientated. It is an interdisciplinary collective learning process which requires alternating slopes of direct personal and medial communication. The exchanges are more random, spontaneous and flexible and thus occur primarily among firms in proximity.

2.6 Discussion

For this study, we applied a firm perspective to understand how proximity and trans-local connections affect knowledge exchange and innovation in highly digitalized ecosystems. Based on the coded interviews and our findings we characterized two types of knowledge which are shared between partners in the ecosystem: Operational process knowledge, which is focused on the operation of 3D printers and incremental improvement of the process versus technology potential knowledge, knowledge, which centers on the understanding of technology driven opportunities. This difference in knowledge characteristics has implications on how knowledge is exchanged in close proximity and over trans-local connections. Table 2. 3 gives a comparison of the two knowledge types. Operational process knowledge has some relations with exploitative learning while technology potential knowledge is more exploratory. Yet, business models might relate to both, reducing the gap between exploration and exploitation. Technology potential learning can cover depth and scope, it might include actors that not only search for technology development but at the same time lay down the fundament for new business models. Operational process learning might need only planned and temporary co-location, but technology potential learning needs multiple direct feed-back orientated learning. Trans-versional, even temporary teams are needed to develop the technology and the business models which both can be very closely related. Learning within these teams benefits from a sense of community. Learning about technological potentials needs co-located teams with individuals from different firms and different knowledge domains. High risks exist when both learning forms occur with the same partners and in proximity.

Table 2. 3 Knowledge characteristics

Characteristics	Operational Process Knowledge	Technology Potential Knowledge
Aim	How to operate 3D-printers	Understanding & developing technological solutions
	Exchange new solutions	Increase technology potential of new products
	Improve capabilities	Open idea exchange
Exchange direction	One directional	Multi-directional & interdisciplinary
Communication	Mainly digital	Regular, direct & personal
Teams	No teams	Forming of teams to work on technology
Meetings	Planned & temporary	Regular, personal & flexible
Feedback	Accasional feedback slopes	Mainly feedback oriented
Importance	Exploitative	Exploratory
	Incremental	Often fundament for new business models
Local/global	Local & global	Local

We also draw a much clearer picture of the 3D printing ecosystem and add to the theory on the location of knowledge sources (Mudambi, 2008; Awate & Mudambi, 2018), by explaining the

different local and trans-local knowledge exchanges in highly digitalized ecosystems. Our results show the high uncertainties and dynamics in terms of technology, market, and players defining the different and layered ecosystems of 3D printing. The analyzed highly digitalized ecosystems move beyond the traditional value chain organization (Mudambi, 2008). Vertical and horizontal, but especially lateral connections between firms occur in close and remote proximity and combine technology development and business model development. Actors move in and out of the system as a cause and result of technology and market dynamics. Adner (2017) argues for a structuralist approach to ecosystems, where activities, actors, positions, and links are clearly defined to generate the final value proposition. Our Analysis of firms in the highly digitalized 3D printing ecosystem show, that high dynamics and especially changing actors complicate this structuralist approach. As 3D printing is an evolving technology (Rindfleisch et al., 2017), so is the ecosystem surrounding it. As actors change frequently and firms search for diverse partners in distant fields, in order to gain benefits and build business the actors and actions appear to be fluid and changing instead of stable. Relating to social capital theory (Bourdieu & Wacquant, 1992; Burt, 2000) the dynamism in the 3D printing ecosystem forces firms to constantly seek new connections to increase performance (Burt, 2000). The firms' network represents pipelines through which knowledge and information flow and which enables the access to critical resources (Owen-Smith & Powell, 2004). The dynamics in the 3D printing ecosystem force firms to constantly seek new connections to increase performance.

Our findings support the view that spatial aspects are important to the study of innovation and technology development and that they have different forms (Mudambi, 2008). We find that trans-local connections go beyond just sourcing complementary knowledge or resources as suggested by Turkina et al. (2016), an idea which is shared by further authors (Mudambi et al., 2018; Paruchuri & Awate, 2017). We find that trans-local pipelines are an important connection and asset for firms usually just acting in local clusters increasing explorative and exploitative learning, innovation and giving them competitive advantages. Our study shows that competence becomes more important than location.

According to social exchange theory interorganizational exchanges are highly important (Bachmann & Lane, 2000; Hosmer, 1995) and required to grow and develop relationships (Blau, 1964; Homans, 1961). Digital technologies might reduce the need for co-location and transfer even sticky tacit knowledge across distances and different local clusters and enable interorganizational exchange over long distances. Yet, we find that even these highly digital connections require the direct and even spontaneous direct personal exchanges for technology

potential learning among firms in geographic proximity. This finding is in line with Cohen and Levinthal (1990a) who show that close proximity increases formal and informal connections in order to exchange implicit knowledge. Another important aspect related to close proximity is trust between the knowledge exchanging actors, which is known to foster knowledge sharing and raise groups performance to higher levels (Adler, 2001), thereby increasing innovation. Our finding of scheduled meetings between remote partners show that digital technologies cannot fully substitute personal meetings, because they are also required to keep friend- and relationships alive that are the basis for trans-local knowledge exchange to function (Bell & Zaheer, 2007).

Companies might increasingly be looking for outside or remote partners as in local clusters the risks of knowledge leakage are high and demands for trust are equally high. We see a danger of unintended spill-overs of proprietary knowledge. It can spill over to other actors in the ecosystem because firms are inter-connected with other ecosystems. Knowledge might spill over from small firms to large even international companies. Large international companies are already strongly pursuing M&A, targeting the small technology firms in the 3D printing ecosystem. Additionally, our data shows, that small and entrepreneurial actors might fail. The failure of one firm brings the risk of losing knowledge connections for other firms. Knowledge might no longer be available. Personnel of the failing firms might be further employed by large firms. The knowledge then migrates from small local ventures to large international firms.

2.6.1 *Limitations and future research*

Like any qualitative study, this study also has inherent limitations regarding the specific context and the generalizability. The study was conducted in the field of 3D printing, which is currently still being developed and therefore undergoes many changes. Therefore, it is unclear if our findings apply to more ecosystems in a more stable environment. Thus, further research could address the effects of proximity and trans-local connections on knowledge exchange and innovation in stable environments. Further, our study is limited to interviews and archival data, observational data could have been beneficial to better understand the different forms of meetings and interaction which play an important role for knowledge exchange especially for technology potential knowledge.

Future research is also needed to test the relationships found, especially the effects on the innovation output need to be evaluated. A sensemaking and sensegiving or new category/field development approach offers the potential to shed light on how to deal with the high

uncertainty, the cues that exist among firms as well as the drivers of the new categories of technology and markets/business models that emerge in the 3D printing field. Sensegiving and sensemaking might be specific for some ecosystem roles and for local or trans-local exchanges. We encourage studies on institutional factors and national level differences. Institutional and national differences might influence the openness to digital technologies and the development of culturally or nationally bound products and therefore should also be considered in future studies.

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Chapter 3: Shared Digital Identity and Rich Knowledge Ties in Global 3D Printing – A Drizzle in the Clouds?

With Ricarda B. Bouncken (2021).

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3.1 Research Summary

Modern audio-visual digital technology enables the immediate exchange of explicit, but also of tacit knowledge world-wide. Still, when not embedded in strong ties, the international exchange of tacit and proprietary knowledge becomes risky. Our flexible pattern matching qualitative research approach develops new theory and finds that in the nascent 3D printing industry firms exchange explicit and tacit knowledge globally, even in weak ties. The exchanges seem to be grounded in identification processes with digital technology forming a shared digital identity. We conceptualize the shared digital identity as the collective self-concept(s) of an in-group towards the creation, emergence, application, and development of digital technology built on a sense of community, enthusiasm, being part of something special as well as common values and norms.

3.2 Managerial Summary

Firms in the nascent digital industry of 3D printing share knowledge world-wide. Potentials of transferring tacit and proprietary knowledge by modern audio-visual digital technologies increase constantly. However, so do the dangers of knowledge leakage and competitive risks. A resolution of this tension comes from a new phenomenon, the shared digital identity. A shared digital identity within and among firms enables and informally guards the sharing of tacit and proprietary knowledge via digital technologies. We conceptualize the shared digital identity by a sense of community, enthusiasm, being part of something special as well as common values and norms. The knowledge exchanges assisted by digital technology occur under the aegis of the shared digital identity and accelerate the emergence of digital technologies and so facilitate global business.

3.3 Introduction

The present study examines and contextualizes local and global knowledge ties in the digitalization context. Digitalization describes the stronger implementation of digital technologies, the progressive transformation of firm's traditional processes to digitized versions, the increasing use of digitalized business models, and/or the increasing use of digital platforms (Bouncken, Kraus, & Roig-Tierno, 2019; Claggett & Karahanna, 2018; Clauß, Bouncken, Laudien, & Kraus, 2019; Fichman, Dos Santos, & Zheng, 2014; Legner et al., 2017; Tallman, Luo, & Buckley, 2018).

Global business of regionally dispersed activities and firms might flourish through digitally supported exchanges (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Fitzgerald, Kruschwitz, Bonnet, & Welch, 2014; Tallman et al., 2018), that are not limited by spatial boundaries (Kohli & Melville, 2019). Firms in industries that are at the forefront of digital technology integration, e.g., 3D printing or artificial intelligence, will be prone to digital knowledge exchanges and merits of digital technologies in global business. However, the digitalization might bear an overestimation of the knowledge exchange potentials and an underestimation of the knowledge spill-over risks. Furthermore, digital exchanges might limit the understanding among international partners (targets, backgrounds, and expertise) resulting in inaccurate generalizations (Yamin & Sinkovics, 2006).

The overestimation of the digital knowledge exchange potentials might be based on the tacit components of knowledge. Such sticky and often rich, complex, operationally embedded, or hidden knowledge is much more difficult to transfer than explicit knowledge, which is easy to express, codify, and exchange (Carlile, 2002; Simonin, 1999; Szulanski, 2000). Tacit knowledge, especially the operationally embedded components (Carlile, 2002), largely demands personal experiences, and it is non-verbalized and intuitive making it hard to express and transfer (Polanyi, 1967). The transfer of tacit knowledge requires direct personal interaction, typically by co-location of individuals and becomes more difficult when international and inter-cultural differences exist so that spatial influences persists (Bouncken & Winkler, 2010; Kumar & Nti, 1998; Mudambi et al., 2018; Pesch & Bouncken, 2018). An overestimation of potentials becomes prospective when (a) digital technologies need localized knowledge, (b) they integrate physical technology, and/or (c) using and advancing digital technology demands co-located knowledge transfers including tacit knowledge. An underestimation of risks occurs when high and multiplex unintended knowledge spill-overs are

present, which become more severe with the easy duplication ease and further transmission of digitalized knowledge. Hence, the increasing use of digital technologies and digitalized processes demands exploring and contextualizing the underlying knowledge exchanges. The research gap is particularly insistent in global business, where digitalization might improve boundary spanning (Schotter, Mudambi, Doz, & Gaur, 2017), reduce spatial boundaries, but simultaneously bears challenges of spatially bound knowledge and spill-overs.

Hence, our study aims at exploring and contextualizing the knowledge ties in global digital business, paying specific attention to the social context that facilitates tacit knowledge transfers and that might reduce risks of unintended knowledge spill-overs. We expect particularly significant, nuanced, and observable empirical insights, when digital technology integrates physical technology and demands human operations resulting in tacit knowledge demands and the prevailing spatial influences. The 3D printing industry is such a case in point that it also represents a 'nascent' and global digital industry.

3D printing is about designing solutions in a socio-technical system that captures operative software, digital designs but also human operations, e.g., set-up activities and post-printing practices. It transfers digital designs into physical goods of polymers, metal, or proteins (Rindfleisch, O'Hern, & Sachdev, 2017). Products can be printed at any location in the world (Bogue, 2013; Kietzmann, Pitt, & Berthon, 2015; Rayna & Striukova, 2016). Suppliers, clients, or service firms in the 3D printing industry can be internationally dispersed. The 3D printing industry is not restricted to a local network. It is a born digital industry following global business models from its beginning (Conner et al., 2014). 3D printing is amenable to global business aligning manufacturers of printers, suppliers of physical inputs (e.g. polymers, metal, and proteins), and service firms that offer software and personal operations. The final production step is typically local to save on logistic costs. In sum, the global, but also local setting of the born digital 3D printing industry allows us to study different knowledge ties and global boundary spanning activities.

We chose a qualitative flexible (stepwise) pattern matching design approach suggested by Sinkovics, Sinkovics, and Yamin (2014) and Sinkovics (2018). It enables a nuanced understanding of social and knowledge exchanges, mindsets, meanings, and social identities on the basis of a theoretic background that is stepwise altered towards new theory (Eisenhardt & Graebner, 2007; Larson, 1992; Pla-Barber, Villar, & Madhok, 2018; Yin, 2014). We employed a multiple case-study approach. Initially, we analyzed six 3D printing firms for initial insights. Later, we conducted a detailed analysis of ten cases of 3D printing firms with

cooperative ties in different locations of the world. We use interviews with the case firms and their cooperation/network partners, integrating secondary data sources on industry data, platforms, and firms.

The main contribution of our research lies in introducing the concept of a shared digital identity. We define the shared digital identity as the collective self-concept(s) of an in-group towards the creation, application, development, and emergence of digital technology built on a sense of community, enthusiasm, being part of something special and common values and norms. The digital technology influences social identification with an in-group and the separation from out-groups. Individuals might share their fondness, enthusiasm, and proclivity towards digital technology and identify with the related group prototype. Connecting with others serves as an act of boundary spanning (Schotter et al., 2017). The group prototype can emerge within firms but also stretch beyond firm boundaries to collaborative arrangements, communities, and industries. The shared digital identity includes shared norms/values, cognitions, and behaviors among individuals that are not limited by national borders. It thus can exist in global exchanges and allows smoothing the exchanges.

The secondary contribution of our research is the duality of digital and direct knowledge ties for global digital business. It drives global digital technology emergence and markets. Our study supports the importance of knowledge in global linkages (Awate & Mudambi, 2018; Cuervo-Cazurra, Mudambi, & Pedersen, 2018; Lorenzen & Mudambi, 2013; Mudambi, 2008; Turkina, Van Assche, & Kali, 2016). In finding 'rich' international knowledge exchanges, we challenge the understanding that codified knowledge exchange is the focus of global ties argued on the basis of international differences and distance (Parkhe, 1991, 1998; Tallman & Phene, 2007).

3.4 Conceptual Background

By building on previous research about digitalization, knowledge ties, and exchange processes, we develop a conceptual model on digital and co-located exchanges of explicit and tacit knowledge in this section. We theorize how knowledge exchange assists associated the emergence of digital technologies, boundary spanning and the globalization of business. In figure 1 we illustrate our model. Digital exchange mechanisms are primarily used for explicit knowledge exchanges while tacit knowledge demands co-location. Only very strong ties allow exchanging tacit knowledge digitally. Given the importance of knowledge exchanges in our

conceptual model, we explain specific characteristics of explicit and tacit knowledge as well as the effects of digital technologies on their exchange processes in the following.

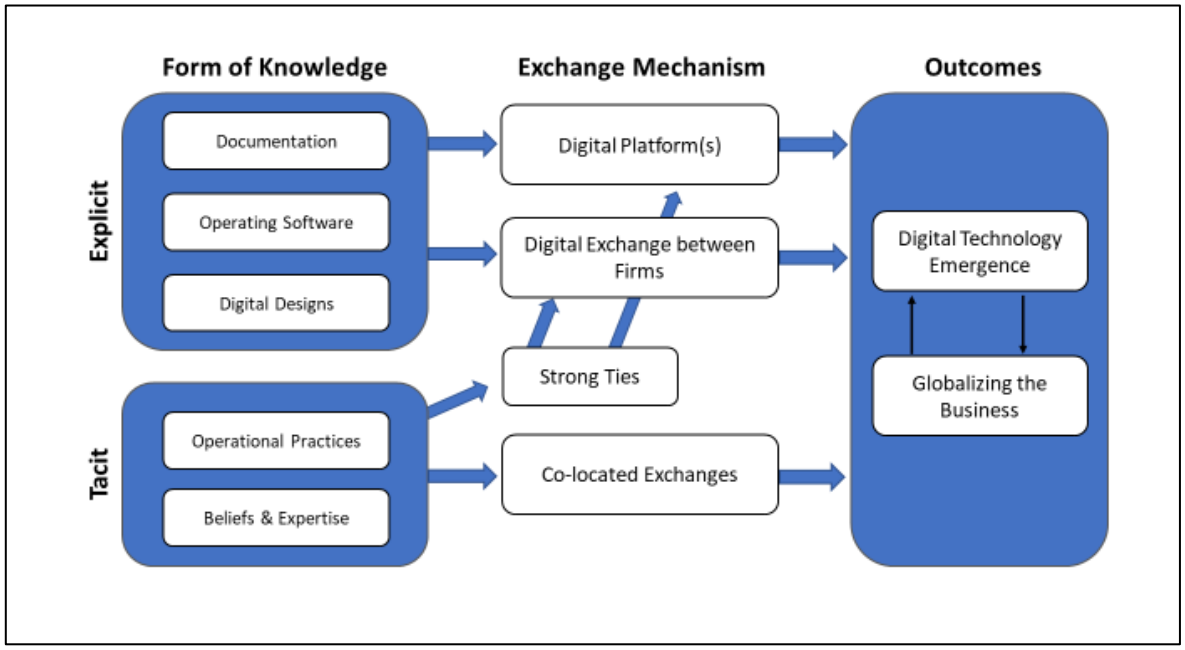

Figure 3. 1 Initial framework

3.3.1 *Initial conceptual model*

Knowledge exchanges and boundary spanning is important to global business (Awate & Mudambi, 2018; Cuervo-Cazurra, Mudambi, & Pedersen, 2018; Lorenzen & Mudambi, 2013; Mudambi, 2008; Pesch & Bouncken, 2017; Turkina, Van Assche, & Kali, 2016). Global business can take advantage of the digital ties that face no spatial limits and allow network-economies (Chu & Manchanda, 2016; Gawer & Phillips, 2013; Sawhney & Zabin, 2002). Firms can use various digital technologies for personal and organizational exchanges both domestically and globally (Manyika et al., 2016). Digitalization can reduce spatial boundaries, align geographically dispersed actors and expedite global business models because the pure digital exchanges are not limited by spatial boundaries (Bouncken & Fredrich, 2016a; Bharadwaj et al., 2013; Kohli & Melville, 2019; Legner et al., 2017; Fitzgerald et al., 2014; Tallman, Luo, & Buckley, 2018). Digitalization demands expertise and adaptations from diverse actors across organizational boundaries in local, regional, or global ties (Nambisan et al., 2017). Digitalization requires heterogeneous, tacit knowledge, constant changes in socio-technical systems, and ongoing learning of dispersed experts who are often not sufficiently available within the firm (Lenka, Parida, & Wincent, 2017). Thus, digitalization not only enables, but also requires firms to share, combine, and generate knowledge using diverse and dispersed organizational sources from different locations.

Digital exchanges, digitally substituted or enhanced physical resources (data-sets, pictures, videos, etc.), digitalized operations, and platforms (Gawer & Cusumano, 2014) all facilitate exchanges among dispersed locations around the world (Lee & Berente, 2012; Lyytinen, Yoo, & Boland Jr, 2016; Tallman et al., 2018). Digital media allow the immediate transfer of knowledge. It connects individuals and organizational entities, and thus might reduce cultural, institutional, and organizational boundaries. For example, digital designs in the 3D printing technology can be digitally transferred and altered in dispersed and globally distributed locations. Digitalization supports and relates to boundary spanning activities that individuals within and among organizations perform to draw connections among multiple cultural, institutional, and organizational contexts (Schotter et al., 2017). We argue that explicit knowledge is relatively easily transferred by digital technology while tacit knowledge exchanges demand co-location. Only when firms have strong ties, characterized by long term, trustful and intense relationships (Hughes et al., 2018; Bouncken & Fredrich, 2016c), they might use digital media supported by audio-visual digital technology to exchange tacit knowledge. Digital exchanges in the form of bi-directional or multi-actor models, e.g. platforms, support reciprocal exchanges and might especially reduce boundaries and therefore enable the emergence of the technology and increases in innovation capabilities (Schotter et al., 2017). Audio-visual solutions (i.e. augmented reality and video) might digitalize some of the tacit knowledge components and improve rich knowledge exchanges beyond spatial boundaries. We explain the reasons in the following.

The set-up of the technological and digital system in 3D printing (similar: Industry 4.0) might require significant tacit and operational knowledge, which relates to embedded practical knowledge (Carlile, 2002). The knowledge exists on the interface of technology, methods and individuals' accumulated conscious or unconscious rules of thumb (Carlile, 2002). Pre- and post-production of 3D printing processes, as well as maintenance processes, demand tacit operational knowledge. The programming and the development of the digital objects and sequences requires constantly changing heterogeneous digital expertise. For example, geometries of 3D objects demand high engineering and programming expertise. Accordingly, firms in industries with strong digital technology integration need not only the exchange of digital(ized) knowledge but also tacit knowledge the embedded practical knowledge. The exchange of tacit knowledge, including practical knowledge, flourishes by bi- or multi-directional exchanges. They can occur as person-based global linkages and/or organization-based linkages, the latter referred to as pipelines (Lorenzen & Mudambi, 2013). While the

digital and tacit knowledge needs to be integrated and contextualized it needs organizational commonality at both ends (Awate & Mudambi, 2018; Cuervo-Cazurra et al., 2018; Lorenzen & Mudambi, 2013; Mudambi, 2008; Turkina et al., 2016). Previous research assumes that individuals have a tendency to stick their accumulated tacit, especially practical knowledge and that change becomes less likely when crossing physical or psychological boundaries (Carlile, 2002). Accordingly, digital media that facilitate the exchange of a wide range of explicit and tacit knowledge might improve boundary spanning activities but is also limited to within-boundaries and identification processes, too (Carlile, 2002; Schotter et al., 2017).

Knowledge exchanges, particularly in international ties and when they relate to proprietary knowledge face risks of unintended knowledge spill-overs (Fredrich, Bouncken, & Kraus, 2019; Kale, Singh, & Perlmutter, 2000). The rich proprietary knowledge exchanges, supported by rich media or by platforms suffer from low protection mechanisms that are even less effective when international distance and differences are present (Ring & Ven, 1994; Tsang, 1999). Thus, firms might hesitate to transfer spatially bound tacit knowledge in international ties.

In essence (see model in figure 1), digitalization can facilitate global knowledge exchanges, but is less suited for the transfer of all the tacit knowledge components. The tacit components including the operational-practical knowledge might stick to within-boundaries and strong ties that have identificational potential (Carlile, 2002; Schotter et al., 2017). Figure 3. 1 shows on the left side the explicit (upper part) and the tacit forms of knowledge (lower part). The knowledge exchanges improve the global business and the emergence of the 3D printing technology (right side). The middle part shows the different exchange mechanisms, platforms as multi-side transfers and bi-directional digital exchange between firms. Tacit knowledge might be exchanged by co-location among firms, but will only be digitalized and exchanged within strong and local ties (Bouncken & Reuschl, 2018). We explain the relationships in more detail in the following.

The socio-technology digital systems require digital and perceptive, responsive, and recursive knowledge transfers of diverse and dispersed firms in local, regional, or global ties within personal ties and pipelines. The transfer will be especially limited when the tacit knowledge is bound to (different) interpretation systems of the actors at the ends of the pipeline. Simultaneously, a digital exchange might not be feasible because of the low protection mechanisms and the easy exchange of digitalized knowledge. Thus, not all of the knowledge that can be digitalized also will be transferred digitally. Co-located and locally bound

exchanges remain and they provide better social mechanisms for the protection of proprietary knowledge (Cesinger et al., 2016). Firms will prefer to share tacit knowledge locally while changing the explicit digitalized knowledge digitally in pipelines and through platforms. Thus, global business and the emergence of the 3D printing technology can take advantage of the digital exchange of knowledge.

Besides the different alternatives, some firms might concentrate on either digital exchanges or personal co-located exchanges, while others could use diverse forms of exchanges. Firms might also focus on certain ties, scope, and intensity of tacit knowledge transfers. Considering the rich literature on strong ties, repeated ties, and social capital, firms might consider specific strong and long-term ties as better suited for the exchange of tacit knowledge (Nelson, 1989; Tortoriello, Reagans, & McEvily, 2012; Tiwana, 2008). Thus, high tie strength might increase firms' tendency to digitalize rich, and proprietary knowledge and share it internationally even through digital channels.

3.5 Methodology

3.5.1 *Research setting and design*

We apply an explorative research design to uncover the multiple facets of knowledge ties in the global 3D printing industry. The 3D printing industry consists of manufacturers of 3D printing devices (e.g. for 3D printing using plastic, metal, proteins), industrial clients (e.g. for rapid prototyping, rapid tooling, and digital manufacturing), suppliers of materials, scientists and labs, software developers, designers of the printed objects, and end-customers (Berman, 2012). 3D printing products and services are expected to reach a worldwide revenue of $15.8 billion in 2020 and $35.6 billion in 2024. The number of producers of industrial 3D printer systems has risen from 135 in 2017 to 177 in 2018 equaling a 31% increase on a year to year basis (Wohlers, 2019). Big industry players such as ThyssenKrupp and IBM collaborate on 3D printing platforms (Stumpfe, 2019).

An exploratory research design is well suited to uncover causalities, allows for contextualization, and helps to communicate theory (Welch et al., 2011). We chose a multiple case study approach with nested pattern matching logic as we are interested in the dynamics within the setting of a single industry (Eisenhardt, 1989; Sinkovics, 2018). We employed a flexible-pattern-matching approach (Sinkovics, Sinkovics, and Yamin (2014), which builds on

a deductive theory-driven research paradigm while simultaneously allowing for new patterns and theory to emerge from the empirical data. The flexible-pattern-matching approach builds on an initial analytical framework (King, 2012).

We developed the analytical framework from the conceptual background. Following this step, we conducted open interviews with the aim of gaining more in-depth insights into the mechanisms driving knowledge exchange processes and contextualizing global knowledge ties in the 3D printing industry. The interviews covered the topics of the firm's business model, the relevance of different forms of 3D printing technology as well as the value of partners and knowledge for the firm. These interviews were carried out between June and November 2017. The broad initial sample allowed us to refine our model and capture the ideas about the relevance of knowledge and partners as well as the importance of knowledge exchange in the 3D printing industry. We further learned about differing motivations and strategies for knowledge exchange. We included these ideas enriching the theory-based analytical framework with a practice-driven approach (Brooks & King, 2014). See Table 3. 1 for an overview of the main characteristics of the initial interview sample.

Table 3. 1 Overview of initial interview sample

Interview	Business model	Industry	Employees	Revenue	Profit	Material	Location	Founded
1	Electronics	Electronics	171	-	$1.9M	Plastic	Germany	1945
2	Full-service 3D printing provider	3D printing	19	$3.4M	-	Plastic	Germany	2006
3	Industrial Machinery and Equipment	3D printing	5000	$754M	$153M	Metal	UK	1973
4	license 3D printer sales agency	3D printing	24	-	$135K	Metal& plastic	Germany	2016
5	3D printer manufacturer	3D printing	300	$75 M.	$8.3M	Metal	Germany	2000
6	Software Information management	Software	180	$13.8M	$8.5M	Metal& plastic	US	1994

Table 3. 2 provides an overview containing the theoretical patterns and patterns developed from the first set of initial interviews. We also provide information on the expected observational patterns and the expected implications for global knowledge ties. The first column indicates the area of study. The second column indicates whether the pattern stems from theoretical

deduction or the initial interviews. The third column shows the specific dimension. Column four specifies the expected observational pattern while the fifth column provides information on expected implications.

3.5.2 *Data collection*

After building our analytical framework, we used purposeful sampling to identify ten firms operating at different positions in the 3D printing value chain. We selected these firms to generate a sample that represents different cases of 3D printing use and intensity to cover our areas of interest (Seawright & Gerring, 2008). Purposeful sampling further enabled us to seek a maximum of variation in our cases (Lincoln & Guba, 1985; Patton, 1980), resulting in a sample consisting of similar and contrasting cases (Lincoln & Guba, 1985). The selection criteria included (1) the firm's position in the value chain, (2) the number of global and local ties and, (3) the importance of 3D printing for their own business model.

At the beginning of the data collection process, we developed a list of firms that fulfill our criteria. We then started contacting those firms and inquired about their availability to participate in our study. After scrutinizing the profiles of the firms from websites, newspapers, industry platforms, and blogs, we shortlisted ten firms for our study. Following Eisenhardt (1989), ten or even fewer cases are optimal for in-depth case study analysis. Table 3. 3 gives an overview of the case firm profiles.

Following the identification of our case firms, we collected qualitative data through interviews with CEOs and managers of case firms and their partners. We only interviewed individuals who were in charge of the 3D printing-related operations, knowledgeable about the case firms, and the topic of global and local knowledge ties. In total, we conducted 35 interviews between December 2017 and February 2018. The interviews were complemented with secondary data from firm websites, press releases, industry platforms, and newspapers. The interview questions started with the firms' stance on the 3D printing technology and future potentials from their point of view. These questions were followed by more sensitive questions on the firm's collaborations, knowledge exchanges, and global and regional factors. Interviewees were asked to give examples of important instances or categorize the importance of specific collaborations. Two researchers conducted the interviews, one leading the interview and the other staying in the background taking notes.

Table 3. 2 Initial analytical framework

	Underlying analytical Framework	Dimension	Expected pattern	Expected implication for global knowledge ties
Forms and modes of global knowledge exchange	Conceptual Framework	Documentation	Digital	Explicit knowledge is available in a documented form and therefore can easily be exchanged using digital channels Digital exchanges facilitate explicit knowledge, save time and money compared to co-located exchanges The digital exchanges enable firms to work with global experts and resources
		Operating Software	Digital	Software sales and services are conducted via downloads on platforms or are made available online, therefore solutions from global players are available to all
		Digital Designs	Digital	Digital 3D printing designs are exchanged in digital form The digital transfer of designs enables collaboration with global players
		Operational Practices	Co-located	Setting up technological and digital system requires significant tacit operational knowledge, which cannot be transferred using digital technology The required sticky knowledge can only be transferred face to face, therefore global partners need to be co-located

		Beliefs and Expertise	Co-located	Beliefs and expertise can only be transferred face to face between people and organizations. This requires temporary co-location of (global) partners Digital exchanges have low protection mechanisms and are therefore risky. Expert knowledge demands co-location for protection Co-located and locally bound exchanges which provide better social mechanisms for the protection of intuitive tacit knowledge
Factors/Motives influencing sharing/exchange of tacit knowledge via digital channels				
Factor (multi-directional)	Conceptual Framework	Tie strength	High	High tie strength might increase firm's tendency to digitalize rich, and proprietary knowledge and share it internationally even through digital channels
Motives (Downstream)	Initial Interviews	Inspire	High	Firms are motivated to use digital exchanges of information to inspire customers Motivate broad and global audience to use the technology
		Enable	High	Platform-based information is provided to enable broad usage of technology Educating the customer Provide information to a work with a global customer market

Table 3. 3 Case sample description

Case	Business model	Industry	Employees	Revenue	Profit	Material	Location	Founded	Suppliers	Customers
A	Design and 3D print, design products and sell them	3D printing	6	$900	-	Plastic	Germany	2015	Global	Global
B	Biomechanical research and development	Biomechanics and sports	8	$800K	-	Plastic	Germany	1987	Global	Global
C	Engineering services	Engineering	150	$11M	$1.5M	Metal& plastic	Germany	2011	Global	Local
D	3D printing service	3D printing	10	$1.5M	$200K	Plastic & biological degradeable	Germany	2011	Global	Local
E	Logistics services	Logistics	72000	$18700M	$550M	Metal & plastic	Germany	2007	Global	Global
F	3D printing software solutions	3d printing	1800	$185M	$3,3M	Metal & plastic	Belgium	1990	Global	Global
G	Additive manufacturing service	3D printing	15	$2.6M	$100K	Metal & plastic	Germany	2006	Local	Local
H	Manufacturer of forming technology and technological ceramics	3D printing	30	$2.5M	$80K	ceramic	Austria	2011	Global	Global
I	Additive manufacturing service/workspace provider	Office sharing	53	$3.6M	50K	metal& plastic	Germany	2015	Global	Local
J	3D printing service	3D printing	2	-	-	metal, plastic& paper	Germany	2013	Global	Local

3.5.3 *Data analysis*

We applied two stages of analysis. We started with a flexible pattern-matching approach analyzing the case data according to our analytical framework. Flexible pattern matching allows to further develop an initial analytical template and enables the researcher to develop new theory (Sinkovics, 2018; Sinkovics et al., 2019; Sinkovics & Alfoldi, 2012). It allows for the development of new and unexpected dimensions, thereby enabling the revision of prior expected relationships. Building theory with flexible pattern matching starts by using matches and mismatches between theoretically expected and empirically observed patterns. These matches and mismatches are used as an aid to theory development (Alvesson & Kärreman, 2007).

In the first stage of the analysis, we conducted two pattern matches. The first was conducted for different forms of knowledge and the exchange methods. In a second pattern match, we limited the sample to only those cases, which were a mismatch to the theoretically expected pattern. Specifically, we analyzed the firms using digital technologies to exchange tacit knowledge. We aimed to identify how exactly these cases were different and what lead to the mismatch. In the second pattern match, we found confirmation for tie strength as a relevant factor driving the use of digital technologies. We further identified a strategy of inspiring, enabling, leveraging and stretching to grow global business. In addition, we identified the new dimensions sense of community, enthusiasm, specialty, and common values and norms.

As these dimensions were of high relevance in the deviating cases and clearly related to the open digital exchange of tacit knowledge we decided to follow up on these findings in more detail. In the second stage of our analysis, we explored the cases independently, looking for the mechanisms behind the dimensions and discovered the underlying concept of shared digital identity.

3.6 Findings

3.6.1 *Dual use of co-located and digital knowledge exchange*

The first two pattern matches were conducted to understand the knowledge exchange of firms in a highly digitalized industry. The first pattern match enabled us to identify which knowledge is exchanged between partners and how the transfer takes place. Table 3. 4 provides an overview of each case and which knowledge was exchanged, also indicating which method was used for the exchange. This pattern match informs that both digital and co-located

knowledge exchange takes place, but their purpose is different. Explicit knowledge, such as documented knowledge, knowledge about software and digital designs, is exchanged on a mainly digital basis when partners are globally dispersed. Platforms have high importance for these exchanges. Case G signposts that explicit knowledge can be exchanged in co-location but appears to be dependent on close proximity of the partners. Further information from the case data indicates that knowledge exchange about operational practices as well as beliefs and expertise takes place in co-location for all case firms. Simultaneously we can show that in six of our ten cases firms use digital exchange mechanisms to exchange tacit forms of knowledge (knowledge about operational practices and beliefs and expertise). This contradicts our expectations and prior literature.

In the second pattern match, we examined in greater detail why firms engage in the digital exchange of tacit knowledge. Following our analytical framework, we focused on the importance of tie strength, motivation, and strategic aspects. For this pattern match, we reduced the sample, excluding cases B, C, E and I, where there was no indication of digital exchanges of tacit knowledge. As there was no variation in the cases regarding the use of digital exchange mechanisms, we have summarized the results in a single table. Table 3. 5 provides an overview of the second pattern match.

The results confirm that tie strength has a positive effect on the exchange of tacit knowledge via digital channels. High tie strength leads to the digital exchange of tacit knowledge. The manager of case firm F, a provider of 3D printing and software solutions, clearly mentioned this:

"A lot happens with old contacts. With us, at least there are a lot of old grown contacts. It is about the assessments of the market. So much knowledge in terms of technology and assessments is very much based on the fact that you have contacts in a variety of companies that are also active in the industry and you exchange knowledge".

In addition to the confirmation with respect to the importance of tie strength, we found evidence for strategic and motivational factors leading to knowledge exchange and knowledge sharing. We identify that firms use platforms and digital technologies for a strategy of inspiring, enabling, leveraging, and stretching. This finding goes beyond the expected patterns of inspiring and enabling which were discovered in the initial interviews.

Surprisingly, we also discovered a new factor increasing and fostering the digital exchange of tacit knowledge. We label this factor as a shared digital identity that relates to a sense of community, enthusiasm, specialty, and common norms and values.

3.6.2 *Multiple purposes of digital knowledge exchange and sharing via platforms*

As first outset in our initial framework, the exchanges between firms can be supported by digital transfers via digital technologies in pipelines and/or on platforms that bundle several actors. Yet, our second pattern match shows that the usage of digital exchange mechanisms, and especially platforms, goes far beyond the simple exchange of explicit knowledge.

Our initial interviews had portrayed that platforms help to inspire and educate customers. We now find convincing case evidence for the existence and transfer of digital knowledge '*packages*' that are meant to deliver assistance, information, and training to current customers. Additionally, the digitalized knowledge on the platforms provides informational, co-creational, and marketing benefits. The platform shows the firm's process expertise, stimulating the use of 3D printing, and thus increasing sales. 3D printing service firms are focal firms of digital platforms. The manager of case firm A describes the situation: *"These platforms are important for service companies because they can generate their orders for smaller or individual pieces".* Case firm J, a small 3D printing service operating with regional customers, confirms and elaborates on the benefits of using platforms:

"There are many new 3D printing service providers. Many have only online platforms, where you upload a file and then you have the price and then everything is great, so it seems to be enough. But eventually, there will be a market shift again. The need for our personal services is currently too high. We do not have the time to talk about each request with a customer on the phone or face to face. That is why such automatic price calculations on platforms are already important."

Customers (often manufacturers) also establish themselves or use public knowledge platforms that store knowledge, making their expertise available to others. 3D printer manufacturers often provide solutions for printer problems on platforms. Platforms also enable exchanges with other users who share their knowledge. We found rich evidence for the existence of a community. For example, a customer of case firm A described the 3D printing industry as "*a community, a network - or 3D printing scene. People are already exchanging ideas about materials, what's cool and which printers are good, etc.".*

Table 3. 4 Pattern match: Knowledge form and exchange mode

orm of knowledge	Mode of exchange	Cases A	B	C	D	E	F	G	H	I	J
Facilitating explicit knowledge		x	x	x	x	x	x	x	x	x	x
	Digital	x	x	x	x	x	x	x	x		x
	Platforms	x		x		x	x		x		
	Co-located		x					x		x	
Operating Software		x	x	x	x	x	x	x	x	x	x
	Digital	x	x	x	x	x	x	x	x	x	x
	Platforms	x				x	x		x		
	co-located				x			x		x	
Digital Designs		x	x	x	x	x	x	x	x	x	x
	Digital	x	x	x	x	x	x	x	x		x
	Platforms	x	x		x	x	x		x		x
	co-located							x			
Operational Practices		x	x	x	x	x	x	x	x	x	x
	Digital	x			x		x	x			x
	Platforms	x									
	co-located	x	x	x	x	x	x	x	x	x	x
Tacit knowledge (other)		x	x	x	x	x	x	x	x	x	x
	Digital	x			x		x	x	x		x
	Platforms	x					x		x		x
	co-located	x	x	x	x	x	x	x	x	x	x

Table 3. 5 Factors driving tacit knowledge exchange using digital technologies

	Factors influencing sharing of tacit knowledge via digital channels	Expected pattern		Observed pattern	
Relational					
	Tie strength	high	firms trust each other	high	Trust between firms leads to the use of digital channels although they are less safe
Growing business strategically					
	Inspire	high	firms inspire customers by showing potentials of the technology	high	Firms were eager to share knowledge with as many customers as possible to educate them on possible uses of the technology Spreading ‘use cases’ of the technology on Youtube and other video platforms Platforms are used to distribute knowledge of different forms
	Enable	medium to high	platform-based information is provided to enable usage of technology	high	Providing extensive knowledge on platforms to help customers with problems Technology Wiki on the homepage Online tutorials/packages of Knowledge are made available Platforms play a key role for knowledge distribution
	Leverage			high	Using digital technology and platforms to approach bogger markets Using platforms saves on human resources Automation of processes (calculations and offers)
	Stretch			high	Goal: market share increases and entering new markets making the technology available and usable by everybody wanting to become the number one technology first, enable the customer and then make them use and distribute the technology

Shared Digital Identity			
	Sense of Community	high	Open and constructive communication with competitors Innovative community All push the topic together Competition is not a primary focus Global networks and communication- one community despite competition
	Enthusiasm	high	Feels like a goldrush Feeling of contributing and developing something important There is recognizable enthusiasm 3D printing is a hot topic
	Specialty	high	Feeling like pioneers Being part of something new and important Developing a new technology Changing how business is done Being part of something special and exciting
	Common values and norms	medium to high	there are recognizable values and norms in the industry same ideas about how things need to be done shared understanding

Our data indicates that the firms not only use the sharing and exchange of knowledge to inspire and enable customers but also for a strategy of leveraging and stretching. Table 3. 5 shows case firms that share knowledge via digital exchange mechanisms to strategically leverage limited resources. Rich digitalized knowledge is made available to approach bigger markets, make better use of limited capacities and increase the automation of sales processes. Especially the smaller case firms (A, D and J) were extensively following this strategy. It allowed them to follow their stretched goals of growing their market share and entering new markets even becoming the market leader for a new technology.

3.6.3 *New differentiation: Technology potential and operational process knowledge*

A deeper analysis of the individual cases uncovered a clear differentiation between two categories of knowledge specifically related to digital technologies: technology potential knowledge and operational process knowledge.

Technology potential knowledge is complex and requires complementarities between the actors. Surprisingly, the exchange of this proprietary knowledge often takes place locally and/or globally. The exchange occurs via informal channels but often with well-known partners. Accordingly, the tie strength is a key mediator for tacit knowledge transfer and the level to which it is digitalized and exchanged globally.

Operational process knowledge includes instructions on how to use 3D printers, including the pre- and post-production processes. Accordingly, it covers explicit and tacit knowledge, which requires personal interaction and co-location. Interestingly, it does not only occur locally but also globally. A printer supplier of case firm A revealed: *"We deliver the machines and software plus all the training (to our customers) and we do it all the time. We always support the customer because they have to learn a lot".* However, operational process knowledge is also about future uses. It enables suppliers to qualify their customers in a one-directional knowledge exchange process. A printer supplier of case firm J made this very clear in the following statement:

"We also offer training for our software. So, for example, our 3D express software, you have to do a week of training to understand it. (...) Training is important because we can pass on our knowledge within a short time and focus on incremental innovations along the process line."

A new factor facilitating local and global knowledge exchange: Shared digital identity

Our key finding on the shared digital identity as a new factor driving the digital exchange of rich and tacit knowledge was discovered in the second pattern match. The cases clearly show that the exchange of knowledge in general, but especially tacit knowledge, is driven by social identification of individuals working in the 3D printing industry. Identification processes base on a strong sense of community or connectedness. We observed a second reappearing pattern of enthusiasm. In case H a supplier of printers even described the situation surrounding 3D printing as a gold rush. Further examples were that managers and employees were feeling like they were contributing to something bigger. In case H a customer even mentioned that this enthusiasm made a significant difference in the war for talent. As a small firm, many qualified people were willing to work for lower wages, just to be part of the 3D printing industry. In all cases, the interviewed CEOs and managers mentioned that they share enthusiasm. Enthusiasm is closely related to the third dimension which we labeled specialty. Specialty refers to being part of something special and changing how things are done by using digital technology. Many firms consider establishing new technology (3D printing) to be more important than short term firm success. Case firm F even referred to the existence of shared values and norms, which is the fourth and final dimension: common values and norms.

These four patterns have obvious effects on the sharing of knowledge as this statement by the manager of case firm F shows:

"There are the same values, norms, so in any case, the enthusiasm of all is recognizable. This is always a beautiful thing. We can also talk with competitors in the best way. And anyone who deals with the topic itself is simply in a very innovative and exciting industry. And that's always great! You notice the enthusiasm in any case, usually with all involved. And that's always nice, so there's no real hate-loving in the industry, that's interesting, yes".

Our cases portray that the shared digital identity explains the broad range of knowledge transfers that occur locally and globally and via direct and digital transfers.

3.7 Discussion

Our study reached out to examine and contextualize knowledge ties assuming that digitalization facilitates global business because it reduces physical boundaries (Lee & Berente, 2012; Lyytinen et al., 2016; Tallman et al., 2018) via virtual information transfers, digital operations, and digitally aided physical resources (Kraus, Roig-Tierno, & Bouncken, 2019; Lee & Berente, 2012; Lyytinen et al., 2016; Tallman et al., 2018). Yet, digitalization also enables tacit knowledge exchanges. Further, it demands the transfer of tacit knowledge. We

find a duality of digital and rich knowledge ties that we discuss in the following section. A shared digital identity can explain some of the tacit knowledge exchanges and the boundary spanning among international firms (Schotter et al., 2017). A shared digital identity is based on a shared sense of community and shared enthusiasm about the digital technology and its uses. We discuss the concept of shared digital identity later.

3.7.1 *Duality of digital and rich knowledge ties*

Global digital business benefits from digital ties that face no spatial limits, e.g. by using platforms (Kwak, Kim, & Park, 2018) and from network-economies (Chu & Manchanda, 2016; Gawer & Phillips, 2013; Sawhney & Zabin, 2002). Digital exchanges can facilitate exchanges while connecting physical technology and human operations with digital technology (McIntyre & Srinivasan, 2017; Zhu & Iansiti, 2012). Digital media does not only transfer explicit knowledge but also allows richer and contextualized exchanges, e.g. by AR/VR devices, video calls, and sensors. Transferring programming sequences, tutorials, designs and/or organizing might leverage or stretch existing physical technology, operating software, designs, novel materials, and altered practices.

Firms exchange two core forms of knowledge: technology potential knowledge and operational process knowledge. Both occur locally and globally and have the potential to span boundaries Schotter et al., 2017) and contain not only explicit but also tacit knowledge. The operational process knowledge relates more strongly to knowledge that is embedded in practice (Carlile, 2002). Using, leveraging, and stretching digital solutions and knowledge is not without social and local contextualization, for example, of physical technology, of operating software, of available input material, and of human or organizational practices. Richer social relations can make better use of the global diversity of knowledge, resources, and users (Bouncken & Winkler, 2010; Pesch & Bouncken, 2018; Tallman & Pedersen, 2015). Hence, we contribute that digital exchanges allow but also need to transport more richer components than mere explicit knowledge. Previous research considered that inter-firm international knowledge exchanges are strongly limited to codified and protectable knowledge (Ring & Ven, 1994; Tsang, 1999). Our finding on the risky rich knowledge exchanges extends and somewhat contrasts previous literature that assumes tacit knowledge exchanges without formal protection as particularly risky under the conditions of international distance and differences (Bouncken & Fredrich, 2016b; Kale et al., 2000; Ring & Ven, 1994; Tsang, 1999). Knowledge exchanges over distance via digital technologies might even require intense co-located exchanges, e.g. in

frequent meetings for understanding and applying digital technology. Face to face meetings improve the exchange, align the cooperation, define future goals, drive technology development, or analyze and optimize a process. We highlight that global transfers in the digital field allow and cause rich knowledge exchanges and at least temporary co-location for knowledge exchange in various situations. This points to a duality of digitalization and rich knowledge transfers. We theorize this duality by the existence of an identity mechanism. Shared identity of an in-group stimulates tacit knowledge exchanges in general and in particular across international and spatial borders without the need for strong ties (Schotter et al., 2017). The community, enthusiasm, and being part of something special requires boundary spanning but also creates an identification processes among individuals who might belong to different units in diverse locations and thus allows boundary spanning (Schotter et al., 2017).

3.7.2 *Shared digital identity: Development of a New Concept*

As the discussion of digital natives shows (Margaryan, Littlejohn, & Vojt, 2011), using and developing digital technology separates in- and out-groups. Individuals who see themselves as in-groups consider others as outsiders. The process of self-categorization describes the depersonalization of an individual's perception, feelings, and behavior with respect to a context-specific in-group prototype (Ashforth & Mael, 1989). It builds on the idea of a taken-for-granted reality among persons (Ashforth & Mael, 1989). The in-group prototype might refer to their fondness of digital technology, expertise, constantly working on improvements, sharing of proprietary knowledge, and working on the emergence and global expansion of the digital technology.

The shared digital identity addresses the existence of a long-lasting, while not necessarily permanent, inter-subjective digital-self(s). Individuals might have a strong identification with digital technology and share the meaning of the technology or of their industry (Anthony, Nelson, & Tripsas, 2016), even when they are located in different firms and in dispersed international locations. Open exchanges and making sense of other's contributions are more likely when individuals consider themselves in a social group that they identify with. Thus, the shared digital identity can explain the open and risky exchanges of explicit and tacit knowledge among individuals and firms via digital media and platforms (e.g. designs and tutorials on platforms). It can also explain the rich international knowledge transfers among dispersed firms and actors who might only be temporarily co-located. Digital technology emergence and globalization becomes easier by a shared digital identity. The fondness of individuals towards

digital technologies, shared proclivity, shared enthusiasm, and shared general mindsets towards working and pushing digital technologies improves exchange.

We define shared digital identity as the collective self-concept(s) of an in-group towards the creation, application, development, and emergence of digital technology building on a sense of community, enthusiasm, being part of something special and common values and norms. It is not elusive to local contexts and can exist beyond national borders and spatial distance. It might connect individuals in firms that collaborate and possibly even compete (see coopetition) in national and international value chains (Bouncken, Fredrich, & Kraus, 2019a; Bouncken et al., 2019b; Bouncken et al., 2018).

3.7.3 *Theoretic foundations of the shared digital identity*

Identities can be created as an intersubjective reality that transcends the individual occurring as a collective identity, for example on the group and organizational level (Ashforth, Rogers, & Corley, 2011; Ashforth & Mael, 1989; Ashforth & Johnson, 2001). The process of self-categorization describes the depersonalization of an individual's perceptions, feelings, and behavior with respect to a context-specific in-group prototype (Ashforth & Mael, 1989). The in-group prototype refers to a shared concept among individuals, which is partly conscious. Social construction and shared meaning might develop an in-group-prototype that covers a normative level associated with proclivity, sympathy, fondness, and enthusiasm towards digital technology and a behavioral level associated with constant work on improvements, the sharing of proprietary knowledge, and the ongoing searches for digital technology advancements and expansion.

The shared digital identity concept refers to shared behavior and behavioral expectations among individuals but also shared values and norms related to digital technology. Similar to an orientation concept (e.g. EO, Covin & Lumpkin, 2011), the identity concept includes proclivity as a behavioral element. Yet, identity has a stronger normative connotation than an orientation concept.

Hence, the stronger use of digital technologies automatically includes a positive valuation, confidence in, attachment to, and even excitement towards digital technologies as a fundament. Shared digital identity means that digitalization has a positive connotation to those of an in-group. Some of the positive attainment is tacit or subconscious to individuals and relates to their norms and valuation. Other elements are more conscious and explicit in choices, technology, and documents. The digital identity of a group of individuals relates specific

expectations and behavioral patterns, influences by specifics of digital technology in general or to certain technologies (operating software, digital designs, etc.). Accordingly, a shared digital identity has normative, cognitive, and behavioral elements that operate at individual as well as collective levels.

The identity set of an individual is built on varying memberships that fluctuate in importance (Hogg, Terry, & White, 1995; Tajfel, 1974; Tajfel & Turner, 1986). Particular (e.g. digital) contexts request a specific social identity to become a salient basis for stereotypical behavior of the in-group and evaluations of the out-group (Tajfel, 1974; Tajfel & Turner, 1986). The identity prototype provides a collectively constructed standard against which members distinguish in-groups and out-groups in organizations (e.g. entrepreneur vs. non-entrepreneurs, Powell & Baker, 2017).

For example, a family firm identity emerges from role identities consistent with group norms and can exist where the family agenda and identity become visible in articulated points of view, needs, values of members and their emotional ties (Miller, Breton ‐ Miller, & Lester, 2011). Accordingly, the firm might provide a micro-level anchorage for social identification. The digital identity might be influenced by certain centralized individuals, e.g. the founder of the firm, the engineer/designer of digital solutions, or a well-known digital expert. Some individuals might be more in the center (e.g. leaders with technology affinity) while others might only be tangential (e.g. IT-experts). In addition, digital identity might develop from using specific technology (operating software, physical technology, digital designs) and concentrate on this one.

Digital identification processes respectively the shared digital identity is also influenced by the communities around a specific technology, e.g. the peers that share their knowledge on the internet especially on platforms. Individuals have mutual interest and enthusiasm. Using and contributing to internet forums, open-source platforms, membership to associations, etc. will drive identification processes, even without the need for direct personal exchanges. Central industry players and celebrities deliver speeches and narratives in which they espouse their values and further inspire identification processes. Digital industries, especially nascent ones such as 3D printing might thus inspire certain shared values, beliefs, and behaviors. Hence, we assume identification processes of macro-anchorage for the digital identity.

In addition, we propose that digital identification as for rich knowledge exchanges are facilitated by stronger ties between firms. Ties might follow economic considerations, but also

include social-emotional factors, e.g. the sharing of visions and enthusiasm about digital technology. Enabling others or being enabled, exchanging ideas, experiencing joint inspiration, and leveraging and stretching uses can further stimulate in-group processes and identification. Thus, the digital identity allows boundary spanning as it pushes borders, units, and individual's mindsets and behaviors, and thus facilitates the change and exchange of knowledge (Schotter et al., 2017).

Inter-firm ties can allow permanent and/or temporary direct social processes of identification. Other exchanges might be only virtual but still might contribute to the development of in-group prototypes for identification because of intense digital exchanges, joint values/norms, and overlapping behaviors. Thus, we assume different firm, inter-firm, and industry anchors of the taken-for-granted reality related to a digital identity that each take advantage of each other.

Figure 3. 2 shows how the shared digital identity resides on the specifics of digital technology, its mediating technologies, and the micro-, meso-, and macro-anchorage. At the bottom of the figure are the different digital technology demands, derived from the literature on digitalization. These technology demands differently coin individual values, cognitions and behaviors, which are also influenced by the specific digital technologies. All these three layers determine the creation of the in-group prototype of a shared digital identity, respectively the out-group prototype. The in-group prototype can become salient and shared within firms (micro-level), among firms (meso-level), and within a specific field, e.g. an industry.

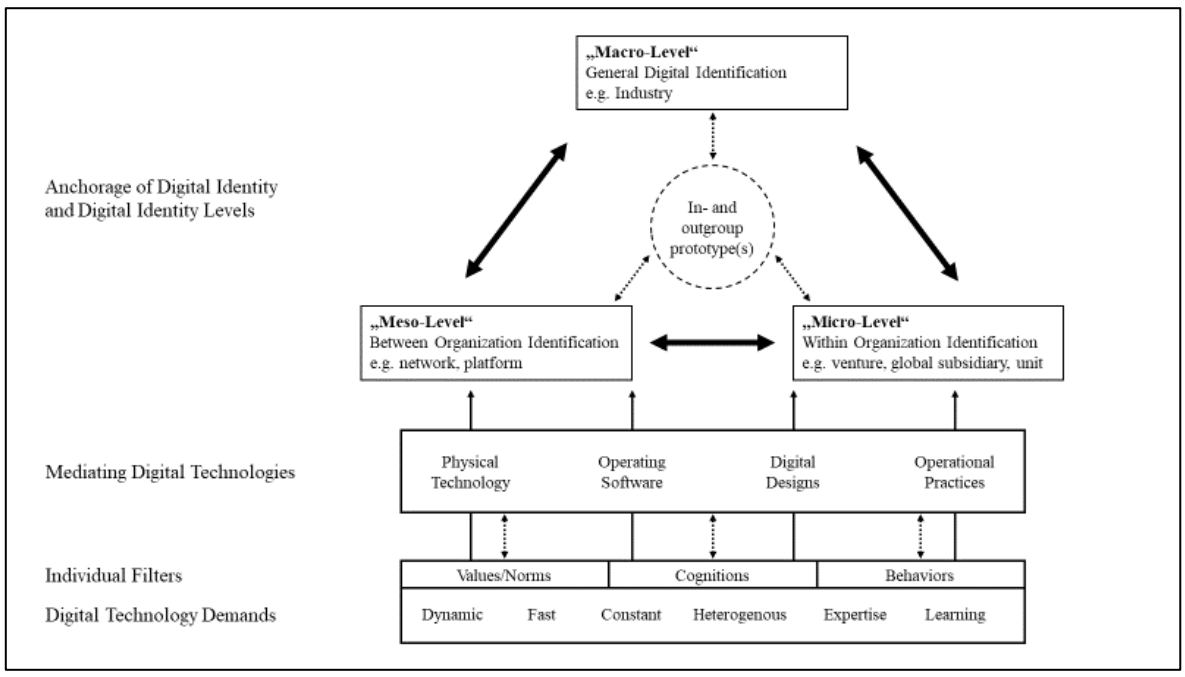

Figure 3. 2 Digital identity in the context

3.7.4 *Digital identity and global digital emergence*

As outset before, the shared digital identity is based on mutual values, norms, meanings, cognitions, and behaviors related to greater fondness, proactivity, in-group's inclination towards digital technology. Shared digital identity includes meaning (Anthony et al., 2016) that can facilitate category development, technology emergence, and expansion in the national and global business contexts (see figure 3). Digital technology evolve by ongoing reciprocal alterations of digital technologies, changes by physical technology, and of human operations. Accordingly, we assume that the shared digital identity relates to intense exchanges but also will have positive indirect and direct effects on boundary spanning which supports technology emergence and expansion in national and global business. These positive influences will be in a complementary relationship with the rich knowledge exchanges and the identification processes. The knowledge exchanges drive boundary spanning and as such technology emergence and international expansion (Schotter et al., 2017). We propose that rich knowledge exchanges occur in local, regional, and global ties. They occur in personal and organizational ties. Digital and personal exchanges will inspire uses, enable uses, and allow leveraging and stretching the socio-technical system of digital technology.

Figure 3. 3 shows how the shared digital identity builds the fundament of the digital and co-located ties and the different strategies for digital technology emergence and global business. Direct ties but also platforms transport the technology potential knowledge and the operational process knowledge that include rich knowledge. With the greater knowledge exchange firms inspire and enable uses in other firms. Firms can stretch and leverage their technology towards other contexts and uses as well as business models when they ally or internationalize (Bouncken & Fredrich, 2016a). This advances the field and global business.

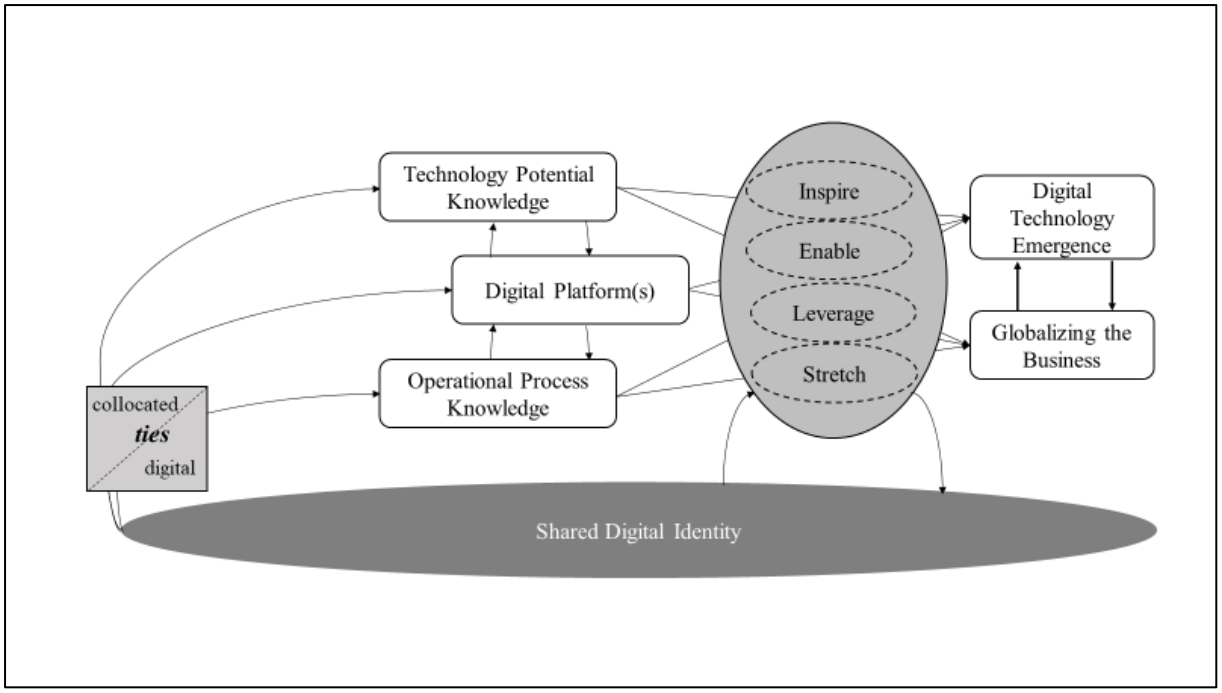

Figure 3. 3 Digital identity influencing ties, emergence, and globalization

3.8 Conclusion

Our qualitative study supports previous research in that digitalization eases global business. It finds that various digital and non-digital knowledge ties are important for global business. Our study departs portrays two forms of knowledge exchanged in local and global ties, the technology potential knowledge and operational process knowledge. Surprisingly, both include rich knowledge. Digitalization facilitates but also demands rich knowledge exchanges indicating a duality of digitalization. In particular, we find mutual values and behavior (e.g. sense of community and enthusiasm) that explain the digital exchange of tacit knowledge. From this, we derive our key theory contribution, the shared digital identity that can occur on micro, meso, and macro levels. We develop the concept of the shared digital identity as the collective self-concept(s) of an in-group towards the creation, application, development, and emergence of digital technology building on a sense of community, enthusiasm, being part of something special and common values and norms.

3.8.1 *Limitations and future research*

As a general limitation, our model relies on qualitative data so that insights might not be generalizable. Furthermore, our findings might have boundary conditions related to the 3D printing industry. Global digital business in 3D printing requires digital, physical, and human

changes that include programming, physical technology, input resources, human operations, and digital designs for 3D printed objects. Global digital business in this so-called mid-range technology relies upon digital exchanges and co-located rich knowledge exchanges to allow inspiration, enabling, leveraging, and stretching the technology. Accordingly, findings on technology potential and the operational process knowledge might only relate to a mid-range digitalization technology, which integrates physical technology and human operations. Future studies might analyze other technology fields for personal knowledge exchanges.

Still, all digitalization advancement benefits from an individual's proclivity, sympathy, fondness, mindsets, and enthusiasm towards digital technologies and being open to exchanges. These characteristics form an in-group and a boundary. Yet, the boundary shifts by communication, coordination, and the perception that others also identify with the digital technology. Thus, digitalization will be facilitated by the shared digital identity regardless of the classification of the digital technology. Future research might analyze precisely how a shared digital identity develops in social interactions. Leadership within a firm might influence a shared digital identity. Some narratives of leaders might be more or less useful in shaping a shared digital identity or organizational digital identity. Researchers might explore how leadership in local or global networks can shape a shared digital identity between firms on a meso-level. Event studies might clarify how shared digital identity developes in digital industries. For global business models, diversity might exist for the antecedents and outcomes of a shared digital identity. Moreover, studies might explore on what bases in-groups identify with others, especially in international ties.

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Chapter 4: Collaboration Strategies of Ecosystem Actors in Emerging Categories

With Ricarda B. Bouncken and Jeffrey G. Covin (2020).

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4.1 Abstract

Digitalization strongly affects industry boundaries and pushes the emergence of ecosystems and new digital categories. While ecosystems have been receiving increasing scholarly attention and are an essential factor in in driving forward innovation, not much is known about how firms, the ecosystem, and the category they operate in, are affecting each other. In a qualitative exploratory study, we investigate ecosystem actors operating in the emerging category of additive manufacturing. Findings indicate that the high dynamics in the category are compensated by strongly coherent norms and values among the different ecosystem actors. We show that at the intersection of the firm and ecosystem, the firms can either follow a passive, developing or radically changing approach to collaboration.

4.2 Introduction

3D printing technologies offer rich opportunities for product, service, and organizational innovation to firms in diverse sectors. Additionally, the 3D printing field includes diverse firms in sectors of manufacturing, services, software and design. Knowledge of 3D printing is dispersed among firms in the field. Innovation in the still emerging 3D printing field is strongly based upon the creation and exchange of knowledge among firms that work in business or knowledge ecosystems. While there is huge research about knowledge creation in firms and in dyad alliances, little is known about it in ecosystems. Our qualitative research explores the characteristics of ecosystems in 3D printing and focusses on how knowledge creation and exchange occur among firms in 3D printing ecosystems. We find that local and trans-local connections play an important

Researchers increasingly consider that the digital age drives changes of market and industry boundaries, new competition, the emergence of categories, and the formation of innovation ecosystems (Agarwal, Sarkar, & Echambadi, 2002; Atluri, Dietz, & Henke, 2017; Brusoni, Jacobides, & Prencipe, 2009; Porac et al., 1995). Thus, firms have to strategically address transformations based on digital technologies and various new forms of accessing and using

them (BarNir, Gallaugher, & Auger, 2003; Nwankpa & Datta, 2017), including new forms of creating and appropriating value. For example, transformations might base on specific technologies (AI, 3D: Chen, Chiang, & Storey, 2012; McAfee & Brynjolfsson, 2012; Rindfleisch, O'Hern, & Sachdev, 2017), on platforms (Boudreau, 2012; Gawer & Cusumano, 2014; Wamba et al., 2017), and on new forms of collaboration in ecosystems (Jacobides, Cennamo, & Gawer, 2018; Kapoor & Lee, 2013).

Previous research has demonstrated the high importance of innovation ecosystems for new technology creation and growth (Adner & Kapoor, 2010, 2016; Brusoni & Prencipe, 2013; Jacobides et al., 2018; Laamanen et al., 2018; Vargo, Wieland, & Akaka, 2015). Innovation ecosystems enable the collaborative sourcing of knowledge, technology, and customer relationships (Adner, 2017; Adner & Kapoor, 2010; Jacobides, Cennamo, & Gawer, 2017). Ecosystems might use digital technologies for their inter-firm coupling and for complementarities of technologies among firms, and enable a more active role of customers shaping the demand (Dedehayir, Mäkinen, & Roland Ortt, 2016; Moore, 1996). The boundary of the innovation ecosystem is not the geographical location. However, instead, the 'collective functionality' (Dedehayir et al., 2016, p. 2), i.e., when the performance of firms is strongly tied to the shared fate of the innovation ecosystems as a whole (Iansiti & Levien, 2004). Ecosystems can include incumbent (giant) firms like Amazon and Google and small and new firms (Singh, Tucker, and House, 1986). Ecosystems can compensate for low category legitimacy and firm-level smallness and newness, complicating accessing critical resources needed for digital technologies (Martens, Jennings, and Jennings, 2007). Innovation ecosystems might improve the resource access and the legitimacy of their members and bear high dynamics of roles, membership change, and changing logics (Adner, 2006; Adner & Kapoor, 2010; Kapoor & Lee, 20132016; Davis, 2016). Thus, concerning the high demands of knowledge, resources, and changes of digital technologies in emerging categories, how can firms use ecosystems to facilitate their legitimacy?

Legitimacy refers to *"a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions"* (Suchman, 1995, p. 574). We reason that legitimation does not just happen to firms but benefits from a strategic approach. Legitimation describes the process of building legitimacy (Zimmerman & Zeitz, 2002). If firms operate in innovation ecosystems, legitimacy is based on evaluations of and the firms' positions within those ecosystems. Firms might strategically pursue legitimation in ecosystems which can differ according to the

evaluating audiences (Fisher et al., 2017) and the legitimacy dimensions (Navis & Glynn, 2011). Socio-political-regulative legitimacy refers to political or explicit regulations of an environment, nation, or cross-national boundary (e.g., Zimmerman & Zeitz, 2002). Normative legitimacy refers to a judgment about the congruence between organizational characteristics and the norms in the institutional environment in which the organization operates (Suddaby, Bitektine, & Haack, 2017). Firms are perceived as cognitively legitimate when they are recognized as *"one of those"* (Bitektine, 2011), conforming to the conventions of their institutional environment (Aldrich & Fiol, 1994; Suchman, 1995; Zimmerman & Zeitz, 2002). Nevertheless, firms strategically compete with others for the attention and resources of their audiences, so they need to raise attention by standing out in their institutional environments (Rindova & Petkova, 2007). Firms also need to convey their distinctiveness (Porter, 1985), and with high distinctiveness (e.g., products, services, practices), reduce the risk of being evaluated by their audiences as too conventional. However, the distinctiveness can violate institutionalized audience expectations (Navis & Glynn, 2011). It can reduce the firm's perceived conformity and thwart efforts for cognitive legitimation. Researchers, especially on cultural entrepreneurship (Navis & Glynn, 2011), discussed how organizations can balance distinctiveness and conformity, introducing the term optimal distinctiveness (Zhao et al., 2017; Zhao et al., 2018). In narrowing down our research question, we ask how firms in 'digital-technology' ecosystems approach normative and cognitive legitimation.

To answer the research question, we use a multi-step qualitative approach. We selected the 3D printing industry in which firms require external resources for category emergence and follow a grounded theory approach (Corbin & Strauss, 1990; Glaser & Strauss, 1967). We conducted 65 interviews and used secondary data of the narratives used by firms and ecosystems. The data gathering started with 31 thorough initial open interviews. We proceeded to examine the results from the open interviews in subsequent stages by conducting multi-partner interviews in 10 ecosystems. We further used narratives and expert interviews to triangulate our data.

To contextualize our contribution, we report some of the key insights in the following. The 3D printing industry shows high dynamics associated with high uncertainty of technology, markets, and their combination but also with membership to the industry and ecosystem. For normative legitimacy, we find a high coherence of values and norms across layers regarding the firm, the 3D printing category, and the ecosystem layer. Change of normative legitimacy occurs when huge well-known incumbent 'giants' enter the category or ecosystem. Firms enter ecosystems to a) use complementarities of physical (digital) technology and b) to access and

develop digital and human processes that operate the technology system. Innovations, products, and services emerge from technological cores and around these operations. 3D printing offers diverse usages. To guide their audiences, firms and ecosystems need to clarify which physical technology and services they bring to the system (Durand & Khaire, 2017; Vargo & Lusch, 2016). Firms and their audiences seem to anchor cognitive legitimacy evaluations firstly on the material (plastic, metal, proteins) and secondly on the physical technology and operations. The material shapes the category. Ecosystems anchor a) around the core material or b) on the solutions they provide to customers by a portfolio of firms with a similar material focus. We find that ecosystems can follow a material or a solution strategy. Changes in the category and in the ecosystem rely on knowledge exchanges. Intense transfer of knowledge on technology potentials reduces the distinctiveness of firms in the innovation ecosystem but also brings forth the technical core of the ecosystem. Intense transfer of operational knowledge drives receptiveness among firms and improves customer service quality by the ecosystem.

We classify (see figure 1) normative and cognitive legitimacy on different layers (i.e., firm, category, and ecosystem). We provide a strategic lens to legitimation (see figure 2), separating a passive-adaptive, developmental-nurture, or disruptive-inflammational approach in ecosystems. Theoretically, our study informs strategic behavior of firms that operate in ecosystems of the digital age (Adner & Kapoor, 2016; Brusoni & Prencipe, 2013; Jackson, 2011; Jacobides et al., 2017) with respect to normative and cognitive legitimation (Navis & Glynn, 2010, 2011; Zhao et al., 2017; Zhao et al., 2018).

4.3 Method

4.3.1 Industry setting

We chose the 3D printing industry as the industry structure mainly consists of multi-partner ecosystems that work together in development as well as production. Further 3D printing is an emerging and growing industry, which is considered as being very innovative. This is due to the number of 3D printable materials constantly increasing, driving technology use and innovation (Rindfleisch et al., 2017). Ecosystems in the 3D printing industry consist of manufacturers of 3D printing devices (e.g., for 3D printing using plastic, metal, proteins), industrial clients (e.g., for rapid prototyping, rapid tooling, and digital manufacturing), suppliers of materials, scientists, and labs, software developers, designers of the printed objects, and end-customers (Berman, 2012). The progress in the surrounding innovation ecosystem has

a major influence on technology acceptance and thereby substitutes old technology in general, but specifically in the 3D printing field where different technologies emerge and are related to different firms (Adner & Kapoor, 2016). The 3D printing category continuously gains importance because of lower production costs, especially for smaller or individualized lots, increases in material variety, increasing usability, allowing fast and flexible prototyping and customized products (Lipson & Kurman, 2013). 3D printing may change business models, value chains and supply chains (Rayna & Striukova, 2016; Piller, Weller, & Kleer, 2015; Teece & Linden, 2017). Accordingly, the 3D printing ecosystem is based upon member's modules, but also on the functional coupling (Akaka & Vargo, 2013; Adner & Kapoor, 2016; Jacobides et al., 2017).

4.3.2 Qualitative methodology

We followed a qualitative exploratory research approach to understand and contextualize legitimization processes in ecosystems active in the 3D printing industry. An exploratory study is well suited to uncover causalities, allows for contextualization, and helps to communicate and develop theory (Welch et al., 2011). Qualitative research enables more detailed insights into the processes underlying the observed phenomena, which are hard to reveal using cross-sectional research designs (Larson, 1992; Taylor & Søndergaard, 2017). We chose a two-step research approach, starting with open interviews. This first step was aimed at creating a general understanding of opportunities, challenges, and involved players. It enabled us to continuously reduce the breadth of our inquiry and concentrate on the emerging topic of multi-layered legitimization processes (Parlett & Hamilton, 1972). Secondary data, collected before the interviews, contextualized the information gathered in this first round of open interviews. For the second step, we chose 10 cases of ecosystems in which we conducted semi-structured interviews focussing on the topic of multi-layered legitimization processes. For the analysis of our interviews, we follow a grounded theory approach indicating important and interesting quotes (Corbin & Strauss, 1990; Glaser & Strauss, 1967)

To address our research question, we selected companies that significantly include 3D printing in their activities. We purposefully selected these firms to generate a sample representing different cases of 3D printing use and intensity to cover our areas of theoretical interest (Seawright & Gerring, 2008Purposeful enabled us to seek a maximum of variation in our cases (Lincoln & Guba, 1985; Patton, 1980). Our sample, therefore, consists of similar and

contrasting cases (Lincoln & Guba, 1985;). We choose new cases simultaneous to the data collection.

We started our data collection by gathering archival material and conducting open interviews with middle and upper managers of companies using or offering products and/or services related to 3D printing. 31 interviews were carried out at different locations in Europe between June and November 2017. Two interviewers conducted the interviews (average: 60 minutes duration). Our main data source consists of 34 semi-structured interviews within ten ecosystems. We started our selection process on archival data to identify five persons in different firms/networks to interview. Afterwards, we applied a snowballing technique to identify additional informants who could enrich each case. We ensured that informants were suitable and covered many different perspectives throughout our sample. Interviewees stem from different hierarchical levels and functional positions. The interviews took place between December 2017 and December 2018.

4.3.3 Analysis

The analysis of the ecosystem cases is based on a two-step process. We started by using an open coding technique (Charmaz, 2014). We coded each interview sentence by sentence, indicating interesting findings and passages. Researchers met regularly to discuss the coding so that we reached a common set of codes. This process ensured that the data was interpreted similarly, and no relevant information was overlooked. We arrived at a final set of codes with sufficient relevance to our research topic through coding meetings and discussions to resolve emerging issues in the data. We scanned the concepts for similarities and differences using axial coding for the specific ecosystem. We then analyzed the archival data and conducted a literature analysis going back and forth between the literature and emerging theory, thereby supporting confidence in our findings (Eisenhardt, 1989). The heterogeneity of managerial decisions is determined by the personal capabilities of managers as well as the available organizational capabilities, as these are the basis for managers' actions (Adner & Helfat, 2003). Dynamic managerial capabilities are shaped by managers' human capital, social capital, and cognition (Helfat & Martin, 2015).

4.4 Results

The first set of interviews was conducted to understand the situation firms in the 3D printing industry face when trying to gain legitimacy. This set of interviews revealed that the firms are

active in a highly dynamic and volatile environment. Development and innovations take place in ecosystems that are dependent upon one another. Our analysis indicates that the ecosystem adds an additional layer to gaining legitimacy with firms aiming to gain legitimacy on the layers of the ecosystem and the emerging category. Entering an ecosystem, therefore, is a strategic decision with a broad impact on the firm. To analyze this dualism, we chose an in-depth case study approach.

Our second step, an in-depth analysis of 34 firms in 10 ecosystems, revealed how these firms deal with the challenges of gaining legitimacy regarding the two different layers and which specific strategies they apply. Our analysis shows that firms focus on normative and cognitive legitimacy. We find that normative legitimacy relates to the congruence of the firm with the norms in its environment – here, in particular, the digital technology category and ecosystem. Our results show that on the category level, community plays an important role for normative legitimation. Community focuses on beliefs about the technology, its potential, and values pertaining to reciprocity, openness, sharing, and common actions. Firms need to embed normative legitimacy in their identities and convey them in narratives. We further find a high coherence of values and norms on the category, firm, and ecosystem layer. These become especially important when new players enter the category or ecosystem.

Our results further indicate that firms and ecosystem specifically refer to the components, which firms contribute to the ecosystem. We find that cognitive legitimacy forms along the material, physical technologies, and operations of the ecosystem. The cognitive legitimation occurs during extensive knowledge exchanges regarding the input material, which appears to be the anchoring point for most ecosystems. We identified an additional source of cognitive legitimacy: the common solution in the ecosystem.

Upon comparing the 10 ecosystems we discovered three distinctive strategies which firms apply in order to gain legitimacy. Firms would either take a passive approach adapting to current norms and values in their chosen ecosystem and making sure to fit in. The second strategy is of a more developmental nature. Firms take over a lead role within the ecosystem and start directing interactions and influencing the ecosystem's components and direction. The third identified strategy is of a radical nature creating disruption within an established ecosystem through ownership change. This approach includes the creation of new identities aimed at new audiences.

4.5 Discussion

Today, firms increasingly enter innovation ecosystems in order to access external resources (Adner & Kapoor, 2010; Brusoni & Prencipe, 2013; Jackson, 2011). Especially, the digital age encourages firms to strategically operate in innovation ecosystems accessing complementary resources and pursuing legitimation. Legitimacy is crucial for firms and their growth, especially when they have liabilities of smallness and newness and when they operate in emerging digital categories with low category legitimacy (Durand & Khaire, 2017; Navis & Glynn, 2011). Emerging (digital) categories as new industries are in the process of legitimation and have little history, standards, or practices of legitimacy (Zimmerman & Zeitz, 2002). Innovation ecosystems allow influencing legitimacy. Firms might purposefully select ecosystems coherent with their legitimacy concerns, i.e., those ecosystems that cohere with values, norms, and expectations in the category.

Additionally, firms might strategically consider how they exert influence on values and norms and on ecosystem legitimation. The ecosystem context might influence how audiences evaluate the legitimacy of firms and how firms might deliberately influence their legitimacy. Previous research looked on ecosystems (e.g. Jacobides et al., 2018) and on legitimacy of new ventures (e.g. Laamanen et al., 2018) separately. Our study approached to understand how ecosystems affect legitimation and vice versa.

Our research is qualitative due to the complexity and richness of the research context, along with the relative paucity of prior theorizing about multi-level legitimacy dynamics in the digital era. Our multi-stage explorative study offers insights into theory development domains pertaining to legitimation. Figure 1 condenses insight to theory building by classifying and explaining normative and cognitive legitimacy on different layers (i.e., firm, category, and ecosystem). We find that cognitive legitimation anchors on the material technology in balancing distinctiveness and coherence on the firm layer. Components and coupling inform about the legitimation on the ecosystem layer. The ecosystem legitimation strategy can focus a) around the core material or b) on the solutions they provide to customers by a portfolio of firms with different and also similar materials focus. These two distinctions indicate a categorization strategy of the ecosystem (Kodeih, Bouchikhi, & Gauthier, 2018).

	Normative legitimacy	**Cognitive legitimacy**	
Firm with reference to category layer	Shared frame by sense of community Technology as value driver pushing the category the firm	Distinctiveness vs. conformity of the firm is anchored on the material-technology	
Firm with reference to ecosystem layer	*Core Values* Trust Mutuality and reciprocity *Processes* Sensemaking and metastructuring in the firms. Signaling of values in personal encounters.	*Components* Optimal distinctiveness anchors on material technology and underlies legitimation for both physical technology and services	*Coupling* Distinctiveness vs. receptiveness to specific partners and ecosystem. Dyad and ecosystem has different coupling approaches due to specific interaction
Ecosystem layer	Coherence of values and sense of community among members and the category transcend to the ecosystem Disruptions by giants from other categories or with a huge resource base and thus different audiences	Optimal distinctiveness follows a mix of product vs. solution strategy and on tight vs. loose coupling. Emergence of the ecosystem by institutionalized learning. Strategy change by giants	
Relations among layers and strategic alternatives	Coherence of normative issues among layers. Signaling of values	Legitimation and strategies of the firm are tighly connected in the categories and ecosystems. Changes remain on learning, especially institutionalized learning (even programs) on physical technology and practice operational knowledge. It enriches a network effect.	

Figure 4. 1 Layers and legitimacy

In a second matrix (Figure 4. 2) we contribute to theory development by stating and separating legitimation as passive-adaptive, developmental-nurture, or disruptive inflammational. Firms and ecosystems can follow a passive-adaptive legitimation strategy. More actively, firms and ecosystems can experience and follow a developmental-nurturing strategy. Third, firms and ecosystems might experience or pursue a disruptive form of legitimation that we refer to inflammational. Key for strategy and legitimation is learning and knowledge exchange (Volberda, Foss, & Lyles, 2010). Knowledge exchanges among firms on technology potential and operations processes develop the firms and the ecosystems.

	Passive-adaptation	**Developmental nurture**	**Disruptive inflammational**
Normative Legitimacy	Coherence among value/category/ecosystem Attending category meetings/workshops Nuturing values	Claim making/signaling in narratives Identity sensemaking Direct interactions among levels of the ventures and layers of the ecosystem	Collaboratation with organizations having dissimilar audiences Changes of ownership/ management team
Cognitive Legitimacy	Selection of venure‘s materials technology anchor Selection of ecosystem entry along its selection strategy on product vs. solutions Selection of components attributed to the ecosystem Seletion and coherence with ecosystem coupling practices: destinctiveness vs. receptivenes	Influence on ecosystem along the components and the coupling approach Deliberate institutionalization of knowledge exchange programs on material technology and operational knowledge develops components and coupling on the venture and ecosystem layer	Crafting ecosystem identites and claims targeting other audiences Sourcing of resources outside the category New entrants in the ecosystem bringing dissimilar audiencnes (large incumbents and customers)

Figure 4. 2 Collaboration Strategies

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Part 2: Internal Perspectives on Managing Digital Transformation and Diversity

Chapter 5: Managing Directors as Enablers of Digital Transformation in SMEs

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5.1 Abstract

The advent of digital technologies is causing companies of all sizes and industries to change dramatically. The integration of digital technologies offers them the potential to renew processes, products, services, as well as business models. While the path to digital transformation has already received scholarly attention for large and medium-sized companies, it remains unclear which capabilities are necessary for small companies, especially those that offer a service directly to the customer. Further, it remains unclear how these capabilities are developed. Based on a qualitative empirical study, we show the decisive role of the manager in the process of digital transformation. Furthermore, our results show how managers of small companies use their own social capital, the renewal of their own managerial cognition, and the development of organizational digitalization skills to go through a digital transformation.

5.2 Introduction

Digital technologies are increasingly transforming and influencing today's businesses (Teece, 2018). In the process, they may undergo a digital transformation (DT), a change in the way a company uses digital technologies to develop a new digital business model and help create more value for the company (Verhoef et al., 2021). DT is accompanied by a fundamental transformation of business strategy, business processes, enterprise capabilities, products, services, business models, and key inter-firm relationships in extended enterprise networks (Bharadwaj et al., 2013; Bouncken & Barwinski, 2021; Vial, 2019). Investments in digital technologies, which are seen as relevant to companies' strategic agility while supporting long-

term success (Yoo, Henfridsson, & Lyytinen, 2010), are steadily increasing globally (Shirer & Murray, 2019).

While current research generally agrees on the importance of corporate DT and the process of DT for large and medium-sized companies has been actively researched (Soluk & Kammerlander, 2021, Verhoef et al., 2021), there is still a lack of evidence on how small firms that cannot rely on strategy departments, digitalization officers or departments can achieve a DT. This question becomes particularly relevant when the companies current business model is designed for direct customer contact, making it challenging to implement a fully digital business model, which is considered the highest level of possible digitization activities (Verhoef et al., 2021). Examples of such businesses are local craft businesses, restaurants, hairdressers, or fitness studios that operate as independent service providers on-site and focus on human-to-human interaction. Processes and products can be digitally supplemented, but a completely digital business model is difficult to imagine.

Large and medium-sized companies can build dynamic and organizational capabilities by implementing CDOs (Horlacher & Hess, 2016), digitalization officers, and digital units (Westerman et al., 2011; Soluk et al., 2021). However, small enterprises (SMEs; < 100 employees) are often characterized by human and financial resource constraints (De De Massis et al., 2018). They must conscientiously weigh the risks to decide whether and how it is reasonable and sustainable to deploy resources on DT projects (Rosenbusch, Brinckmann, & Bausch, 2011). In this regard, the responsibility for the DT in small firms rests with the general managers (GM), and the success of the DT depends on their capabilities (Li et al., 2018). We use the Dynamic Managerial Capabilities (DMC) approach (Adner & Helfat, 2003; Helfat & Martin, 2015) as the theoretical background for our study, as it invokes different personal capabilities of GMs as a feature of heterogeneous managerial decisions (Adner & Helfat, 2003). The DMC framework appears to be the best possible approach since in small firms, the GMs themselves decide for or against DT and determine its scope. Their capabilities determine the direction and actions of the companies. Leading us to the following research questions: (1) How can GMs of small, established companies shape digital transformation? (2) Which skills of the GMs are crucial for a successful digital transformation?

For this purpose, we carry out a theoretical and then a qualitative-empirical investigation of the necessary management skills. In the qualitative study, we examine independent fitness studios that are exclusively owner-led regarding their handling of DT.

Our analysis shows that small firms in the service sector will only start DT if GMs first develop dynamic management capabilities and then use them to build organizational digitalization capabilities. Furthermore, we show the central role of the GM in the DT of small firms and how small service firms use DT to increase their service quality and compete with cheaper digital competitors.

5.3 Theory

5.3.1 *Digital transformation*

In recent years, countless studies (Besson & Rowe, 2012; Cha, Hwang, & Gregor, 2015; Cha et al., 2015; Vial, 2019), special issues in academic journals (Bresciani et al., 2021; Lamberton & Stephen, 2016; Lanzolla et al., 2020) and contributions to practice and policy (Bilefield and Seitz, 2017; World Economic Forum, 2017) have been published on DT. In this regard, the existing literature presents a diverse picture with a wide variety of definitions of DT. For example, in the information technology literature, DT has been defined following Lucas Jr et al. (2013) as transformation brought about by transformational information technologies. However, in marketing, the focus is on social media, advertising opportunities, and the different channels used to reach customers (Lamberton & Stephen, 2016; Verhoef, Kannan, & Inman, 2015). In strategic management, the focus is on conceptualizing as well as changing business models (Foss & Saebi, 2017). To ensure a broad view, we follow Verhoef et al. (2021), who define DT as a change in the way a company uses digital technologies to develop a new digital business model that helps create and appropriate more value for the company.

DT is driven by new digital technologies such as Big Data, artificial intelligence, the Internet of Things, blockchain, or cloud computing (Nambisan, 2017). These technologies have a far-reaching impact on the way companies operate and are changing internal processes (Verhoef et al., 2021). With new digital technologies, the competitive environment is also changing, with more and more digital startups competing with established companies. Furthermore, customer needs are also changing due to the availability and familiarization with digital technologies. In the context of a DT, a company first goes through the digitization stage, in which analog information is transformed into digital information (Verhoef et al., 2021), followed by digitalization, in which IT and digital technologies are used to change existing business

processes (Li et al., 2016). DT is seen as the highest level in which company-wide change leads to new business models (e.g., Kane et al., 2015).

5.3.2 *Digital transformation in SMEs*

Concerning the DT of SMEs, few studies explicitly address this issue. Matarazzo et al. (2021) show that DT changes the value creation and co-creation process and creates competitive advantages. Hassan, Reuter, and Bzhalava (2020) show that not only managerial attitudes but also internal capabilities contribute to the adoption of social media and cloud computing solutions. Li and colleagues (2018) are the only ones to address the relevance of the dynamic capabilities of the GMs themselves and their contribution to the innovation of platform companies.

Current research on digital technologies in SMEs has mainly focused on selected drivers and consequences of DT. Peer influences (Macredie & Mijinyawa, 2011) positively impact decision-makers regarding the use of new software. Moreover, the adoption of digital technologies can be particularly beneficial for manufacturing SMEs (Müller, Buliga, & Voigt, 2018). Recently, Soluk and Kammerlander (2021) showed that DT in family-owned SMEs follows a stage model by first digitizing processes, then products and services, and finally the business model. Following these stages, companies need to develop operational and dynamic capabilities (Soluk & Kammerlander, 2021).

Therefore, it is crucial for smaller companies to recognize how far their company is actually digitalized to develop and implement strategies for DT (Bley, Leyh, & Schäffer, 2016; Soluk & Kammerlander, 2021). Especially in consumer-oriented industries, such as healthcare, retail, tourism, sports and entertainment, legal services, or financial services, the digitization of direct customer touchpoints and experiences can lead to a better understanding of customers and sales processes (Dai & Kauffman, 2002; Pyo & Bouncken, 2003) and result in a decisive strategic advantage (Gray et al., 2015).

In this context, Besson and Rowe (2012) already noted that DT is more of a management problem than a technical problem: Successful DT requires not only the procurement and provision of technical resources, but above all, the overcoming of management problems (Doherty & King, 2005). Several studies indicate that IT-based organizational transformations need to be initiated from the top level (Westerman et al., 2011). Especially in SMEs, there are often no internal structures (departments and positions) to deal with such strategic issues (Duhan, Levy, & Powell, 2001). In addition, GMs in small firms often do not have the

appropriate training or adequate experience to recognize the potentials of digital technologies for their company (Santarelli & D'altri, 2003) and successfully design a DT. In the process of DT of small firms, the cognitive inertia of many managers may pose an additional challenge (Li et al., 2018). To date, research has not explicitly addressed the necessary skills of small firm managers in the context of DT.

5.3.3 *Dynamic Managerial Capabilities*

The focus on DMC is significant in the context of small firms because managers in small firms have a critical influence on the strategic direction and success of the organization (Li et al., 2018). In contrast, the Dynamic Capabilities approach (Teece, Pisano, & Shuen, 1997) is often used as a basis for considering DT in large and medium-sized enterprises (Soluk et al., 2021; Matarazzo et al., 2021). Here, dynamic management capabilities refer to the ability of managers to develop, integrate, and change organizational resources and capabilities (Adner & Helfat, 2003).

The heterogeneity of managerial decisions is determined by the personal capabilities of managers as well as the available organizational capabilities, as these are the basis for managers' actions (Adner & Helfat, 2003). Dynamic managerial capabilities are shaped by managers' human capital, social capital, and cognition (Helfat & Martin, 2015).

In this context, human capital refers to the skills and abilities of managers, which can be developed through school and company training, practical experience, or learning-by-doing (Adner & Helfat, 2003). Generic knowledge can often be helpful, whereas the transferability of job-, industry-, or company-specific knowledge may not (Helfat & Martin, 2015). A diversified team of managers with complementary knowledge, experience, and skills is more likely to identify and exploit opportunities (Wright, Coff, & Moliterno, 2014) and reconfigure organizational resources, capabilities, and structures (Helfat & Martin, 2015).

Entrepreneurial social capital results from managers' social relationships and can confer influence, control, or power (Helfat & Martin, 2015). The basic assumption here is that goodwill from managers' social relationships can be transferred to other situations, such as the entrepreneurial context (Adner & Helfat, 2003). In particular, information can be transferred from another context (Adner & Helfat, 2003), market opportunities and risks can be better identified (Adler & Kwon, 2002), and organizational resources can be put to new uses (Helfat & Martin, 2015). This supports GMs in the execution of DT.

Managerial cognition refers to managers' views, beliefs, and thought patterns that serve as the basis for decision-making. It includes both the knowledge and assumptions of managers about future events and their impact on the business. It is of particular importance because managers do not have absolute information transparency of future events. Each of the three components can per se be the cause of different dynamic capabilities of managers and therefore of different strategic decisions. Moreover, the capabilities interact with each other (Adner & Helfat, 2003).

5.4 Method

5.4.1 *Research design*

We used a qualitative study to answer our research question. A qualitative approach is particularly suited to answering questions about how and why the observed phenomena occur (Yin, 2009).

Our study follows an exploratory research design to investigate managerial capabilities (Welch et al., 2011). The study is based on multiple case studies within a single industry (Eisenhardt, 1989), as case studies are particularly suited to provide accurate and valuable theoretical insights within new research contexts (Eisenhardt & Graebner, 2007). Although we are studying a new phenomenon, our main goal is not to establish a radically new theory but to further develop existing theory (Graebner, Martin, & Roundy, 2012).

For this main objective, systematic combination is particularly suitable as an evaluation approach (Dubois & Gadde, 2002). It is characterized by a systematic matching of empirical data and literature (Dubois & Gadde, 2002). Therefore, an abductive logic is used that integrates inductive and deductive reasoning (Durand & Vaara, 2009). The approach allows for the integration of existing literature and new empirical findings.

5.4.2 *Setting and case selection*

Our study is based on 16 small firms in the German fitness industry. The German fitness market was chosen as the setting to enable an investigation of small firms that offer a service that cannot be fully digitized. The study of fitness studios allows the investigation of DT in an industry where the physical presence of customers characterizes the business model and yet have to compete with fully digital offerings (e.g., Freeletics). The focus on small firms excludes the large and global companies and puts the empirical focus on the role of GMs. Furthermore, the fitness and health industry is undergoing a transformation due to digitalization (Pfannstiel

& Da-Cruz, 2018). Fitness studios as service providers focus on the digitalization of direct customer touchpoints (Gray et al., 2013) and the digitalization of the training experience.

The German fitness market was the most successful in a European comparison, with annual sales of 5.3 billion euros (2018) (Rutgers et al., 2019). Over 11 million members, 4.5% more than in the previous year, train in one of the total 9,343 private fitness facilities (Rutgers et al., 2019). While 35% of members work out at the largest 10 provider chains (Rutgers et al., 2019), individual providers can still compete in the market. Increasing investment by chain operations complicates the situation for single providers and necessitates investment in digital technologies. Digital technologies, especially mobile apps, are increasingly entering the fitness and health industry and gaining user acceptance (Pfannstiel & Da-Cruz, 2018). Changing customer needs and expectations drives the industry's digitalization, resulting in lower barriers to entry for new potential competitors and providing opportunities for existing providers to innovate and grow (Pfannstiel & Da-Cruz, 2018). Training devices themselves are also becoming increasingly digitized (Kamberovic et al., 2019).

We purposefully selected 16 cases and interviewed key informants to investigate the DT of SMEs in the fitness industry (Kumar, Stern, & Anderson, 1993). We applied purposeful sampling to replicate the phenomenon of DT in order to derive commonalities (Yin, 2009). Due to their overwhelming importance in the context of DT (Li et al., 2018), we predominantly interviewed owners, GMs, and club leaders as they have the best insights (Kumar, Stern, & Anderson, 1993) on DT. Table 5. 1 provides an overview of the fitness studios we studied and classifies them into the stages of DT.

5.4.3 *Data collection*

We conducted semi-standardized interviews for data collection. We interviewed a total of 16 owners or GMs. In addition, we interviewed a sales representative, as several interviewees portrayed manufacturers of digitized training software as key partners in the process of DT. The interview with the sales representative allowed us to better categorize the case companies and to improve the global understanding of DT in the fitness industry. The semi-standardized interviews included questions about digitalization in strategy and business model, digitalization of the company, training experience, company culture, company environment, and the future of fitness industry digitalization. The interview guide was written in collaboration with industry experts, taking into account the specifics of the German fitness market. At the beginning of the study, we conducted a pilot interview to further optimize the interview guide. We carried out

the interviews in person, on-site at the informants' companies between January and May 2018. Each interview lasted approximately 60 minutes. The interviews were recorded and subsequently transcribed. During the study, the guide was adapted to emerging insights to continuously improve the knowledge gained (Corley & Gioia, 2004) . In a further step, data triangulation was made possible by adding internal and external secondary data.

Table 5. 1 Description of the companies and interview partners

Case	Legal form	Foundation	Monthly charge	Members	Number of employees	Main informant	Position Since	Age	Digitization phase
1	GmbH	1990	74,00 €	1.100	16	Owner-manager	2009	54	Process & Service
2	GbR	2016	64,00 €	148	2	Owner-manager	2016	38	Process
3	GmbH	1991	88,00 €	634	21	Owner-manager	2013	32	Process
4	GbR	2006	65,00 €	1.500	19	Studio management	2017	23	Process & Service
5	GmbH	2003	55,00 €	1.571	15	Managing Director	2010	36	Process & Service
6	GbR	2003	65,00 €	1.850	50	Owner-manager	2003	40	Process
7	EU	2010	85,00 €	1.080	14	Owner-manager	2010	49	Process
8	GmbH	1989	112,00 €	2.300	55	Owner-manager	2011	37	Process & Service
9	GbR	2003	77,00 €	2.280	50	Studio management	2017	38	Process & Service
10	EU	2018	49,99 €	200	2	Owner-manager	2018	33	Process & Service
11	EU	2017	69,90 €	1.900	22	Owner-manager	2017	30	Process & Service
12	GmbH	1986	78,00 €	1.600	35	Owner-manager	2010	36	Process & Service
13	GmbH	1982	64,00 €	600	9	Owner-manager	2010	42	Process
14	EU	2007	61,00 €	1.600	20	Managing Director	2007	57	Process
15	GbR	1992	85,00 €	1.300	18	Owner-manager	1992	54	Process
16	EU	2016	69,99 €	230	7	Owner-manager	2009	28	Process
17	Self-employed	-	-	-	-	Sales representative	-	-	

5.4.4 *Data analysis*

The data analysis is based on the coding process presented by Gioia, Corley, and Hamilton (2013). After a thorough transcription process, we used an open coding technique. Informants' statements were coded in vivo, i.e., as close as possible to the informants' wording and understanding (Gioia et al., 2013). If this was not possible, we paraphrased statements using short sentences (first-order concepts) (Strauss & Corbin, 1998; Van Maanen, 1979). We clustered the codes into categories and used axial coding to look for similarities and differences between the categories to condense the first-order concepts into second-order themes. In this step, we looked for patterns in the concepts while also looking for existing theories that could explain the patterns and further deepen the understanding of DT (Gioia et al., 2013). In this process, we derived five overarching categories that map the necessary capabilities for DT of small firms. Last, we used selective coding to further condense related categories into overarching dimensions (Strauss & Corbin, 1998). Table 5. 2 shows an overview of the data structure evaluated. Appendix 1 provides an overview of sample citations for each category.

Table 5. 2 Overview of the data structure

1st order concepts	*2nd order themes*	*Aggregate dimensions*
▪ **Strengthening internal relations** o **Family and customer involvement** o **Preservation of the family corporate culture** ▪ **Strengthening the external network** o **Establishing and maintaining own network** o **Achieve loyalty and long-term cooperation through personal commitment**	*Development of own social capital*	**Dynamic management skills**
▪ **Occupation with new trends** o **Exchange with industry insiders** o **Engagement with industry press, social media, and attendance of trade congresses** o **Interest in new technologies** ▪ **Reflection of the current standards** o **Questioning the status quo of industry processes** o **Questioning the technologies currently in use** o **Willingness to divest & invest**	*Renewal of own thought and cognitive patterns*	
▪ **Use of external digitization expertise to build up KnowHow and KnowWhy** ▪ **Establishment and use of knowledge management**	*Development of technological know-how*	**Development company digitization capabilities**
▪ **Managing director as role model** ▪ **Building a forgiving culture** ▪ **Empowerment of employees/ delegation of responsibility** ▪ **Exchange of experience**	*Building experiential knowledge*	
▪ **Positive work mentality** ▪ **Development of emotional intelligence** ▪ **Communication skills training** ▪ **Building Coaching Skills** ▪ **Arouse curiosity and enthusiasm in customers**	*Promotion of social and leadership skills*	

5.5 Findings

Our results show that for DT in small gyms, GMs themselves take a central role. GMs face diverse challenges and new opportunities with an initially traditional business model based on the physical presence of customers and local training. The analysis shows that the firms themselves were in different stages of the DT process. Companies 2, 3, 6 ,7, 13, 14, 15, and 16 were in a phase where the GMs themselves were still developing their digitalization capabilities.

Companies 1, 4, 5, 8, 9, 10,11, and 12, on the other hand, were in a phase of developing organizational and dynamic capabilities and began to integrate digital training equipment and software. This phase began as soon as GMs had built their own dynamic management capabilities and shifted their focus to DT. In the following, we describe the individual aspects that lead to a) forming dynamic management capabilities and b) an entrepreneurial digitization competence.

5.5.1 *Dynamic management skills*

The evaluation shows that GMs of small firms need specific and dynamic skills to initiate DT. The two central dynamic skills are developing the managers' own social capital and renewing their own thought and cognitive patterns.

Strengthening internal relations

Successful DT requires strong relationships with the relevant stakeholders. Our evaluation shows that, in addition to family and employees, customers play an important role in this process. Among other things, customers were seen as *"part of the studio family"* (I6). It was elementary for the GM to strengthen the relationships with these groups and involve them in decision-making.

In a large number of companies, trust between management, employees, and customers was highlighted as a core element. This trusting relationship is the basis for convincing customers to make changes: *"People are the focus. My guests come here, they give me trust, and I want to justify the trust by solving problems"* (I3). Strengthening internal relationships remains critical for GMs to retain customers over the long term. Including internal stakeholder groups such as own family and employees and building trust and developing and maintaining a family corporate culture contributes to strengthening relationships. Many GMs even see customer loyalty as the highest corporate goal, which remains a central factor for companies in all their DT considerations.

Strengthening the external network

A well-maintained personal network of the GM is listed as a critical success factor in the fitness industry: *"Without a network, you are just nothing in the fitness industry."* (I17). The interviewed managers used advanced training or congresses to develop networks that still exist today and thrive on the personal relationship between the managers.

In general, GMs attach extraordinarily high importance to expanding their networks. Establishing contacts across industry boundaries is also the goal of many GMs: *"Otherwise, of course, as an entrepreneur, owner, it is always nice to be out and about in different industries, simply to actually expand my network"* (I11). Relationships are maintained regularly to keep a positive relationship. In building relationships, GMs focus on loyalty and long-term partnership. This applies to relationships with other fitness entrepreneurs, as well as manufacturers and vendors (I6). The ability to strengthen the external entrepreneurial network helps GMs access a broader range of experience as well as information from different industries. Thus, the external network contributes directly (contact with technology providers) and indirectly (experience from different industries & personal sentiment) to a successful DT.

Renewal of own thought and cognitive patterns

In order to successfully deal with the challenges at the beginning of the DT process and not be overtaken by competitors, the GMs regularly deal with new trends and developments. They also critically reflect on the attractiveness of current industry standards to keep their offering attractive to customers and prospects. These activities enable the GMs to shed their old ways of thinking and mental models and see digitalization as an opportunity rather than a threat.

For many of the service entrepreneurs interviewed, the analog approach is still the *focus "I actually have more analog construction sites than digital ones"* (I7), but it is nevertheless evident that all of the managers are keeping up with new trends in order not to lose touch. To this end, the managers use external networks, trade journals and exchange information with industry insiders. In particular, visiting the fitness and bodybuilding trade show (FIBO) is the standard for many of the respondents: *"FIBO is one of the big topics in the fitness sector. I mean, all the innovations are always visible there"* (I4).

The GMs are not limited to their own industry and also visit trade fairs on the topic of digitalization that are not related to their field. Keeping abreast of new trends and developments requires openness and an interest in change. Only those who are open to new things will consciously take the time to deal with trends and developments. This approach helps the GMs surveyed to take on a pioneering role:

> *"I haven't had any special training, it's just the interest in it. I have an affinity for technology myself, in terms of different platforms as well, and I simply want to introduce things that others don't even have on their radar yet."* (I5)

When dealing with new developments, the surveyed GMs look at the industry and their own company to critically reflect on current standards. GMs scrutinize their customer journey, such as check-in or additional services in the catering area. Along with this, the use of existing technologies is also regularly scrutinized. For example, GMs analyze whether membership management is up to date or whether the management software needs to be expanded in some areas. Technologies, if outdated, can have a negative impact on the development of the company. For this reason, they must always be critically analyzed and kept up to date.

The final step is to reflect on processes that are customary in the industry and to deal with current developments: In this step, the fundamental willingness to invest as well as disinvest is evaluated, because: *"you have to invest in order to generate growth in the long term"* (I12). However, investments do not always turn out as hoped. GMs must, therefore, also be prepared to disinvest (I15). The ability to renew managerial cognition is a complex and highly individual process. Thus, DT can be initiated through the constant renewal of entrepreneurial thought patterns and decision-making bases, despite the lack of technological capabilities.

5.5.2 *Development of company digitalization capabilities*

The results show that GMs of companies 2, 3, 6 ,7, 13, 14, 15, and 16, after developing their own dynamic capabilities (See Chapter 4.1), made efforts to develop digitalization capabilities and digitalize the training equipment as well as the training software in the company. They had recognized that as technology changes continue, companies need different dynamic and operational capabilities to deal with change. As Soluk and Kammerlander (2021) found out, operational capabilities are essential for digitalizing services, such as a technological infrastructure, dynamic capabilities to reorganize routines, and capabilities to process and use new information. We refer to these capabilities as the digitalization competence of companies. In companies 2, 3, 6, 7, 13, 14, 15, and 16, digitization competence is composed of the ability to develop technological know-how, build up experiential knowledge, and promote social and leadership competence.

Development of technological know-how

Due to a lack of their own technological capabilities, the GMs surveyed often draw on external digitalization expertise to develop technological know-how and know-why. Manufacturers and providers of technological solutions act as knowledge brokers and set the pace for developments in the industry. In addition to their actual products and services, they increasingly offer additional services in form of training or continuing education. Training is often provided

by specially trained personnel who impart both technical basics and concept knowledge. It is important that GMs and employees understand why new technologies are used and what the benefits are for all concerned: *"It's not how you use it, but why you use it that is decisive"* (I12). Only if employees recognize the benefits for themselves and their members in the new technology will they also pass this knowledge on to members. The GMs are the driving force here, initiating the workshops and training sessions.

In principle, the topics of training and further education play a major role for all the GMs surveyed. After all, the fitness studios surveyed position themselves in a quality niche, which requires highly qualified personnel. Professional and innovative training is a particular focus of the managers.

External training and continuing education are used to generate knowledge and strengthen the external network. Here, every employee must have basic knowledge in all areas. It is therefore essential to keep knowledge within the company and to implement internal training for knowledge sharing. The GMs surveyed, which are already making efforts to develop digitalization expertise at the firm level, are always striving to build up in-house technological know-how, keep this within the company and pass it on to all employees.

Building experiential knowledge

Understanding the functionality and benefits of digital technologies forms the basis for further development and practical application in the company. All employees were encouraged to use digital technologies and integrate them into the company. The managers are role models and drivers who motivate employees through their own willingness to change and learn (I12). Furthermore, the managers tried to create an atmosphere in which employees feel comfortable and are encouraged to experiment with digital technologies. Error tolerance was named as a decisive criterion for a fast learning curve (I4).

In the course of a project, the managers want to hand over responsibility to employees in the final step to gain additional experience and build up security and competence. This is also an advantage for the managers, who can use their time for new projects. Experience gained, as well as technological know-how, is exchanged within the team in order to improve processes continuously. Some managers hold regular workshops for this purpose.

Promotion of social and leadership skills

Despite the ongoing digitalization of the fitness industry, it is inconceivable for many of the interviewees that fitness employees will be replaced entirely by technologies and machines in

the future (I11). Instead, people are playing an increasingly important role for quality providers in the context of advancing digitalization and automation: *"The human component is very important, i.e., we see ourselves as knowledge brokers, we really see ourselves as coaches"* (I8).

The GMs do not see the focus here as being on a fully digitalized business model, but rather on optimization of services and products through digital technologies. The time capacities gained should enable employees to concentrate on personal support as a core element: *"that the employee has much more time for the customer"* (I1). In direct contact, employees must identify customers' goals, guide them and motivate them. The GMs interviewed particularly address the necessary emotional intelligence of employees, who need extraordinary empathy, tact, and good communication skills in direct customer contact.

The promotion of organizational social and leadership skills in the fitness industry was already crucial before the DT to retain customers in the long term. In the context of DT, that skill is becoming increasingly relevant in order to continue to work personally and individually with members despite the growing use of new technologies. GMs cite this capability as critical to survival. Therefore, the ability to promote social and leadership skills can be seen as a crucial success factor in mobilizing internal resources and working successfully with both technologies and customers.

5.6 Discussion

The study aimed to investigate how the GMs of small, established companies can shape DT and what skills are required to do so. Our study provides important contributions to the understanding of the DT of SMEs, the role of the GM, the handling of service companies where customer presence is an important aspect, and the handling of digital competitive pressure.

First, the study results show that small firms face different challenges than medium-sized and large companies, which have both higher financial and human resources (De Massis et al., 2018). While organizational and dynamic capabilities are paramount in midsize and large companies, they are initially secondary in small firms. In small firms, transformation does not occur if the GM does not engage with digital technologies and the potential transformation itself. A sole focus on organizational and dynamic capabilities of the organization (Soluk & Kammerlander, 2021) is not sufficient in small firms. These findings complement Hassan et al.'s (2020) view that internal capabilities can influence a decision to use digital technologies.

However, we show that in the digitization and digitalization phase of small firms, the GMs themself provide the impetus for the formation of these internal capabilities.

Furthermore, we show that the organizational and dynamic capabilities (Soluk & Kammerlander, 2021), which are necessary for the digitization of processes, products, and services in small firms are only triggered by the GM. For example, Soluk and Kammerlander (2021) show that hierarchy in the company that leads to decisions against digital technologies can be intervened by other members who frame digitalization as a money-making opportunity. This process cannot be applied to small firms in this way; although the results show the importance of internal and external social networks, there was no evidence of active influence.

Regarding the found digitalization capabilities in the company, we present how active knowledge management can bundle the knowledge necessary for DT and make it applicable. These findings are supported by previous studies by Bouncken and Pyo (2002), which show that knowledge management is essential as a competitive advantage. Furthermore, our findings that experience sharing and involvement of all employees are essential for DT are confirmed by Bouncken, Ratzmann, and Winkler (2008), who showed that teams only reach their full potential when they have a specific diversity.

Finally, in the area of promoting social and leadership skills, our results show that the digital business model, often postulated as the ultimate goal of DT (Verhoef et al., 2021; Soluk & Kammerlander, 2021), is not pursued by all firms. Several of the case firms positioned themselves in such a way that the digitalization of processes, products and services were merely supporting measures. These enabled them to focus on service and higher quality standards in their dealings with customers. This indicates that service providers, for whom customer presence is an important aspect, expect competitive advantages from an analog focus. This result is exciting because it shows companies a possible way to survive in the changing market without committing to a fully digital business model. This point will also become more relevant after the current Covid 19 pandemic when the question arises as to whether the current accelerated digitalization of all aspects will continue beyond the pandemic or whether there will be a trend back to more analog business models.

In addition to the theoretical implications presented above, our results have practical relevance for the GMs of small firms. Our results clearly show that in small firms, DT must be initiated by the respective leading GM. GMs need to actively engage with technologies, challenge their views, and build an active network both internally and externally to address DT successfully.

Further, we show that a fully digitalized business model does not always have to be the goal for every company. In industries that offer the opportunity to use direct customer contact to position themselves as service providers, this is a valid option. DT should nevertheless be actively used as a tool for optimizing processes and freeing up human resources.

Like all scientific studies, our study is subject to certain limitations, which offer potential for future research. The qualitative study exclusively surveyed owner companies from the fitness industry in Germany. The results of the present work could therefore be unique to the specific regional and economic context. In particular, the industry specificity may limit the transferability of the results. Validating the results in other contexts or investigating the benefits of analog business models in digital times offer the potential to advance current research on digitalization and provide a more nuanced view of DT.

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5.8 Appendix

Table 5. 3 Overview of sample citations

Topic	Quotes
Strengthening internal relations	*"Yes, you also have to get [...] the employees [...] on board. So it's no use saying from the top: starting tomorrow it will be implemented this way, if the willingness to do so is not there at all, you have to [...] get everyone on board." (I1)* *"So our vision is indeed, as they say, to create a personal environment, even though we have a lot of members here, to really create the family environment. Yes, that is, even in the team the mission statement is quite simply not a collegial approach, but really a friendly approach to each other. And there we also look for people who fit into the team accordingly." (I5)*
Occupation with new trends and developments	*"So for me personally, the most important thing was these network meetings. That is, the exchange with the other studio operators. [...] And in these network meetings, of course, the manager, or whatever you want to call it, always pointed out new trends and presented new things. So we were always up to date." (I1)* *"[...] I'm online an incredible amount. And I actually catch everything there. So I'll say it very gently and tenderly, I'm very much on the go on Instagram, Pinterest, Facebook and whatever else [...]" (I7).*
Reflection on current standards	*"And then if you basically want to reconcile the whole thing with your conscience and really say you want to be a good trainer and help people move forward as safely as possible, then you can just say doesn't work with the concept like that [...]." (I10)* *"So there is nothing where I would say that we have a very, very big brakeman. So that will definitely not prevent us from becoming even more successful than we currently are." (I5)*

Development of technological know-how	*"We provide the framework conditions where we know that it is necessary, but the operator does not always see it that way and knows it. That is also not the task of a studio operator to know that. [...] The industry has to be able to communicate that." (I17)* *"I had had two training sessions through eGym [...]. Who then came to us in-house [...]. Once a concept briefing, then again a technical briefing." (I8)*
Building experiential knowledge	*"[...] With every new topic that comes along, I naturally have to develop myself accordingly and then also pass this on to my employees." (I1)* *"First and foremost, I am always the project manager. And my task as studio manager is then also to inform the employees about the project, the content and if necessary [...] also to train them and to make sure that they are controlled [...]." (I9)* *"[...] I then rather moderate that and then say ok, what did you notice and how do we want to improve that. What ideas do you have. That works very well with the employees, because there is a very great momentum." (I8)*
Promotion of social and leadership skills	*"So that the employee has much more time and is not only busy with some bureaucratic tasks [...], but that the employee simply has much more time for the customer, also sometimes for a personal conversation." (I1)* *"The whole interpersonal thing, which plays a huge role. That's completely in the foreground here. We have members who are really grumpy if you don't ask them in training how it's going [...]" (I10).* *"[...] Education and training [...], when it comes to sales training for the employees, is very, very important, or that the employee knows what words to use to describe the benefits [...]." (I12)* *"It's going to be the human component, the coach, that's going to become more important, that's what we're modeling. Coaching will become more important because I can now capture good training plans digitally." (I8)*

Chapter 6: Cross-Cultural Diversity-Management in Service Firms

With Ricarda B. Bouncken, Andreas J. Reuschl, Céline Viala (2018).

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6.1 Abstract

The European health care sector is facing tremendous challenges, especially related to international diversity. The demographic change is generating an ageing population with rising demands for medical services, lacking the ability to train sufficient numbers of medical professionals. Foreign health care professionals migrate to central Europe, especially to Germany to fill the gap in the health care labor market. The migration and internationalization increases national and cultural diversity in hospital workforces. Our study contributes an adaptation of a Service-Profit Chain model for hospitals and then empirically investigates the impact of diversity on the service capabilities of German hospitals. Our results show that the Service-Profit Chain is applicable to hospitals and that workforce diversity has a negative indirect impact on employee job satisfaction and thereby on productivity.

6.2 Introduction

European, especially German hospitals have been struggling with a tense economic situation for more than a decade. They face a demographic change and the intense migration of refugees that require health care, as next major challenges. The ageing population in Germany requires a higher proportion of sufficiently trained health care professionals which are not available in Germany. Trend analysis show an alleviation of the skills shortage by a considerable migration of medical professionals (Reuschl et al., 2013).

Whereas the migration supports the efforts of hospitals to retain and enhance their service capabilities, the effective management of workforce diversity becomes a major challenge for hospitals. Empirical studies show the high importance and effects of diversity on organization and performance within firms in other industries (Jonsen et al., 2011; Stahl et al., 2010; Zhou and Shi, 2011). However, services in hospitals differ from services and non-services in other industries. Berry and Bendapudi (2007) identified several important characteristics of hospitals: Patients, the so-called customers, are not actively demanding health care services, they are sick, have to give up their privacy, and often their lives are at risk. The customers for hospitals are

dependent on receiving the service at the right time in the right quality. The provision of services in hospitals relies on human labor. Although high-technology medical equipment builds the core of the service process, standardization and automation have high limitations.

Health care services in hospitals require the interaction of employees and patients as well as the participation of professionals with different professional backgrounds. The service sector is one of the most relevant sectors for the growth of the international economy (Parellada et al., 2011) and it relies heavily on human labor. While initial issues like personal conflicts or communication difficulties (Stahl et al., 2010) already arise in a non-diverse setting, negative interaction effects intensify with the introduction of various nationalities and cultures in the service delivery process. Cultural values play a very important role in how institutions work (Sagiv and Schwartz, 2007), thus the interaction between health care professionals and patients can be endangered as people from different cultures have different expectations of appropriate service (Donthu and Yoo, 1998). In contrast to other service offerings, in hospitals already minor misunderstandings or misconceptions can induce serious health problems in the medical treatment.

Following Harrison and Klein (2007), diversity describes the heterogeneity in an organization related to specific attributes. Therefore, the internationalization of the workforce adds new attributes to the already inherent diversity, endangering the efficiency and effectiveness of the service processes. The research on the organizational impact of diversity is inconclusive and insufficient for the health care sector. Numerous studies show a positive impact of diversity on different aspects of organizational performance, especially innovation performance (Bouncken et al., 2016; Jonsen et al., 2011; Zhou and Shi, 2011). A number of studies provide evidence on a negative impact (Gonzalez and DeNisi, 2009; Weech-Maldonado et al., 2011). The tense economic situation, the demographic change and the increasing migration highlight the importance of studying the impact of age, gender, and cultural diversity on satisfaction, and e.g. performance. Thus, the question is how hospitals are affected and can cope with diversity.

This paper follows the question of how the diversity of hospital employees influences the service quality of hospitals, organizational outcomes and how a hospital can cope with the effects of diversity. We draw on the Social Identity Theory to explain the effects of diversity, propose the Service-Profit Chain (SPC) as an empirical framework to test if diversity influences employee job satisfaction via internal service quality and we test if diversity management influences the impact of diversity.

We assume that diversity has a direct impact on the internal service quality in hospitals which in turn affects the organizational outcomes via the already well-established SPC logic. The contemporary research on service companies offers the SPC as a framework for the analysis of selected influences on service companies (Heskett et al., 2008; Heskett et al., 1997; Kamakura et al., 2002; Silvestro and Cross, 2000). The SPC proposes a series of variables that explain how an organization's attributes enable the creation of services and the generation of growth in profits and revenue. The SPC connects internal and external factors, explaining the success of service companies (Heskett et al., 1997). Diversity describes the composition of the workforce related to specific attributes. Hence, it facilitates an assessment of the structural level of organizations which represents the SPC's starting point.

We develop a modified SPC that investigates the impact of diversity in hospitals based on the social identity theory and test our hypothesis using a large-scale data-set. Our data-set includes 529 responses from physicians and nurses employed in 30 German hospitals matched with quantitative secondary data from German health insurance companies.

Our paper contributes to the literature in two content-related areas. First refining the prevalent work on the SPC (Heskett et al., 2008; Homburg et al., 2009; Loveman, 1998; Silvestro and Cross, 2000; Steinke, 2008) we introduce a modified SPC for hospitals. Second, we show that increasing diversity in the German health care workforce influences the Service-Profit Chain. We provide novel insights on the literature on diversity in hospitals, a specific form of service firms, and diversity management (Curşeu, 2013; Janssens and Zanoni, 2005; Skaggs and Kmec, 2012; Stahl et al., 2010). In methodological terms, we contribute an adapted framework of the SPC for empirical analysis that use information from two sources, from hospitals and insurance companies. Our results provide empirical insights into the impact of employee diversity on their satisfaction, the service quality and hospital outcomes. Additionally, we show that a superficially implemented diversity management is not capable of effectively managing diversity. Finally, detailed descriptive statistics give managerial implications to improve the effectiveness of diversity management.

6.3 Theory

6.3.1 *Service-Profit Chain in hospitals*

The SPC, introduced by Heskett et al. (2008), consists of a chain of variables which explain the link between internal service quality and the profitability of service companies. The model

received great attention in service management research and has been validated in numerous empirical studies (Bates et al., 2003; Homburg et al., 2009; Kamakura et al., 2002; Lau, 2000; Loveman, 1998; Steinke, 2008). The basic SPC consists of six links, explaining the impact of internal service quality on performance. Subsequently, the linkages of the SPC are summarized following Heskett et al. (2008):

(1)The internal service quality represents the attitude of employees towards their work, which is determined by human resources practices and, e.g., workplace design. Internal service quality positively influences employee job satisfaction.

(2)Employees with high satisfaction levels are supposed to be more productive and to have a higher intention to remain in their organization. Employee job satisfaction positively influences employee retention and productivity.

(3)External service value represents the performance in service delivery, perceived by the customers. Employees who plan to remain in an organization and show high levels of productivity improve the perceived performance. Employee retention and productivity positively influence external service value.

(4)Customer satisfaction is a function of expected and delivered service quality: External service value equals the perceived service quality and positively influences customer satisfaction.

(5)Satisfied customers are expected to request a service more frequently: Customer satisfaction positively influences customer loyalty.

(6)Customer loyalty implies more frequent business, high levels of recommendation, and a growth in the customer base: Customer loyalty positively influences revenue growth and profitability.

The basic structure of the SPC is profit oriented and offers important implications for the management of profit-oriented service companies. Though hospitals are service providers (Lynch and Schuler, 1990), the nature of the service itself is different to ‘standard’ service firms. Customers try to avoid the consumption health care services but often need to, especially in the case of an emergency (Berry and Bendapudi, 2007). Even the delivery of high-quality services is no guarantee for a patient’s full recovery (Lynch and Schuler, 1990). Revenue is regulated by the German government (Schreyögg et al., 2006). Steinke (2008) acknowledges these circumstances through the introduction of the service outcome chain, a modification upon

the structure-process-outcome paradigm (Donabedian, 1980). Therefore, employee retention and productivity are substituted through service climate and employee empowerment, revenue growth and profit are replaced by client empowerment. This approach allows for bypassing the restricted profit orientation in the public health care sector. Considering the economically tense situation and the anticipated increase in demand for health services, it is particularly important to retain the basic economic principles of the classic SPC. Therefore we will stick close to the model introduced by Heskett et al. (2008) and adjust the SPC on the process and outcome level. Our proposed research model is depicted in Figure 6. 1.

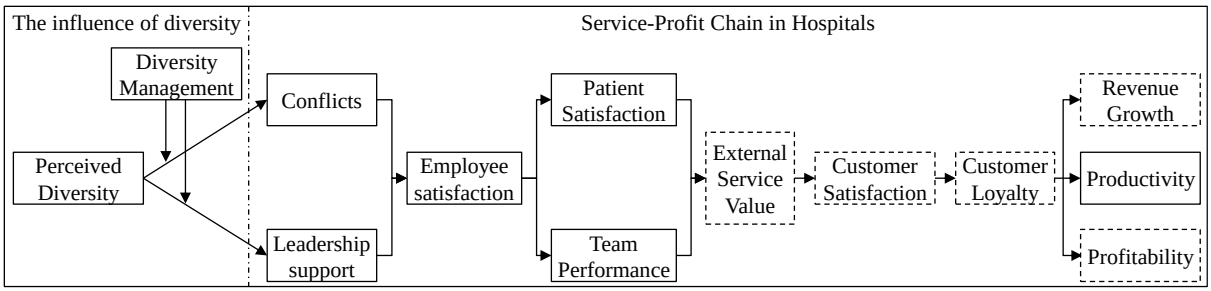

Figure 6. 1 Research model

In terms of internal service quality, the structure level of the SPC, hospitals equal service providers in other industries. The internal service quality represents *"the feelings that employees have toward their jobs, colleagues, and companies"* (Heskett et al., 2008, p.168). Loveman (1998) puts internal service quality in concrete terms and defines the construct as the quality of organizational support. Based on the author's argumentation, we apply two dimensions in our modified SPC. Conflicts serve as an indicator for the horizontal interaction quality, leadership support for the vertical interaction quality in the workforce.

Following the SPC logic, the internal service quality positively influences employee job satisfaction which is the starting point of the process level. While we maintain the link between employee job satisfaction and team performance, we forgo employee retention which is already well-known to be highly correlating with employee job satisfaction (Tett and Meyer, 1993). Following Homburg, Wieseke, and Hoyer (2009) we establish a direct link between employee and patient satisfaction which is supported by numerous studies (Rucci et al., 1998; Schlesinger and Zornitsky, 1991). The measurement of patient satisfaction represents an approach to integrate the constructs external service value and customer loyalty, as the satisfaction of patients is a result of the experienced services and higher levels of satisfaction increase the intent to repeat the utilization of services from an organization (Johnston, 1995; Newman et al.,

2001). In fact, most patients are not sufficiently qualified to judge the quality of a medical treatment and satisfaction hence is an excellent indicator of the overall service quality (Marley et al., 2004).

Another modification at the SPC is necessary at the outcome level. In contrast to other sectors of the service industry, such as hotels and restaurants, where customer satisfaction often leads to loyalty which translates to revenue growth and profitability (Soriano, 1999, 2002), hospitals have only limited possibilities to use this strategy. The frequency of the utilization of hospital services is determined by random external factors which lead to emergencies (Berry and Bendapudi, 2007) and the profitability is regulated on the state level (Schreyögg et al., 2006). We argue that the logic of the SPC is applicable to hospitals regardless of these limitations. The service productivity literature agreed on the important role of the customer in service processes (Grönroos and Ojasalo, 2004; Parasuraman, 2002; Vuorinen et al., 1998). This is especially relevant in hospitals, where the service production is dependent on an efficient interaction between staff and patients. Therefore, we argue that high levels of patient satisfaction and team performance positively influence the hospital productivity. Productivity is the ratio of the output divided by the input of an organization. The prevailing productivity measurement in the hospital productivity literature is the ratio of the number of treated patients (output) divided by the number of employed personnel (input) (O'Neill et al., 2008). With the introduction of a productivity ratio instead of profit or revenue, we are able to maintain the economic foundation of the SPC while adjusting it to the core service of hospitals, patient treatment.

H0: The modified hypotheses of SPC are valid for hospitals. Conflicts negatively, and leadership support positively influences employee job satisfaction. Employee job satisfaction positively influences patient satisfaction and team performance. Patient satisfaction and team performance have a positive influence on hospital productivity.

6.3.2 *Social Identity Theory and diversity*

The SPC represents a structured setting for understanding important factors in the service provision of hospitals. The framework of the social identity theory (SIT) enables a deeper understanding of the single constructs in the SPC. The SIT proposes that individuals try to categorize their social surroundings (social categorization) and themselves (social identity) based on selected features (e.g. color, occupation, nationality, gender) into groups (Ashforth

and Mael, 1989; Homburg et al., 2009; Tajfel and Turner, 1986). The application of specific criteria for the categorization process depends on the individual preferences. It is not even necessary to apply salient features to initiate categorization processes. Experiments gave evidence that the formation of groups on the base of randomized features is sufficient to start categorization processes (Hogg and Turner, 1985; Turner, 1984). Employees in a hospital might form social groups based on profession (physician, nurse), age (old, young), or e.g. based on a random team composition.

Being a member of a group raises the self-awareness through the favorable comparison of in- and out-groups and creates a positive social identity (Tajfel and Turner, 1986), leading to better team performance (Hajro, 2009). Individuals have the ability to allocate themselves to a group with the highest degree of similarities in their value concept. Following Tajfel (1982) the group membership has a cognitive, evaluative and emotional component. Members are aware of their belonging to a specific group, positive values are attached to this membership, and emotional investments sustain the membership, while altruism is fostered (Acar, 2014). Simple examples illustrate the possibility of changing a group by personal efforts. Either a change of mind enables an individual to leave a psychological group like a political party, or an effort to change salient features facilitates the change, for example, advancement in the career. However, the cognitive elements, personal values, and emotional investments attached to the membership in a group represent exit barriers (Tajfel and Turner, 1986).

An application of the SIT on the SPC offers an important explanatory value, especially for the integration of the influence of diversity. As diversity describes the heterogeneity in a group based on certain attributes like gender, culture, nationality, or e.g. occupation, it can be acknowledged as an additional trigger for social categorization processes (Harrison and Klein, 2007). If people perceive themselves to be very different, they can be expected to form delimited groups. The similarity/attraction paradigm supports this proposition and states that people who perceive themselves to be very similar are attracted to each other (Hentschel et al., 2013). Both approaches emphasize the influence of diversity. As diversity increases, the availability of visible and invisible characteristics grows, too. Categorization features like occupation, gender, or age can be complemented by characteristics like nationality, culture, language, or religion.

Numerous studies measure diversity on an objective level (Østergaard et al., 2011; Richard et al., 2007; Stahl et al., 2010; Zhou and Shi, 2011). The distinction between objective (visible)

and subjective (invisible) characteristics implies that categorization processes are based on perception (Hogg and Turner, 1985). Two physicians might consider each other as completely different on the base of culture, or they might perceive themselves as similar due to their occupation. Based on the SIT we agree with the recent literature and emphasize the importance of perceived diversity (Allen et al., 2008; Hentschel et al., 2013; Hobman et al., 2004).

The considerable impact of diversity on organizations has already been demonstrated. Stahl et al. (2010) conducted a meta-analysis and analyzed the effects of diversity in teams with the data of more than 100 empirical studies. The results showed that diversity can enhance creativity, satisfaction, but conflicts as well. The authors could also support the propositions of the SIT, as the negative impact of diversity on social integration was demonstrated. A final decision on the impact of diversity on performance could not be reached, yet (Jonsen et al., 2011; Richard, 2000; Weech-Maldonado et al., 2011). However, the importance of mediating variables in the diversity-performance link is obvious (Kearney and Voelpel, 2012). Whether diversity unfolds a positive or a negative effect depends on further influences like organization, management, leadership, and of course on the perception of diversity (Cunningham, 2009; Puck et al., 2010).

6.4 Hypotheses

The SPC emphasizes the importance of internal factors for a successful organization and offers a line of argumentation for the connection of internal factors to performance indicators like revenue growth and profitability (Heskett et al., 2008). Consequently, internal service quality can be viewed as the origin of profitability and revenue. Internal service quality *comprises "(…) the feelings that employees have toward their jobs, colleagues, and companies."* (Heskett et al., 2008, p.168). Following the given definition, the constituent part of internal service quality are the relations between employees on a horizontal dimension (colleagues) and a vertical dimension (organization). This is especially true for hospitals, as the production of services in hospitals relies upon the interaction between employees in interprofessional teams and the interaction of these teams with patients.

Based on the interaction perspective of internal service quality, the effective management of the increasing diversity in German hospitals gains an important position for the long-term success of hospitals. The state-of-art research on diversity-related effects is supporting this

assumption. While prior research assumed a direct effect of diversity on outcomes such as performance (Williams and O'Reilly, 1998), more recent literature expects diversity to be effective via mediating variables (Kearney and Voelpel, 2012; Stahl et al., 2010). Based on the SIT, the consideration of mediating variables seems to be accurate. Firstly, social categorization processes evolve when differences between individuals are perceived; the sole existence of diversity cannot be held responsible for any effects. Harrison et al. (2002) could give evidence on the mediating role of diversity perception between actual diversity and outcome variables. Secondly, the actual and consequently the perceived diversity can be expected to have a major organizational impact when diverse members are involved in direct interaction. Of course, diversity can directly affect global organizational variables like climate. However, the major effects on communication, creativity, innovativeness, or for example trust result from the interaction of the employees in the work process (Hentschel et al., 2013; Stahl et al., 2010).

In correspondence with our research framework, diversity is able to affect horizontal and vertical relations in the workforce. The horizontal relations comprise the interactions between employees on the same hierarchical level. According to the SIT, increasing diversity is offering more characteristics or features for categorization processes. If the workforce consists only of male employees of the same nationality, with the same professional background, chances are high that the workforce conceives itself as one group. Increasing the diversity of a workforce in terms of gender, language, and e.g. professional background raises the likelihood for the formation of separated subgroups. Social categorization processes could occur on the base of each feature. A typical categorization feature in hospitals is the occupational background, which leads to the formation of physician and nurse groups. The SIT enables an understanding of the negative effects of such group formations in hospitals. Individuals strive for a positive self-awareness, which can be reached through the differentiation of in- and out-groups. As a group comprises individuals with shared value concepts, negative feelings are attached to the out-group, which is formed by members with differing characteristics. The comparison between in- and out-group can lead to the emergence of conflicts or even discrimination (Ashforth and Mael, 1989; Messick and Mackie, 1989). Especially when occupational barriers prevent the switching of groups by own efforts (Tajfel and Turner, 1986).

Conflicts are an important consequence of social categorization processes (Jehn, 1995; Jehn et al., 1999; Stahl et al., 2010; Wegge et al., 2012) and can be distinguished between relationship and task conflicts (Jehn, 1995). While relationship conflicts are based on interpersonal

incompatibilities, task conflicts emerge from differing viewpoints and ideas concerning how a task has to be approached. As the differentiation shows, conflicts are the result of social processes. Both kinds of conflicts, therefore, are a qualified measure to judge the internal service quality between employees on the same hierarchical level. Frequent conflicts attest unsolved or latent and smoldering issues within the workforce (Pondy, 1967). As the SPC argues, the internal service quality, determined through conflicts can cause a decreasing employee job satisfaction (Heskett et al., 2008; Steinke, 2008).

Increasing diversity is leading to more conflicts (Stahl et al., 2010). The introduction of new features like gender, educational background, or e.g. cultures on a visible surface-level is connected with the introduction of new value concepts, beliefs, and routines on a deeper level. The effects of diversity are extensive and range from the formation of subgroups and increasing conflict potential to discrimination and social exclusion (Burkard et al., 2002; Jehn et al., 1999; King et al., 2012; Pelled et al., 1999). The SPC facilitates the understanding of diversity in an organizational context. Thus we hypothesize that diversity is increasing conflicts, which in turn reduce employee job satisfaction.

H1: Conflicts mediate the negative effect of perceived diversity on employee job satisfaction in hospitals.

Leadership support is the second dimension to describe the internal service quality. While conflicts serve as an indicator of the quality of horizontal relationships in the workforce, leadership support represents hierarchical relationships. The concept of leadership support is closely linked with organizational support, social support and social integration (Cobb, 1976; Cohen and Wills, 1985; Eisenberger et al., 1986). House, Umberson and Landis (1988) point out that the single constructs have been used interchangeably to gain insights into the quality of social relationships. Generally, the complex concept of support includes an emotional, instrumental, informational, appraisal component (House, 1981; Leavy, 1983). High levels of support offer trust (emotional), help in difficult tasks (instrumental), the availability of information (informational), and feedback concerning work style (appraisal). Consequently, leadership support can be regarded as a qualified indicator to measure the internal service quality between employees and their superiors. Embedded in the SPC, high levels of leadership support are supposed to increase employee job satisfaction (Lim, 1996; Netemeyer et al., 1997).

Perceived leadership support describes the evaluation of employees concerning their relationship to their superiors. Similar to the already introduced relations between employees

on the same hierarchical level, social categorization processes shape the perception of support. Especially the emotional and appraisal components have a high explanatory value. If superiors are regarded as members of an out-group especially the emotional and appraisal component are deteriorated. The explanatory characteristics for initial categorization processes could be salary, educational background, but also gender or nationality. Tsui and O'Reilly (1989) demonstrated that demographic characteristics shape the dyadic relation between superior and subordinate. The authors show that gender, race, and educational background have a significant effect on the dyadic relationship.

According to the SIT, additional differences between leaders and subordinates start additional categorization processes. Hence diversity will have an impact on the perceived quality of superior-subordinate relationships. Especially when diversity based on nationality, culture, language, and e.g. religion is increasing, additional effects can be expected. Communication processes are deteriorating (Davidhizar and Dowd, 1999; Gudykunst and Nishida, 2001), conflicts are increasing (Jehn, 1995), and the risk of open or concealed discrimination rises (Milliken and Martins, 1996). We argue that, overall, diversity has a negative influence on the perceived leadership support. Perceived leadership support in turn has a positive influence on employee job satisfaction, which is reversed by the negative effect of perceived diversity.

H2: Leadership support mediates the negative effect of perceived diversity on employee job satisfaction in hospitals.

Diversity is supposed to impact the internal service quality and consequently the whole SPC. Therefore, understanding the meaning of diversity and developing an effective diversity management is inevitable for service companies. As we know from the SIT, categorization processes, social identification, and diversity are a matter of perception. Only characteristics of individuals which are recognized have the ability to cause diversity-related effects (Schneider and Reichers, 1983). Consequently, an effective diversity management should develop the power to emphasize the commonalities and reduce the perception of dissimilarities. Thereby perceived diversity and the reasons for social categorization processes according to the SIT can be reduced or prevented (Schneider and Reichers, 1983; Turner, 1984). This is possible through the creation of an organizational climate which is promoting diversity and open-mindedness (Montoro-Sánchez and Soriano, 2011). MacKay et al. (2008, p.350), define diversity climate as *"(…) employees' shared perceptions that an employer utilizes fair personnel practices and socially integrates underrepresented employees into work*

environment (…)". Thus, establishing a diversity climate means teaching the members of the workforce to perceive diversity as beneficial.

Diversity management refers to all managerial actions with the purpose of increasing diversity and/or fostering amicable, productive relationships in a heterogenic workforce (Jonsen et al., 2011). Given that an increasing diversity in the German hospital sector is unavoidable, especially the actions aiming at improved relationships are relevant. The outcome of a successful diversity management is a diversity enhancing and inclusive climate (Triana et al., 2010). As Herdman and McMillan-Capehart (2010) argue, diversity management is an antecedent to a positive diversity climate. The organization and the management serve as role models for an acceptable handling of diversity, as they demonstrate how diversity is valued. Already the organizational implementation of a diversity management can be considered as an important and effective step towards a positive diversity climate. It demonstrates that diversity is valued and the organization is willing to invest in its positive utilization. Attitudes towards diversity are malleable (Blair, 2002; Dasgupta and Greenwald, 2001) and diversity training can teach employees to perceive diversity as an asset (Goldstein and Smith, 1999).

The SIT stresses that the formation of social identity and groups is based on the individuals perception of their surrounding (Ashforth and Mael, 1989). Diversity management offers the opportunity to influence the perception of employees. Therefore, an effective diversity management is capable of forming the effect of diversity on internal service quality. Employees can be taught how to avoid or how to handle conflicts and how to judge superior-subordinate relationships without biases (Curtis and Dreachslin, 2008; King et al., 2012). Therefore, we argue that diversity management reduces the positive effect of diversity on conflicts and the negative effect of diversity on perceived leadership support.

H3a: The positive effect of perceived diversity on conflicts is moderated by diversity management.

H3b: The negative effect of perceived diversity on leadership support is moderated by diversity management.

6.5 Method

6.5.1 *Sample*

Our sample consists of 529 employees from more than 30 German hospitals. This part of the health care sector is characterized by a growing skills shortage. One strategy to cope with the

lack of qualified personnel is the employment of foreign employees. This accounts for physicians as well as for nurses. Moreover, the hospital industry context provides good chances to demonstrate the logic and consistency of our study. As the training as physician *"(…) intend[ed]s to be color-neutral, sex-neutral, class-neutral (…)"* Beagan, 2000, p.1260 we can expect the proposed effect of professional identity to superpose the effects of dissimilarity Apker & Eggly, 2004.

The data for the current study were collected between January and June 2014. Questionnaires were filled out via two channels. First, randomly selected health care professionals from the physician and nursing service in German hospitals were asked to participate in a web-based survey. Second, a paper-pencil based study was conducted in some supporting hospitals. Therefore, the questionnaire was distributed to all physicians and nurses in the respective hospitals and the completed questionnaires were collected by the works council. Participants could choose between a German and an English version of the questionnaire. The items were originally formulated in German, translated into English, and translated back to test for comprehensibility. Divergences resulted in the reformulation of some items.

Overall, we received 907 questionnaires. After deleting outliers, incomplete questionnaires, and duplicates 529 cases remained. Next, we analyzed missing values and found that we had no systematic missing data (missings account for slightly more than 10 percent of all values). Table 6. 1 presents the descriptive statistics for personal characteristics of the respondents, institutional attributes of the hospitals, and characteristics of the survey.

Table 6. 1 Descriptive statistics for the sample of 529 employees

	Mean	*S.D.*
Respondents' characteristics		
Share of male employees	*31.80*	*.47*
Employees' age	*48.41*	*25.13*
Share of foreign employees	*17.13*	*.38*
Share of physicians	*41.11*	*.49*
Tenure in years (current job)	*13.15*	*10.74*
Days absent (last 12 months)	*2.36*	*1.54*
Institutional characteristics		
Number of employees	*632.31*	*1177.97*
Physicians	*27.95*	*33.79*
Nurses	*47.19*	*45.69*
Others	*24.86*	*10.51*
Beds	*455.94*	*612.30*
Cases 2013 (stationary)	*18850.69*	*26703.09*
Share of male employees	*25.52*	*26.12*
Share of foreign patients	*23.22*	*16.46*
Sample characteristics		
*Survey method**	*1.76*	*.43*
Duration (in minutes)	*6.20*	*6.70*

** 1 = online; 2 = paper and pencil*

6.5.2 *Measures*

In this study we use eight variables: perceived diversity, diversity management practices, conflicts, leadership support, employee job satisfaction, team performance, patient satisfaction, and productivity. The first six variables are measured as latent variables on a multi-item-scale with three to four indicator items for each construct. Patient satisfaction and productivity were captured as objective criteria from hospitals' annual quality reports. Items were assessed on a five-point Likert-scale, ranging from 1 (not at all) to 5 (I totally agree).

To cope with non-response bias we offered participants a free report of the study's results. This incentive convinced some initial non-respondents to support our study resulting in 907 responses out of which 529 were evaluable.

As we used single informants to capture most of our data common-method bias is likely to occur. To account for this statistical problem we followed the recommendations of Podsakoff et al. 2003 and Podsakoff and Organ 1986 using Harman's single-factor test and controlling for partial correlations. Both techniques resulted in satisfying outputs. Harman's single factor test for all variables except productivity used in our study resulted in a factor explicating less

than 30 percent (28.6%) of the variance of all constructs. To apply partial correlations we built a factor of the independent variables (diversity, conflicts, and leadership support) with our main dependent variable (employee job satisfaction) and then analyzed correlation coefficients controlled for the new factor named "M" (or merge). When controlling for "M" correlations coefficients between dependent and independent variables were still significant. Hence, common-method bias seems not to be an issue in our analysis.

The independent variable in our research design is the perceived diversity of migrated physicians and nurses. Hobman, Bordia, and Gallois 2004 developed six items to measure the perceived visible, value, and informational dissimilarity of individuals (Cronbach's alphas .94, .82, and .88). We use three of the six items to create an overall measure of perceived dissimilarity. Sample items are *"The employees in my work unit are very different regarding their personal values"* or *"The employees in my work unit are very diverse on general terms".* The chosen items enable the measurement of surface-level and deep-level dissimilarities. The items fulfill statistical criteria for factor loadings (>.6) and they have good indicator reliability (>.4). The latent variable perceived diversity has a Cronbach's alpha of .83 and explains more than 60 percent (.62) of the construct's variance.

The scale of diversity management is meant to measure if an organization is already actively dealing with the diversity and if these actions lead to positive results. The scale was originally published by Hegarty and Dalton 1995 and also used by Triana, Garcia, and Colella 2010. We added two items *"Top leaders demonstrate a visible commitment to diversity"* from the diversity climate scale from McKay, Avery, and Morris 2008 and the newly self-developed item *"My superiors consider the diversity of the workforce when assigning tasks"*. Hereby we want to grasp the management of diversity on the organizational, leadership and task level. In our study we achieved good factor loadings and high indicator reliability for the three items. Cronbach's alpha and average variance explained largely exceed minimal requirements as can be seen in Table 6. 6 (c.f. appendix).

Our four-item scale of conflicts was developed by Spell et al. 2011 and expresses the extent of dissimilarities in the planning and the accomplishment of work due to different opinions and values. Both, single items and latent variable show good to excellent statistical fit.

The variable leadership support was chosen to capture the extent of employee-centered actions of supervisors. The three items measure to what extent supervisors show interest in the personal well-being of their subordinates. The items were chosen from the short survey of perceived

organizational support Eisenberger et al., 1986 and contain questions such as *"My supervisor really cares about my well-being"* and *"My supervisor strongly considers my goals and values"*. The variable's fulfillment of statistical criteria is excellent.

The main dependent variable in our analysis is employee job satisfaction, measuring how satisfied an individual is with his/her current job. Our scale traces back to Chew and Chan 2008 and contains three items (e.g. *"I feel fairly well satisfied with my present line of work"* or *"Most of the days I experience moments of enthusiasm"*). As for the variables mentioned above, statistical criteria are well met.

The team performance-scale captures the team's work outcomes subjectively rated by respondents. Researchers found that performance measures tend to be overrated if performance is only evaluated by single persons. We tried to avoid possible distortions by adopting the idea of 360°-feedback Brett & Atwater, 2001 to our measure of team performance. Respondents were asked to state the performance of their work-group in comparison to other groups, to state the evaluation of team performance of the hospital's general management and to quote the patient's judgment of team performance. Further, we captured performance on the more aggregated team-level instead of individual performance to avoid biases arousing from common tendencies to overestimate the individual performance Atwater et al., 1998. The resulting latent variable shows partially poor indicator reliability (ranging from .34 to .55) and yields in an average variance extracted from slightly less than 50 percent (45%). Nevertheless, we include the variable into our model because of its strong correlation with objective criteria of team performance as stated in the hospital's quality reports (medium to high correlations).

The last latent variable used in our model is patient satisfaction. As employees can't judge patients' satisfaction reliably we derived the data from hospitals' publically accessible quality reports. Our scale consists of three items measuring patient satisfaction with physicians, with care or nursing personnel and the overall rate of recommendations by patients (*"Would you recommend this hospital to your friends or relatives?"*). Each item was stated in percent ranging from 0 (not satisfied at all) to 100 (totally satisfied). Statistical criteria for the items and the construct are excellent.

The dependent variable productivity was also captured from hospitals' quality reports. It represents an index calculated by the number of stationary cases divided by the number of physicians and nursing personnel. The applied productivity ratio is already widespread in the

literature O'Neill et al., 2008. The index of productivity indicates how much personnel is needed to handle a hospital's overall workload.

Table 6. 6 in the appendix depicts the items, the constructs and their statistical criteria.

6.6 Results

To examine our hypotheses about the effects of diversity and diversity management we used the co-variance-based structural equation modeling approach (SEM) in the software package Mplus 6 Muthén & Muthén, 1998-2012. Table 6. 2 shows the correlations of the used variables.

Table 6. 2 Bivariate correlations

(N=529)

	*Bivariate correlations**	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1	*Perceived diversity*	*1*							
2	*Diversity management*	*-,083*	*1*						
3	*Work-related conflicts*	*.390***	*-.180***	*1*					
4	*Leadership support*	*-.131***	*.358***	*-.364***	*1*				
5	*Employee job satisfaction*	*-.146***	*.244***	*-.315***	*.464***	*1*			
6	*Team performance*	*-,006*	*.244***	*-.236***	*.355***	*.317***	*1*		
7	*Patient satisfaction*	*-.144***	*.243***	*-.155***	*.246***	*.124***	*.116**	*1*	
8	*Productivity*	*-.124***	*.161***	*-.104**	*,046*	*-,025*	*-,010*	*.249***	*1*

*Correlations are significant at the level p<.001***, p<.01**, and p<.05**

Our first assumption (H0) contains the application of the service profit-chain for hospitals. We therefore compiled a structural equation model with different levels of dependent and independent variables as shown in Figure 6. 1. Table 6. 3 presents the results.

Table 6. 3 Service profit-chain in hospitals, empirical results

Model-Fit: Chi2/df=2.290; CFI=.973; RMSEA=.049; SRMR=.069 (N=529)

Independent variable	*Dependent variable*	*Effect size*	
Conflicts	*Employee job satisfaction*	*-0,193*	***
Leadership support	*Employee job satisfaction*	*0,451*	***
Employee job satisfaction	*Team performance*	*0,426*	***
Employee job satisfaction	*Patient satisfaction*	*0,156*	***
Team performance	*Productivity*	*-0,027*	*(n.s.)*
Patient satisfaction	*Productivity*	*0,291*	***

*Results are significant at the level p<.001***, p<.01**, and p<.05*.*

Table 6. 3 clearly confirms that the idea of the service profit-chain is also applicable to hospitals. Our data show significant effects for each level except of a positive relationship between team performance and productivity. Thus, H0 is accepted.

Our first two hypotheses address the effect of perceived diversity on employee job satisfaction. We postulated a negative indirect effect of diversity on employee job satisfaction through increased work-related conflicts (H1) and a decrease in leadership support (H2). Though, conflicts and leadership mediate the effect of diversity on employee job satisfaction.

"Mediation, or an indirect effect, is said to occur when the causal effect of an independent variable on a dependent variable is transmitted by a [third variable, the] *mediator"* Preacher et al., 2007, p.186. To ascertain the existence and the strength of the mediating effect of conflicts and leadership support we compiled a multiple mediation model measuring both, direct and indirect effects simultaneously MacKinnon, 2008; Muthén & Muthén, 1998-2012. Results are shown in Table 6. 4.

Table 6. 4 Mediator analysis for the effects of perceived diversity on employee job satisfaction

Model-Fit: Chi2/df=1.795; CFI=.990; RMSEA=.039; SRMR=.024 (N=529)

Independent variable	*Dependent variable*	*Mediator*	*Effect size*		*acc./rej.*
Perceived Diversity	*Conflicts*		*0,464*	***	
Perceived Diversity	*Leadership support*		*-0,145*	**	
Perceived Diversity	*Employee job satisfaction*		*-0,015*	*(n.s.)*	
Conflicts	*Employee job satisfaction*		*-0,177*	**	-
LeaderSupp	*Employee job satisfaction*		*0,438*	***	-
Perceived Diversity	*Employee job satisfaction*	*Conflicts*	*-0,082*	**	*H1: acc.*
Perceived Diversity	*Employee job satisfaction*	*Leadership support*	*-0,063*	**	*H2: acc.*

*Results are significant at the level p<.001***, p<.01**, and p<.05**.*

First, we find no direct effect of perceived diversity on employee job satisfaction indicating that there is no direct relation between both variables. Second, we find that diversity has a significant direct positive effect on conflicts and a direct negative effect on leadership support. Third and as already reported for H0, conflicts and leadership support significantly affect employee job satisfaction. Fourth, we find an additional significant indirect effect of diversity on employee job satisfaction via conflicts (β=-.082**) and leadership support (β=-.063**). According to Zhao, Lynch and Chen 2010 this represents an indirect only mediation and therefore, H1 and H2 are accepted. Diversity reduces employee job satisfaction through increased conflicts and a decreased perceived leadership support.

The last two hypotheses H3a and H3b postulate that diversity management compensates the positive effect of diversity on work-related conflicts (H3a) and the negative effect of diversity on leadership support (H3b). We analyze both hypotheses with a multiple moderator model using latent interactions. Latent interaction signifies that *"the effect of a latent exogenous variable on a latent endogenous variable is itself moderated by a second exogenous variable"* Klein & Moosbrugger, 2000, p.457. The model has to contain the direct effects of the independent variables and the interaction term Muthén & Muthén, 1998-2012. For a moderator to occur the product of the two exogenous or independent variables on the dependent variable has to be significant Klein & Moosbrugger, 2000. The results of our empirical model are presented in Table 6. 5.

Table 6. 5 Moderator analysis for the interaction effects of diversity and diversity management on

employee job satisfaction

Model-Fit: Chi2/df=2.000; CFI=.981; RMSEA=.044; SRMR=.060 (N=529)

Independent variable	*Dependent variable*	*Moderator*	*Effect size*		*acc./rej.*
Perceived Diversity	*Conflicts*		*0,455*	***	-
Perceived Diversity	*Leadership support*		*-0,130*	**	-
Perceived Diversity	*Employee job satisfaction*		*-0,012*	*n.s.*	-
Diversity management	*Employee job satisfaction*		*0,075*	*n.s.*	-
Diversity management	*Conflicts*		*-0,201*	***	-
Diversity management	*Leadership support*		*0,430*	***	-
Conflicts	*Employee job satisfaction*		*-0,182*	***	-
Leadership support	*Employee job satisfaction*		*0,416*	***	-
Perceived Diversity	*Conflicts*	*Diversity management*	*0.012*	*n.s.*	*H3a: rej.*
Perceived Diversity	*Leadership support*	*Diversity management*	*-0,071*	*n.s.*	*H3b: rej.*

*Results are significant at the level p<.001***, p<.01**, and p<.05*.*

As it can be seen in Table 6. 5, the effects of perceived diversity on conflicts and leadership support persist. Additionally, the effects of diversity management on conflicts and leadership support are unveiled: diversity management decreases conflicts and increases leadership support. But contrarily to our hypotheses the interplay of diversity and diversity management does not have a significant influence neither on conflicts (.012 n.s.) nor on leadership support (-.071 n.s.). Thus, diversity management cannot compensate the positive effect of diversity on conflicts (H3a) or the negative effect of diversity on leadership support (H3b). Thus, H3a and H3b have to be rejected.

6.7 Discussion

Hospitals in industrialized countries have to meet a growing demand of an ageing population, overcome a personnel shortage, and increase their financial performance. This study suggests the SPC as comprehensive framework to face these challenges. First, we proposed a customized SPC for hospitals and conducted a preliminary test to build a framework. Second, we empirically tested the effect of diversity on employee job satisfaction, the central stage in the SPC. Specifically, we portrayed the effect of perceived diversity on employee job satisfaction, mediated via conflicts and perceived leadership support, two indicators for internal service

quality. Third, we tested the ability of current diversity management practices to shape the impact of diversity.

First, we consider the customized SPC to be valid for hospitals. Results indicate that hospitals are subject to the same cause-effect relationships as common service companies, despite the specific characteristics of health care service provision. Results show significant effects of employee job satisfaction via patient satisfaction on productivity. The effect of team performance on productivity was insignificant. This result could be a measurement issue. In contrast to employees in other service firms, physicians and nurses in our study could evaluate their performance based on medical instead of economic success.

Second, we investigated the impact of perceived diversity on employee job satisfaction. Results show a negative impact of diversity on employee job satisfaction, mediated via internal service quality. Based on the SIT, conflicts and perceived leadership support represent internal service quality. The variables describe the quality of the workforce's horizontal and vertical relationships. The results showed a highly significant negative influence of perceived diversity on the internal service quality of hospitals. The results contribute to theory-building as research on internal service quality is particularly insufficient. Heskett et al. 2008 forgo a detailed definition of this stage, later studies employed customized constructs Loveman, 1998; Steinke, 2008 or simply skipped the first stage Homburg et al., 2009. Further research should build on our definition and develop a measure of internal service quality based on the relationship or interaction quality of leadership.

Third, we rejected the moderating effects of diversity management on the influence of perceived diversity on conflicts and leadership support. This is an interesting result as the purposeful management of diversity should impact our results Stahl et al., 2010. This might point at quantitative and/or qualitative issues in our study. Regarding quantity, our sample of 40 different hospitals shows that diversity management practices such as top-management awareness and support, firm-wide workshops, and the consideration of diversity for task assignment are not common. The medium scope of all measures of diversity management is 2.4 on a 5-point-Likert-scale. Considering qualitative issues, our measures comprise organizational practices of diversity management. If firm-wide practices cannot compensate the negative effect of diversity, hospitals' diversity management should rather adopt a team focus Harrison et al., 2002.

We asked participating physicians and nurses in our survey to indicate if they know about training offerings in their organizations. 18.4% indicated not know about any training or workshops in their hospitals. We gave the remaining participants a list of specific training offerings (teambuilding, language classes, intercultural training, conflict management training) and asked them to indicate if these offerings are available and if they attended them. The responses reveal that training is rare and attendance is scarce. 13.4% of the participants knew about teambuilding training, 8.5% attended the training; 16.2% know about language training, only 2.7% made use of it. Only 3.8% indicated that their hospital offers an intercultural training and only 0.9% completed such a training. Even more frequent training such as conflict management were hardly visited, 39.4% indicated the existence of a training on conflict management and only 19.3% completed it. Besides qualitative and quantitative issues in our study, these statistics point at management issues in hospitals. Implementing an organizational diversity management is only a first step. However, diversity management cannot become effective without motivating employees and allowing them sufficient time to participate in such training.

Results indicate a strong need for further research on diversity management. As diversity and its management depend on different organizational contexts, definitions, and research approaches, a systematic research agenda is overdue Curtis & Dreachslin, 2008; Jonsen et al., 2011. A better understanding of how and when diversity management becomes effective might be achieved by investigating specific diversity management practices Yang & Konrad, 2011. However, future studies should also consider organizational mechanisms to increase the participation of employees in such trainings.

The results provide managerial implications for hospitals. First, the hospital-specific SPC enables a better understanding of the influence of employee job satisfaction on the performance of hospitals. Second, as prior research already indicated, the influence of diversity on organizational outcomes is mediated by variables such as creativity, conflicts, social integration, or the effectiveness of communication Kearney & Voelpel, 2012; Stahl et al., 2010. Whereas the direct influence of diversity on performance is contestable Stahl et al., 2010; Weech-Maldonado et al., 2011; Zhou & Shi, 2011, the mediated influence is evident. Diversity affects the SPC and thus all of its stages, from internal service quality to performance. Diversity can be an asset in service organizations Donabedian, 2005, but the utilization of this asset determines the achievable outcomes. However, according to the SIT it is particularly important to create an organizational climate of social inclusion with a focus on diversity to convert it

from a burden into an asset. Ashforth and Mael 1989b point out that the perception of diversity and the creation of a diversity-enhancing organizational climate can be achieved by managers Schneider & Reichers, 1983. Employees with differing educational, professional, cultural, and social backgrounds perform cognitive and manual interactions in the course of a medical treatment. The well-known effects of diversity Stahl et al., 2010 such as conflicts, communication problems, but also the positive effects such as creativity and creativeness become effective during the service provision. The introduction of diversity training can help to avoid process losses and improve organizational outcomes.

We recommend further research on both parts of our study, the modified SPC for hospitals as well as the impact of diversity. The measurement and necessity of the single stages of the SPC have to be investigated thoroughly considering the particular characteristics of hospitals. The influence of diversity, especially at the contact points with the SPC should be subject to further studies as well. We think that diversity can have a direct effect on further stages and moderating effects between the stages of the SPC. However, the hospital context is challenging for diversity-related research. As physician training is *"(…) intend[ed]s to be color-neutral, sex-neutral, class-neutral (…)"* Beagan, 2000, 1260 professional identity is capable of superposing the effects of dissimilarity Apker & Eggly, 2004.

Besides the impact of employee diversity on hospital productivity via the SPC, especially the diversity of patients should be considered in future research. According to the United Nations High Commissioner for Refugees 2016 in 2014 more than one million refugees entered the UN. These people, coming from a different cultural background, often struggle with European health care, as they have different expectations toward health care services Donthu & Yoo, 1998. Our paper addresses the diversity within health care service organizations. Health care services, however, always require the interaction of service providers and service recipients. Increasing diversity on both sides will strengthen the positive and negative impact of diversity and require particular attention Clark & Kruse, 1990; Langlois et al., 2016. Therefore, we want to encourage further research on diversity to consider the interaction between employee and patient diversity in health care services.

6.8 Conclusion

Facing the imminent demographic challenges, the shortage and migration of health care professionals, our study offers important findings for the effective management of diversity in hospitals. We applied a modified Service-Profit chain for hospitals and tested the influence of diversity on internal service quality. Our results show that the effects of diversity are mediated by conflicts and perceived leadership support on employee job satisfaction. As employee job satisfaction is the cornerstone of the Service-Profit Chain, we are able to explain how diversity is affecting the productivity of hospitals. A hypothesized positive influence of diversity management on the negative effects of diversity had to be rejected, pointing at the urgent need for in-depth research on diversity and the development of improved diversity management methods for the practical application in hospitals. As the Service-Profit Chain is an acknowledged research framework for service companies, we expect our results to be valid for service companies in general.

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6.11 Appendix

Table 6. 6 Results of a confirmatory factor analysis (CFA) for the measurement model

Construct	Items	Standardized factor loadings	Indicator reliability ≥ 0.4[b]	Cronbach's α ≥ 0.7[c]	Composite reliability ≥ 0.6[d]	AVE ≥ 0.5[e]	Fornell-Larcker < 1[e]
Perceived diversity	The employees in my work unit are very different regarding their personal values.	.727	.635	.829	.830	.620	.715
	The employees in my work unit differ regarding their attitudes about work.	.821	.674				
	The employees in my work unit are very diverse on general terms.	.743	.552				
Diversity management	Top leaders demonstrate a visible commitment to the management of diversity.	.730	.553	.802	.800	.572	.644
	Classes, workshops, and/or seminars for training of the diverse workforce were sponsored.	.780	.608				
	Diversity of the workforce is considered when assigning tasks.	.758	.575				
Work-related conflicts	Employees in my work unit frequently have conflicts about ideas.	.864	.746	.908	.908	.767	.795
	Employees in my work unit frequently have strong conflicts about the work we do.	.897	.804				
	Employees in my work unit have huge opinion differences	.867	.752				
Leader support Supportive leadership	My supervisor really cares about my well-being.	.914	.835	.950	.950	.826	.873
	My supervisor strongly considers my goals and values.	.907	.823				
	My supervisor always provides help when I have a problem.	.876	.767				
	My supervisor intensively cares about my general satisfaction at work.	.938	.880				
Job satisfaction	I feel fairly well satisfied with my present line of work.	.914	.835	.834	.840	.640	.794
	I feel satisfied with my present line of work all things considered (i.e., pay, colleagues, etc.).	.773	.598				
	Most of the days I experience moments of enthusiasm.	.698	.487				
Team performance	The performance of my department is superior to other departments.	.585	.342	.664	.706	.450	.598
	Top leaders are very satisfied with the work performance of my department.	.672	.452				
	Patients are very satisfied with the work performance of my department.	.740	.550				
Patient satisfaction	Patient satisfaction with physicians	.883	.780	.886	.918	.790	.927
	Patient satisfaction with care personnel	.807	.651				
	Patient recommendations	.969	.939				

[a]All factor loadings are significant ($t > 3.1$; $p < .001$). [b]Bagozzi & Baumgartner (1994). [c]Nunnally (1978). [d]Bagozzi & Yi (1988). [e]Fornell & Larcker (1981).

Fit-Indizes: chi2(df)=.000; CFI=.985; RMSEA=.032; SRMR=.037 (N=529)

Part 3: Coworking spaces as local ecosystem hubs for innovation and empowerment

Chapter 7: Changing with the Time: New Ventures' Quest for Innovation

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7.1 Abstract

New ventures are often based on new ideas and innovation. For creating and improving the innovation new ventures can draw on internal and external resources, to which they often have limited access. Our study analyses how new ventures can improve their innovation search by entering collaborative workspaces, so-called co-working spaces. In our qualitative study, we use participative observation and analyze 8 cases of new ventures operating in a coworking space. Key findings are that forms of innovation search differ with respect to the venture's life cycle. The new ventures search focus alternates between internal and external search, depending on the current stage of the venture. In general, the co-location of ventures in collaborative workspaces offers rich opportunities for social interactions, information exchange, and collaboration which are especially important for early stage ventures.

7.2 Introduction

New ventures are known to suffer from liabilities of newness because they have limited internal resources and no established connections to external actors (Brunswicker & Vanhaverbeke, 2015; Ceci & Iubatti, 2012; Edwards, Delbridge, & Munday, 2005). These limitations affect their search for internal and external knowledge and information, which are essential for innovation (Owen-Smith & Powell, 2004) and build the foundation for new business models (Chesbrough, 2010).

Current literature emphasizes the importance of search in order to be innovative (Cohen & Levinthal, 1990; Katila, 2002; Leiponen & Helfat, 2010). Also suggesting that every additional external link to information sources benefits the potential innovation outcome (Love, Roper, & Vahter, 2014). A broad variety of external information sources increases the likelihood of innovation (Leiponen & Helfat, 2010; Roper, Du, & Love, 2008), by (1) increasing the flow of

external knowledge and (2) increasing the chances of complementarities between external and internal knowledge. But there are limits to the usefulness of external knowledge (Katila, 2002; Rosenkopf & Nerkar, 2001). Broad external knowledge search leads to high opportunity costs as it takes away attention and resources from internal matters (Laursen & Salter, 2006). This is especially problematic for new ventures with limited resources. Therefore, extensive amounts of external search might cripple their capacities.

Although facing limitations new ventures are known to be the drivers of innovation and industry change due to their often innovative and creative solutions (Acs & Audretsch, 1987; Kraus, Roig-Tierno, & Bouncken, 2019). The reasons are unique advantages such as high flexibility regarding new usees of existing resources and the lack of limiting structures (Katila & Shane, 2005). The concept of innovation search has so far focused on established companies (Dahlander & Gann, 2010; Lakhani et al., 2007; Laursen & Salter, 2006) or small and medium-sized enterprises (Vahter, Love, & Roper, 2014), neglecting new ventures. New ventures build on social capital and the existing networks of the entrepreneurs (Konsti‐Laakso, Pihkala, & Kraus, 2012; Zhang & Li, 2010;).

Our study empirically investigates new ventures dealing with the challenge of generating innovations from a limited resource base. We answer the following research questions: How do new ventures generate innovations using internal and external sources for innovation? What role do coworking spaces play in the process?

We chose the setting of a local coworking space (CWS) for our study. In CWS entrepreneurs share office spaces with other businesses (Bouncken & Reuschl, 2018; Gandini, 2015). Entrepreneurs can easily build relationships and seek knowledge and information on different topics from various actors (Bouncken & Aslam, 2019). They can further learn from their competition (Bouncken et al., 2018b) and become part of the local community (Garrett, Spreitzer, & Bacevice, 2017). We conducted a two-stage qualitative research, starting with 2 months of participative observation in a local Chinese CWS. During this time we realized that the ventures could be grouped into two distinctive subgroups. We chose 4 ventures for each group and conducted 8 semi-structured interviews. We investigated how the ventures used external and internal resources to generate innovations.

Our results indicate that there are different stages of innovation seeking in new ventures. We find that nascent ventures seek innovation resources through serendipitous connections in an open process. Growing ventures focus on restricted external sources and internal development

in organizational evolution. Established ventures gain allocable resources to seek opportunities both internally and externally. The effects of CWS on the ventures' innovation search strategy changes according to the venture's stage. And cover a range from radical to incremental with ambiguous outcomes at the established stage.

Our results add to the literature on innovation seeking (Cohen & Levinthal, 1990; Dahlander, O'Mahony, & Gann, 2016; Katila, 2002; Leiponen & Helfat, 2010), by displaying, that new ventures begin their external search with a broad unstructured approach to innovation search. They look for serendipitous connections and resources, which build the basis for innovation. In the second stage, the focus changes to a deeper search with limited but close external partners. This process opens up after the venture reaches a stage of establishment. We thereby reveal that the search strategy of ventures follows the organizational life cycle (Chandler, 1962). We further find that the co-location of entrepreneurs in collaborative workspaces offers a multitude of connection possibilities which are highly important for early stage ventures.

7.3 Theoretical Background

7.3.1 *External search for knowledge, information, and innovation*

The term 'innovation' in entrepreneurial ventures describes a problem-solving activity of ventures in which they solve identified problems through the combination of knowledge elements to create new products, solutions or business models (Katila, 2002). Innovation search can take place in internal sectors (e.g. knowledge created within the venture) and external sectors (e.g. knowledge created by others) (Katila, 2002; Rosenkopf & Nerkar, 2001). The search for knowledge and new ideas within the internal sector is limited and is often less likely to generate new technological solutions (Rosenkopf & Nerkar, 2001; Dearborn & Simon, 1958). Previous research suggests that only exposure to diverse sources of information (e.g., Owen-Smith & Powell, 2004; Powell, Koput, & Smith-Doerr, 1996) provides the required variety of knowledge and ideas needed to create innovation. Solutions and discoveries are usually reached when a unique breadth of knowledge and experience is combined with the ability to draw knowledge from seemingly unrelated areas (Maggitti, Smith, & Katila, 2013).

Innovation search in the external sector has been further differentiated according to the breadth and depth of the search (Katila & Ahuja, 2002; Laursen & Salter, 2006). External search breadth relates to the variety of different knowledge sources outside of the venture. Search depth is related to the intensity with which each source is penetrated (Katila & Ahuja, 2002). Various

studies demonstrate that the breadth and depth of external search have positive effects on innovation performance (Foss, Lyngsie, & Zahra, 2013; Rosenkopf & Nerkar, 2001). A broad search for innovation increases the likelihood of a successful payoff given the risk and uncertainty associated with innovation endeavors (Joshi & Anand, 2018; Leiponen & Helfat, 2011). This idea is known as the variance hypothesis. According to Gouldner (1957) individuals who are in contact with a broad external network will gain greater knowledge and excel at taking advantage of it. These individuals benefit from the expertise generated from external ties. Research also highlights that a diverse range of expertise excels the application of solutions from the old to new domains. This enhances the efficiency of the innovation search (Gruber, Harhoff, & Hoisl, 2013; Singh & Fleming, 2010). A broad search approach goes along with access to unique information and knowledge resulting in a broader vision. It can be used for innovation of products, processes and business models (Bouncken, Kraus, & Roig-Tierno, 2019).

A broad external search scope can benefit ventures in three major ways. First, in order to innovate ventures require a huge amount of information. Information regarding other firms' product offerings and innovation activities can make opportunities more visible to new ventures (Ahuja, 2000). Second, a broadened external search scope can enrich a new venture's knowledge pool and provide more choices for the venture. This enables the venture to solve problems in new ways (Katila & Ahuja, 2002). There is a limit to the number of innovations that can be created by using the same set of knowledge elements. Search with a broad scope can increase a venture's innovation scope adding new elements to its knowledge pool. This improves the possibility for the venture to find new useful combinations of elements (Katila & Ahuja, 2002). Third, a broadened external search scope can help new ventures locate external complementary resources and capabilities that are critical for their innovation (Porter, 1998; Wolpert, 2002).

However, external search for knowledge and information does have its limits. It is recognized, that broad and deep external innovation search goes along with opportunity cost as it takes attention away from other activities relevant to the firm (Dahlander et al., 2016). This is especially limiting for new ventures who lack the depth of resources.

7.3.2 *Challenges for new ventures*

New ventures have a short history and suffer from liabilities of newness (Mas-Tur & Soriano, 2014; Stinchcomb 1965), such as limited financial, organizational, or human resources

(Williams Jr et al., 2018). Their capacity for internal innovation search is limited and external search becomes more important (Brunswicker & Vanhaverbeke, 2015; Ceci & Iubatti, 2012; Edwards et al., 2005). Prior research suggests, that new ventures can greatly profit from external ties and resources when searching for innovation (Angelsberger et al., 2017; Zhang & Li, 2010; Baker & Nelson, 2005; Starr & Siverson, 1990). Especially ties to established firms, research institutes or universities (Baum, Calabrese, & Silverman, 2000; Shan, Walker, & Kogut, 1994) have positive impacts on their innovations.

Although external ties and knowledge search are important for new ventures, they may face difficulties building up connections with established organizations. The reason lies in their short history, lack of proven performance record, limited financial and human resources, limited legitimacy and status (Stinchcombe, 1965). This often leads to limited trust (Massaro et al., 2017). They, therefore, tend to have a narrow external search scope because they typically have limited external contacts (Stinchcombe, 1965). These ventures rely upon their immediate and often personal networks for identifying opportunities (Baker & Nelson, 2005; Starr & Siverson, 1990). New ventures can further be handicapped in external innovation search by increasing search costs. Even modest external search can be too costly for ventures in terms of financial and organizational resources as well as time consumption.

While facing many disadvantages new ventures have unique advantages in benefiting from an external innovation search. New ventures do not have existing specialized structures and routines allowing them to use existing resources in new ways (Katila & Shane, 2005). They are therefore often able to integrate and recombine various forms of external knowledge to create innovations, implement them and create new forms of value (Bouncken, Fredrich, & Kraus, 2019).

7.4 Method

We applied a two-step qualitative approach for which we selected the setting of a CWS. CWS are specifically designed to cater to the needs of entrepreneurs and new ventures, who are trying to generate innovations (Bouncken & Reuschl, 2018). These hubs also provide technical, financial, and networking services that new ventures usually cannot afford individually (Saxenian, 1990). They further build on a wide network of linkages facilitating the flow of knowledge and information. Thus, entrepreneurial firms located in a CWS provide a unique realm to examine the impact on external innovation search. We selected a single CWS to minimize the influence of distinct contextual factors and focus on the research question.

7.4.1 *Research Setting*

New ventures need to focus on external knowledge sources and information and need relationships and collaborations. We believe that collaborative workspaces (e.g., accelerators, CWS or innovation hubs) where entrepreneurs share office spaces with other businesses (Gandini, 2015), are a great starting point for our study. Entrepreneurs can easily build relationships and seek knowledge and information on various topics (Bouncken et al., 2018b). They can interact and collaborate with external partners and can employ external knowledge and resources and become part of a community (Garrett et al., 2017). Increasing and improving entrepreneurship is a major motivation for users of CWS (Fuzi, 2015).

The location was DeltaHub the biggest innovation hub in China which embraces diverse entrepreneurial ventures rather than focus on one field, DeltaHub is further famous for its efficient resource integration and influential entrepreneurial activities and events. This environment allows for an active search for external innovation.

7.4.2 *Data collection*

We conducted a two-month field study observing how users work in the CWS, participating in their events and workshops, and talking with users. Aiming to describe processes of ongoing impacts from external actors. We selected a research design including participant observation, semi-structured interviews, and secondary data analysis.

Participant observation: Two researchers started the observation within DeltaHub, from August 2018 through to October 2018. They worked as observers who witnessed and recorded all daily activities. They did not reveal their role as researchers to not bias the interaction. Only the hub coordinators knew about their role and supported them by inviting them to join all the events and public meetings, as well as providing basic information about all the entrepreneurial teams in the hub, including team size, founding date, directions of their current projects. The researchers tried to minimize the influence of their presence by doing nothing except watching and recording (Edmondson & McManus, 2007).

One researcher worked in the open space and recorded each interaction between team members, among teams, and with external actors (out of DeltaHub). Due to the open-plan and loft design of the innovation hub, all the activities could be tracked. The other researcher recorded interactions in workshops and events. After one month of observation and ongoing analysis of the records more than 100 pages of field notes were generated and a substantial difference in

practices between entrepreneurial teams began to emerge: Early ventures, who are looking for ideas, were constantly interacting and discussing with other team members while entrepreneurial teams which already had a business focus and structured organization mostly focused on communication within the team and to resources outside of the innovation hub. Records from workshops, meetings, and events consolidate this finding.

The distinct attitudes toward resources in the CWS and external resources imply their different business logic as well as various effects derived from external sources. To further analyze how these distinct groups of ventures applied external innovation search strategies we purposefully selected 8 cases and conducted semi-structured interviews with key informants.

Semi-structured interviews: We followed suggestions from case study literature and selected 8 case teams in DeltaHub (Miles & Huberman, 1994), 4 cases in the early entrepreneurial phases and 4 for the later phase. To fulfill the study's objective to study external innovation search, we selected the 8 cases based on four criteria:1) it was an entrepreneurial team or venture project. 2) the team/firm had resided in DeltaHub for no less than 6 months. 3) the team/firm took advantage of the shared space by approaching experts or taking part in activities. 4) there should be an equal number of cases representing each entrepreneurial phase. More details on the 8 cases are provided in Table 7. 1.

We conducted interviews with the founders of each case team because they have the most comprehensive view of their business and innovation strategy (Eisenhardt, 1989). To ensure interview data captured the concept of searching for external sources of innovation, we develop our guideline based on prior literature with similar research context or research objects. All interviews were conducted in October 2018 by two researchers at DeltaHub and lasted about 75 minutes on average. A combination of all the recorded data implies that the entrepreneurial teams and DeltaHub frequently interacted with some big firms in multiple ways. For example, big firms initiated some events, collaborated with entrepreneurial teams or invested in some new ventures. This allowed us to understand how big companies leverage innovation hubs as external sources for knowledge and information.

Archive data: Additionally, we identified and analyzed websites and 4 online video interviews of case teams. For those early entrepreneurial teams which had not been reported by media yet, we were granted to access their documents and data collected by coordinators of DeltaHub as they regularly recorded status and needs of each team.

Table 7. 1 Description of interviewees and case firms

Start-up team	Industry/ Domain focus	Start-up stage	Team size (at time of interviews)	Background of the founder/ CEO (type of office/place worked in)
ES1	Big data and medical technology	Start-up stage	3	- Worked in an innovative sector of state-owned company - Worked at home when the project just set up - Move to CWS since Febrary 2018
ES2	Data collection and processing	Start-up stage	1	- Worked in a company - Started his own project in 2016
ES3	Online overseas shopping platform	Start-up stage	3	- Have tried 4 start-up projects in the CWS - Now is working on the fifth one
ES4	Application development	Start-up stage	2	- Worked in a company as a software developer - Worked in several other CWS before move to wespace
IS1	Network service system	Growth stage	5	- Worked in an international company as an engineer - Now is developing a new system with her teammates
IS2	Professional image management and education	Growth stage	6	- Was a professor in a university - Had rented a traditional office for 1 year - Moved to wespace since january 2018
IS3	Online jewellery store	Growth stage	6	- Worked in a big company - Moved to wespace for a start-up project
IS4	Online media businesses	Growth stage	8	- Worked in a big company as a journalist - Started up his own project and moved to Wespace since 2016

7.4.3 *Data analysis*

The full data-set consists of more than 300 pages of interview transcripts and field notes. We managed this data using MAXQDA 12. We started analyzing the data during the collection and observation process, as advised by Strauss and Corbin (1998). We follow a grounded theory approach indicating important and interesting quotes (Corbin & Strauss, 1990).

We started by writing down all our field notes and carefully transcribing the interviews, sending the finished transcript to the interviewees for confirmation. Next, we analyzed the data by building individual case studies for early and later stage new ventures going back and forth between interviews, field notes, and secondary data once new insights regarding innovation search emerged. As suggested by (Eisenhardt (1989) we conducted a cross-case analysis, which helped us gain retrospective insights of the development and unique patterns of each case and also facilitates a comparison of influence among cases with distinct features. We compared the cases to find common challenges and refine unique aspects of each case. From the comparison, an initial logic started to emerge, which we followed up on in an iterative process to develop our results.

7.5 Results

When analyzing the interviews and research notes it became evident that entrepreneurial teams in different stages hold distinct opinions. We discern three disparate impacts that external resources exert on the entrepreneurial process. We structure these in the following section and discuss more intensively towards theory development afterward.

7.5.1 *Nascent ventures seek innovation resources through serendipitous connections*

At the very beginning of venture projects, entrepreneurs face the problem of limited immediate resources, including network, information, sources of ideas, which are important for shaping their business logic. As ES2, who has rich experience in several start-up projects, stated,

ES2: *"Since we have only a few team members, we are eager to share our workspace with other companies, so that we can have business interactions with other companies and get connected to the market."*

Many early ventures are like ES2 and put emphasis on broadening their connection with external actors, in order to seek complementarities for their initially limited resources and accumulate social capital for the development of their business. In CWS, the geographic assemblage of entrepreneurs with various backgrounds offers them an excellent platform to search for sources of knowledge and innovation. For instance, an entrepreneur who just started a project said,

ES3: *"In fact, entrepreneurs bear tremendous stress, but starting in these hubs may be easier because entrepreneurial teams gather here doing various business. You won't fear how small your team is because you can always ask them for help… And when facing some troubles, it is also possible to ask others because they might have experienced the issue you are struggling with."*

Expanding their initial business network through physical assemblage with other entrepreneurial teams is a strategy many interviewees mentioned. They can efficiently get in contact with like-minded people and gain awareness of potential partners as ES2 stated: "It is really helpful to know each other and know other peoples' business". ES1, ES2, and ES4 mentioned that it is an essential driver for the establishment of their business to communicate and interact with other teams with similar backgrounds.

ES1: *"We are so different from big firms since we have less communication with our team or even strangers, which makes you socially isolated. But it's different here (in the CWS). You can meet different people with some greetings and chats, and then you have the sense of what they are doing, and you can follow up with the latest information from them."*.

ES3: *"The most important thing is the interaction with each other. You are never smart enough to know all the opportunities, and you are always the one who can't recognize the weakness of your ideas"*.

ES4: *"It's good for entrepreneurs to improve their knowledge, develop their mind, and learn from each other by communication, helping each other and talking about the status of this industry."*.

While broadening the breadth of their external search, entrepreneurs at a nascent stage described their practice to strategically construct their network or build up connections with certain organizations in their ecosystem. The development of their entrepreneurial projects asks for resources relating to certain areas, but the constraint of initial and internal resources is not able to cover all of them, so they have to seek certain sources out of the sphere of their teams.

ES4*: "I knew ABC company usually holds some entrepreneurial roadshows and it is one of the reasons I chose their space. I told their operation team yesterday to deliver my wish of meeting their VCs because we need more funds though we already got financing once."*.

ES1: *"We found there are various companies in this space like companies doing program writing. We may have more interactions with them to outsource part of our projects. In that case, we can easily communicate and share knowledge with each other during daily work, for we are in the same space."*.

The accumulated external resources may finally impact the business logic of entrepreneurial projects. From one side, some entrepreneurs internalize externalities and adjust their business ideas accordingly, which could further affect their internal innovation. An entrepreneur stated:

ES2: *"Here (in the CWS) when I talked with people about the application I am developing, they gave me some feedbacks like our price is too low, and they also told me their demand in using this type of APP. These comments are really supporting us as a nascent team!"*.

From the other side, the increasing number of ties with multiple external actors also raises the possibility of collaboration with other organizations, which is an essential factor in their business model development. All of the nascent entrepreneurial teams we interviewed realized the substantial impacts of external resources. As one of them told us,

ES4: *"It's useful for us to get the others to know about your business because it possibly bridges you and a chance to cooperate with a partner. This is still a matter of communication."*.

Also, entrepreneurs who have been through this process, when talking about the initial stage of their projects, also admitted the importance of connecting with external resources. IS4 described

"For novices who have never been a CEO, it is crucial to working together with people outside of the team. The network they build up and investors they know will play an important role in the later stages."

7.5.2 *Growing ventures focus on restricted external sources and internal development*

The interviewees in growing teams emphasized that they already have an established and clear business goal, as well as a substantial connection with organizations in their ecosystem. So, for them, it is not as important to expand their external resource sphere. A founder of a start-up project with 5 members stated:

IS1: *"When I first started up a project, this (looking for external resources) can be quite helpful, with the information you can get from others, workshops where you can learn knowledge for running a project and activities to build up your network. But for me now, since I have already experienced all of them, and now it is quite clear for our team about what to do and how to handle most of the problems, it is not as valuable for me as those beginners."*.

Additionally, we find entrepreneurs leading "on track" ventures hold a distinct attitude toward looking for external possibilities with those at previous stages; they exhibit the need to make a trade-off between external search and internal development. In other words, while entrepreneurial teams grow from identifying ideas to developing the idea into a business, they experience a switch of attention from external to internal. For instance, a founder who leads a team informed us:

IS2: *"Even though I communicated a lot with other teams when I was in my nascent stage, I find it is not that useful now. Because getting your own business well done is of the highest importance, and then you can gain the potential to attract resources in your ecosystem. Attending too many workshops or activities is kind of meaningless because they are doing projects in various fields which is nothing to do with you. Socialization is a time-consuming practice, and I am trying to decrease my ineffective social activities."*.

IS2 further shared the reasons of this trade-off:

"Maybe everyone has a limited time for various reasons. Since our team is still young and small, we can't manage to develop a deep contact with too many organizations. We have to focus on the development of existing projects.".

For developing teams, the creation of a business logic and organization structure is a hard undertaking, which might involve some trial and error. So, this process asks for a substantial effort to focus on the internal implementation of their innovative ideas:

IS4: *"Most of my teammates have only one purpose of handling their tasks in hands because everyone somewhat has more than one hat... I don't think we have much extra energy to interact with people here (in DeltaHub)"*.

The switch of attention doesn't mean that growing teams are isolated from external organizations. Rather, the relatively established network changes their allocation of attention. When talking about the team's need for external search, IS4 further explained,

IS4: *"Even if our marketing colleague may have such a need (of talking with external actors), they have already a targeted group of people… And for me (the CEO), effective communication is really important, I would prefer to decrease unproductive talks."*.

Therefore, we learned from IS4 that the reason for the shift from external search to internal development comes from two aspects, the need to shape their own business landscape and the accumulated accessible resources. This finding is also in line with the story of IS3, who has initiated an online jewelry store project,

IS3: *"We've got in touch with many mature suppliers and design studios. We will first visit them to decide which designs have potential for sale… We also give them feedback about the defects and imperfections of their design. Benefited from the communications with them, we have more knowledge about the market, which can be more effective than just randomly talking with someone out of this field."*.

Starters who actively interacted with external parties also recognized the distinct demand for big teams and potential changes in the future after their projects develop and get mature. An entrepreneur working for his venture alone described,

ES2: *"It's more appropriate for our tiny teams to have this cooperating relationship and interaction than to work alone. Obviously, that's not suitable for big teams with an established organization. Because they have much internal business and they don't need to worry about requirements, for the requirements they have are too much to be solved. When my project grows probably, I will face this shift."*.

7.5.3 *Established ventures gain allocable resource to seek opportunities both internally and externally*

From the conversations with the coordinators of DeltaHub we learned that established ventures who are residing outside of the CWS still keep in contact with the hub in order to search for ideas from new ventures. One entrepreneur told us about his earlier contact with CWS as he was still working for a state-owned company:

ES1: *"I had contacts with several of these spaces, like SOHO in Wangjing, which offers services for designers and creative people, and Co-working Factory, which is mainly a business incubator and shared office. Because I was in an innovation department in that state-owned enterprise, which made me keep in touch with these spaces frequently."*.

Intensive conversations with the managers of the CWS also informed us that they are receiving many applications from external companies and investors to come and host events for the new ventures working in the CWS. These external companies are often global players with their R&D or innovation units being in charge of external innovation search. Some companies are even considering letting their innovation units work in the CWS as a CWS employee told us:

"The big companies are really interested in what we are doing, they want to host events on a regular basis, to get in touch with the startups. These events are good for both sides, as the entrepreneurs get access to established companies and might raise funding, and the established companies stay in touch with all the new ideas. Company X is also working on a plan to put their team into our location.".

What ES4 told us also consolidates the statement of this coordinator as the roadshows and active Venture Captial activities were the key attraction of residing in this CWS. Therefore, another finding here is that big firms, in spite of the richness of their internal resources, are still expanding their external searching sphere. In order to dig into the impacts of external innovation search on big firms, we contacted a manager of company X. The manager told us a creative unit of company X is in a specific need to work in DeltaHub:

"The unit is quite independent because their work is more creative rather than routine-based, and we have new customers in this city. We got to know DeltaHub from an event we held here and then thought about moving the unit here. At very first, we were attracted by the various activities here, because for us it is also a new market, we have to know more about it. Later, we found the CWS is filled with an entrepreneurial atmosphere, which matched the work of this unit… With a branch in this city, we are able to collect feedback from markets and new customers and transmit the information to our headquarters.".

7.6 Discussion

Past research has revealed a trend among firms to pursue external innovation search in various forms, such as open innovation (Chesbrough, 2003). There is rich research on how the breadth and depth of external search improve ventures' innovation performance (Foss et al., 2013; Leiponen & Helfat, 2011; Rosenkopf & Nerkar, 2001), giving them more options and a variety of knowledge to use for their innovations. At the same time, Dahlander et al. (2016) demonstrate that external innovation search includes significant costs. People engaging in external search are only successful when they spent all their time on this task. They also show that internal innovation search can be very successful along with lower transaction costs.

Few studies such as Brunswicker and Vanhaverbeke (2015) or Vahter et al. (2014) investigated the innovation search process within small and medium-sized manufacturing firms. Zhang and

Li (2010) show that network connection is of high importance for new ventures in technology clusters. Research has also studied the effects of entrepreneurial characteristics (Unger et al., 2011) and social capital (Baron & Tang, 2009) on the performance of new ventures. Additionally, literature suggests that new ventures need to focus on external innovation seeking (Ceci & Iubatti, 2012; Edwards et al., 2005). The literature though does not cover how the ventures are supposed to deal with external innovation search while facing restrictions due to limitations of smallness and newness.

Our results show, that new ventures go through different stages that influence which resources they apply to seek innovation. Dahlander et al. (2016) have shown, that internal innovation seeking has benefits for firms and external innovation seeking is only successful when pursued with high resources. In the following we discuss the insights we found in light of previous research, structure them and provide a matrix of our results.

7.6.1 *Early stage ventures*

New ventures at a very early stage suffer from limitations of smallness and newness (Stinchcombe, 1965; Brunswicker & Vanhaverbeke, 2015; Ceci & Iubatti, 2012; Edwards et al., 2005). They can only rely to some extent on internal resources to generate innovations. Literature shows that, in general, they are better off seeking external innovations (Ceci & Iubatti, 2012; Edwards et al., 2005). Ties to established companies, service intermediaries or general network building demonstrate positive effects on new ventures' innovation performance (Mas-Verdú, Ribeiro-Soriano, & Roig-Tierno, 2015; Zhang & Li, 2010). New ventures whose business models are often not yet fully established and offer more flexibility towards change. For them, new knowledge can often be the starting point for the creation of a completely new business model. Our results show a high breadth of innovation search for new ventures at this early stage. We demonstrate, that ventures are trying to get in contact with as many external sources as possible. Thereby building their network and trying to find inspiration. The process appears to be unstructured and the entrepreneurs stated that they were trying to talk to as many sources as possible. Our observation showed that this group was much more communicative, attending meetings and events, also actively contacting sources in the CWS. This stage indicates the biggest impact of external innovation search on the new ventures. According to the information and knowledge they gather and resources they can obtain, their business will change to fit the new resource base.

7.6.2 *Growth stage ventures*

When new ventures leave the first stage, they have accumulated additional resources and started an internalization process. The venture focusses on growth rather than expanding the breadth of external networks. For growing ventures with limited human resources, it is critical to balance the needs and costs of information search (Irwin et al., 2019). Prior research indicates that opportunity costs are a downside of extensive external innovation search and can lead to disadvantages in the daily business (Laursen & Salter, 2006). With the information and network ventures cultivated in the initial phase of wide external innovation search, they have founded the basis to start a phase of productivity. At this stage, the time required to continue a broad innovation search and maintain close outside relationships increases significantly (Dahlander et al., 2016; Tushman & Nadler, 1978) and takes away time from earning money. We find that new ventures at this stage focus their attention and available resources on the ideas gathered from external resources and try to internally develop these ideas further, using a local innovation search strategy (Chebo & Kute, 2019; Hansen, 1999). We also find, that ventures at the growth stage hold contact to few specific external partners, whom they use for deep innovation search. This finding is supported by Adam, Strähle, and Freise (2018) who show that long-term relationships and external knowledge sources are essential for success. Our interviews and observations prove that a switch takes place from a broad and unstructured external innovation search to a structured, very restricted, deep external search. Further research indicates, that identified opportunities, accumulated social capital, the further development of a project and innovation need to be integrated into the firm to become functional (Dahlander et al., 2016). Second, the growth of an entrepreneurial team also requires the creation of some form of organizational structure and organizational processes which are a huge endeavor and take up a substantial proportion of limited resources (Stinchcomb 1965). At this stage the business model of the venture is stable and the input from deep and internal innovation search is used to incrementally develop current products and business.

7.6.3 *Established ventures*

Established ventures distinguish themselves from prior-stage ones by mature business logic and a structured organization (Teece, 2010). Our study indicates that residing in a network with rich sources and comprising more members, ventures compile more manageable resource which enables them to allocate attention between internal and external opportunities for innovation search. Thus, they are not restricted to a monolithic approach to search. Rather, organizations

can adopt a distributed approach to seek possibilities in various domains (Fleming & Waguespack, 2007). Thus, they are able to develop their competitive advantages and simultaneously adjust innovation activities with dynamic demand from the external market. We found that established ventures who are residing outside of the CWS keep in contact with CWS in order to search for ideas from new ventures. Establish companies enter CWS by offering events or even placing part of their teams in them. Table 8. 2 gives an overview of internal and external search efforts at the different stages.

7.6.4 *Venture life cycle*

We propose that the innovation search process follows the life cycle of the venture, with the early stage being characterized by broad and very open external search, the productivity stage by internal and deep, focussed external innovation search. The venture reentering a broad external search once it is established and can free up resources.

Table 7. 2 Venture stages and search strategy

	Internal	External
New venture	• Internal brainstorming of ideas found externally	• Focus on external due to limited internal resources • Building relationships • Connecting to the network • Open for various ideas
New venture at the stage of productivity	• Focus on internal developments and productivity • Resources are bound internally • Very specific/restricted external search for innovation	• Restricted deep search in close cooperation with core partners
Established venture	• Local search using internal sources	• Offering events and funding to new ventures e.g. in CWS • Putting employees in charge of staying in contact with local CWS • Letting whole units work at the CWS • Search for new technology

The idea of a life cycle describing the development and different stages of an organization was first introduced by Chandler (1962) who suggested that organizations evolve and change as they grow. The concept has had great influence with researchers giving evidence that managerial priorities (Smith, Mitchell, & Summer, 1985), indicators of organizational effectiveness (Quinn & Cameron, 1983), as well as organizational pressures, threats, and opportunities, vary with changes in life cycle stages (Anderson & Zeithaml, 1984; Dodge &

Robbins, 1992). We now add that the stage of the life cycle has a significant influence on how new ventures engage in innovation search.

Our results further add to research on innovation seeking (Rosenkopf & Nerkar, 2001), by indicating, that depending on the stage the innovation seeking strategy differs and ventures set different foci according to the situation they find themselves in. We also demonstrate that restricted resources play a very important role in the choice of innovation search strategy as opportunity costs are a very important factor, especially for new ventures. We believe that the extended time required for external innovation search can only be afforded at later stages once the venture is established and is able to free up resources to apply to full-time external search. Balancing productivity and broad external search appear to be too much of a challenge for growing ventures and the entrepreneurs running them. We give a first answer to the question Klotz et al. (2014) raise regarding the extent to which new ventures build on social capital to substitute financial, human and psychological resources. We show that once the venture has secured the right resources and enters a phase of productivity, broad social capital is not as important as stable and deep connections.

7.6.5 *Limitations and future research*

Although our research did not focus on the effects of CWS or collaborative workspaces, we found that the co-location helps new ventures build important relationships, access knowledge, and ideas as well as secure resources. We believe that the study of collaborative workspaces as a mechanism, to broaden the search for innovation offers many potentials, especially to entrepreneurs and ventures. CWS further offer the opportunity to analyze the effects of socialization and trust (Pesch & Bouncken, 2018) on the innovation search.

Our study has some limitations which give directions for future research. The current research on innovation search mainly studies established and big firms, which have the resource capacity to make active decisions on which information sources to seek. Small and especially new ventures face different limitations and might not be aware of their search strategy as much as established ventures. The dynamic setting of CWS enables studying the effects of knowledge exchange with competition (Bouncken et al., 2018a) and the effects of shared identities (Bouncken & Barwinski, 2020) on the success of innovation search.

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Chapter 8: Co-Creation in Coworking Spaces: Boundary Conditions of Diversity

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8.1 Abstract

Knowledge and collaboration are the basis of value co-creation in coworking spaces. The unique and flexible settings found in there enable companies and individuals to engage in fruitful discourse. The diversity of participants allows for multisided exchange relationships leading to highly innovative outcomes. Referring to literature on service management and value co-creation we present a qualitative study which analyses under which boundary conditions knowledge exchange and value creation is expected to exceed predictions. We analyze data from 12 coworking spaces and show that contradictory to established literature, in coworking spaces there appears to be an optimal degree of diversity regarding individuals' social background and the knowledge bases. Additionally, we found that a likeminded work ethos between coworkers is crucial for value co-creation, relativizing the diversity as driver of co-creation. We also show that participants can take differing, non-pre-determined roles in the process of value co-creation and, contributing to different forms of value creation.

8.2 Introduction

The 21st century world is characterized by a strong individualization trend (Lewis and Bridger, 2001; Windham and Orton, 2000). This trend does not only become visible in shopping or other commodity areas, it also changes the nature of work. Because of this individualization trend, employees change jobs more often and are no longer deeply tied to one company (Statistics, 2017). They want to be an own individual, also affecting the corporations they work for on individual levels and promoting their individual contributions. Furthermore, employees tend to strive for independence which is reflected e.g. in the number of freelancers reaching an all-time high of 55 million (35% of the U.S.

American workforce) people in 2016 (upwork, 2016). Additionally, around 25 million Americans founded their own business (Kelley et al., 2016).

The described trend towards more individualization and the resulting changes in modes of work are of utmost importance from a research perspective as they depict a major change in the nature of work. Especially technological breakthroughs as well as changes of preferences and lifestyles provide opportunities for new ways of creating value (Payne, Storbacka, & Frow, 2008). However, the strong individualization trend challenges the inclusion of economic actors into traditional ways of value creation (Vargo and Lusch, 2004, 2008), indicating a fundamental problem for modern businesses.

Technological (digital) solutions increase flexibility with regard to workplace models and company structures. This allows employees to work from home or more generally speaking outside traditional workspaces which fundamentally affects individual well-being (Garrett, Spreitzer, & Bacevice, 2017). However, this trend for individualism on many levels so far did not change the factors of emotional well-being. Talking to other people, being part of a social community, and interacting with people are still core elements to fulfil our basic needs. Also, living without belonging to any social group reduces the support that individuals can receive for any given situation. Consequently, individuals working independently and remotely often feel isolated and socially adrift although they proactively chose this situation. This causes a strong need for a community and a joint (social) work environment (Garrett, et al., 2017). This need is reflected in the rise of so-called coworking spaces. Coworking spaces (CWS) are basically shared office spaces. They provide infrastructure but much more importantly a social network and likeminded coworkers (Spinuzzi, 2012). They depict a new kind of work environment that is characterized by a strong dynamic aspect. Following the notion of service-ecosystems introduced by Vargo and Lusch (2011), CWS fulfil the conditions to be a service-ecosystem as they depict a specific infrastructure that allows for a combination of individual work, the creation of a social community, and following Vargo and Lusch (2011) the co-creation of value. CWS are a kind of a platform (cf. Eisenmann, Parker, & Van Alstyne, 2006, 2011, 2010; Täuscher and Laudien, 2017) that allow independent individuals as well as employees with flexible workplace contracts to engage in value co-creation processes that replace traditional company-bounded ways of value creation. This happens on four different levels: First, by interacting with each other, coworkers have broader access to more diverse knowledge and skills. Combining the knowledge and

skills enables innovative behaviour and by this creates value, among others by increasing the well-being, the success of the project or the results of the company. Second, working together based on the free will and interacting on a personal level creates friendship. This makes the coworkers help each other with business orders and tenders from their customers, recommending other coworkers to their customer for tasks they themselves cannot fulfil alone. Third, when recognizing they complement each other in certain business matters, coworkers create service offers together or even form new businesses or ventures. Fourth, the social interaction itself is a value, especially for self-employed people and people, who would usually not interact on a regular basis with other people. This social interaction fulfils one of our basic needs as human beings.

So far, coworking spaces and their role in value co-creation processes lack a detailed understanding. This new approach to organize work is – apart from very few publications (for a detailed review see Gandini (2015)) – by now mainly ignored by research. CWS are of research interest and managerial interest because they allow for bridging a high demand for individualism and a coeval need for social integration. Therefore, they appear to be a solution to the inherent ambiguity of current requirements of modern work life. However, it not clear yet, what elements foster value co-creation behaviour in this context of future work. Consequently, we ask: What factors influence the value co-creation in coworking space?

In our study, we analyze CWS as hubs of value co-creation based on a qualitative research approach. We highlight determinants of value co-creation in CWS in detail and show unique characteristics of this new type of work organization. We especially carve out the dynamics of this environment that is determined by a constant role chance of CWS users from being a recipient to being a provider of value as well as a constant chance of involved actors. In our study we found that compatible and at least partly homogeneous social backgrounds of CWS-users are preconditions for value co-creation in CWS. In this context, we identified direct socialization as booster for value co-creation. Diversity, on the other hand, seems to have an inverted u-shaped effect on value co-creation. Considering these and other aspects, our results suggest that working in a CWS might only be adequate for certain people.

The paper enhances value co-creation (Prahalad and Ramaswamy, 2004) literature by adding a distinct understanding of the role CWS as new framework for value co-creation play to this literature stream. We provide a theoretical reasoning as well as empirical

support for the importance of CWS in 21st century work environments and show how they function in detail. By doing so, we also make use of service-dominant logic (SDL) literature (Lusch and Vargo, 2014; Vargo and Lusch, 2004, 2008, 2011) and try to enrich and broaden the, by now quite narrow, view on value co-creation and especially service ecosystems provided in this context.

In the following, we introduce you to the theoretical background with paragraphs on value and value co-creation, the service ecosystems and coworking spaces. In the subsequent section on our methodology we explain our research method, the data collection process and the applied data analysis. We conclude our paper with the results of our analysis, the discussion of the paper and the overall conclusion.

8.3 Theory

8.3.1 *Value, value creation, and value co-creation*

To better understand value co-creation, it is necessary to develop a basic understanding of the value concept. Following Vargo and Lusch (2008), companies cannot deliver value on their own but only offer a certain value proposition – statement that can be seen critical as it is by no means clear why a company can coevally co-create and not deliver value.

Several approaches have been brought forward to conceptualize value (Sánchez-Fernández, Angeles Iniesta-Bonillo, & Holbrook, 2009; Khalifa, 2004; Woodall, 2003). These approaches emphasize the heterogeneity and elusiveness of this concept. Value has been approached on an individual level (Holbrook, 1999); as an evaluation of the relation between benefits and drawbacks (Day, 1990; Zeithaml, 1988) or as means-ends-model (Howard, 1977; Woodruff, 1997). More recently, the cognitive perspective on value has shifted into a more holistic perspective emphasizing the importance of customer experience (Heinonen and Strandvik, 2009) as well as social systems (Edvardsson, Tronvoll, & Gruber, 2010; Epp and Price, 2009). In general, value is one of the most ill-defined concepts in business research (Carù and Cova, 2003). For our study, we understand value as the outcome of the actions of involved participants who combine and transform existing resources (c.f. Bowman and Ambrosini, 2000). As a consequence, very little is known about value creation and especially value co-creation. What we do know about co-creation are motivators of consumer co-creation engagements. Following approaches from motivation theory, Roberts, Hughes, & Kertbo (2014) derive three

reasons for engaging in co-creation: (1) egocentric motives, (2) altruistic motives, and (3) opportunity/goal motives.

However, value creation is a complex construct as it on the one hand encompasses so-called value-in-exchange and on the other hand so-called value-in-use (Vargo and Lusch, 2004). Value-in-exchange is considered as utility that is constantly inherent in a resource as singular entity. It can be exchanged against other utilities or money at one point in time (Grönroos, 2008). Value-in-use as a concept describes to which extent a customer feels better off (or worse off) by making use of a certain good or service. This means that value is created during the process of usage (Grönroos, 2011). The problem arising with defining the process of value creation arises from the dualistic (Thompson, Locander, & Pollio, 1989) nature of value. Value is perceived differently by providers and customers, it may be something very different for both parties.

SDL puts the company in control of value creation processes (Vargo and Lusch, 2004) and describes the customer as invited co-creator of value. The notion of co-creation originally emerges from customer engagement literature (Heskett, Sasser Jr., & Schlesinger, 2014; Peppers and Rogers, 1993; Pine and Gilmore, 1999; Prahalad, 2004; Zeithaml, Parasuraman, & Berry, 1990). This literature streams shows the development of the customer role from involvement in self-services to co-designing and finally co-producing solutions (Prahalad, 2004).

Value co-creation as a concept has been brought forward considerably by Vargo and Lusch (2004). Generally speaking, the concept aims at explaining how customers and suppliers jointly design production processes with the aim of creating value. This is of interest as classical approaches to value creation ignore the customer contribution and explain value creation only from a company perspective (Porter, 1985). In line with this approach, Prahalad and Ramaswamy (2004) define (value) co-creation as *„the joint creation of value by the company and the customer"* that *"allows the customer to co-construct the service experience to suit their context"*. Prahalad and Ramaswamy (2004) add that for successful co-creation open communication between the company and the customer is important. This includes access to information as well as transparency. Ballantyne (2004) claims that communication is the key to renew knowledge, making it necessary for generating new knowledge. Following this idea, Ballantyne and Varey (2006) call for active communication between participating actors in value co-creation processes. They claim that communication, learning, and adaption are basic requirements

for a successfully co-creation of value. Payne, et al. (2008) call it the shift *"from attention seeking communication to dialog with customers"*. The relevance of communication for value co-creation is also emphasized by Gupta and Bostrom (2013). Value co-creation is a customer-focused (Sheth, Sisodia, & Sharma, 2000) as well as market-driven (Day, 1999) concept. Following this train of thoughts, value co-creation can be characterized by collaborative behavior, reciprocal learning, and flexibility towards change (Vargo and Lusch, 2004).

Value co-creation requires a structured surrounding. This includes rules, values, and norms, that build an institution around the collaborating parties (Vargo and Lusch, 2016). Following institutional theory (Bruton, Ahlstrom, & Li, 2010; Meyer and Rowan, 1977; Tolbert, David, & Sine, 2011), structures, processes, and organizations do not only evolve by following set principles. They can also develop by relying on common beliefs on the ideal design (Meyer and Rowan, 1977; Tolbert, et al., 2011). This idea is linked to the idea of ecosystems that group actors from a certain business environment (Spigel, 2015). Institutions and organizations change over time. They are influenced by inner and outer aspects, such as changes in technology, regulations, and social values.

Furthermore, researchers show that actors pursue value co-creation activities very often in networks (Corsaro, Cantù, & Tunisini, 2012; Dhanaraj and Parkhe, 2006; Freeman, 1991). This network idea implies a static perspective. However, following the line of reasoning of Vargo and Lusch (2016), value co-creation requires a dynamic system rather than a static network. This dynamic view is supported by studies from Corsaro, et al. (2012) as well as Geels (2004).

8.3.2 *Service ecosystems*

In contrast to the network perspective, early SDL researchers very often assumed a clear separation between providers and consumers. Companies were considered providers and customers were considered consumers of (service) offerings (Vargo and Lusch, 2011). This view limits the understanding of how multiple parties contribute to value co-creation (Vargo, Wieland, & Akaka, 2015). Taking into account that innovations are very often the result of joint efforts (Corsaro, et al., 2012; Dhanaraj and Parkhe, 2006), the simple binary view on value co-creation needs to be extended. The central idea of service in SDL is the application of resources for the benefit of another party, therefore, resources play a key role (Vargo and Lusch, 2004). However, there is more to it than just resources.

Studies also found, that additionally knowledge seeking activities are highly relevant for considering a network as successful ().

As resources and knowledge need to be obtained from different sources, network theory is closely related to co-creation. In the context of co-creation, there are further dynamic aspects that resource networks do not cover which calls for a special view on co-creation networks. Co-creation networks are systems which have the potential to constantly reconfigure and self-adjust because each instance of resource integration, service provision, or value creation changes the current system and the context for the following iteration process (Vargo and Lusch, 2011). Therefore, Lusch, Vargo, & Tanniru (2010) define a value network as *"a spontaneous sensing and responding spatial and temporal structure of largely loosely coupled, value proposing social and economic actors interacting through institutions, technology and language to (1) co-produce service offerings, (2) engage in mutual service provision, and (3) co-create value."*. Vargo and Lusch (2016) later describe a *„service ecosystem as a relatively self-contained, self-adjusting system of resource-integrating actors connected by shared institutional arrangements and mutual value creation through service exchange"*. Using a service ecosystems perspective on the process of value co-creation integrates multiple actors inside and outside the operations of a company's boundaries, thereby broadening the overall view (Akaka, Vargo, & Wieland, 2017). Being part of such ecosystems also means being connected to people from other organizations or other fields of work. Research shows, that this implies a higher success for the individual participants (Ng and Feldman, 2010).

8.3.3 *Coworking spaces (CWS)*

CWS provide infrastructure and dedicated space to facilitate professional and social interaction (Bouncken, 2018; Bouncken and Reuschl, 2016; Gandini, 2015). The professional space comprises the necessary equipment to conduct business activities. Depending on the specialization of a coworking space, the equipment can range from simple desks with Wi-Fi to fully equipped workshops (Johns and Gratton, 2013). Cafeterias, lounges, and bars constitute the social space that drives networking, knowledge exchange, initiation of collaboration and joint leisure activities, leading to community formation (Bouncken and Reuschl, 2018; Gandini, 2015). CWS are often set up in central, exposed, and attractive locations, matching an attractive interior to the

external urban space. However, CWS are also found in the countryside as centers promoting local and regional entrepreneurship (Fuzi, 2015). The interior is purposefully designed to be more informal than traditional office concepts (Schopfel, Roche, & Hubert, 2015) to create an atmosphere of coworking and to foster interaction between users (Garrett, et al., 2017). In addition to the offered working environment and social aspects, CWS provide their users with special services like coaching, trainings, events, (start-up) consulting or the access to networks with externals like incumbents, venture capitalists, or business angels (Capdevila, 2014; Spinuzzi, 2012). Incumbent firms are starting to take upon this institutional change while accessing the creative environment of CWS and experimenting with new organizational forms for innovation (Tracey, Phillips, & Jarvis, 2011). Incumbents can rent space for their employees in independent CWS. Their employees then mingle in with other coworking-users in the social and workspace (e. g. freelancers, start-ups). This new interaction creates more, new or other ideas to pursue the regular work for the employer. Following a more strategic approach, incumbents (e.g. manufacturers as Bosch, BMW, Merck) also imitate big IT-companies (e.g. Google, Facebook) and set up internal shared work and social spaces. Very recently, consulting companies (e.g. PwC Experience Centers in Chicago, Los Angeles, and Hallandale) have started imitating the idea of CWS and provide dedicated spaces for novel ideas and project work for their internal and external clients.

Individuals and teams working in CWS have the opportunity to interact with others, receive feedback, build partnerships, create trusted relationships, and collaborate with other users. Therefore, CWS can be considered innovative hubs for value co-creation (Bouncken, Laudien, Fredrich, & Görmar, 2018). They provide a dynamic environment to mutually create value with different actors inside and outside the CWS.

8.4 Methodology

8.4.1 *Research method*

Due to the newness and complexity of our topic, we decided to make use of a multiple-case study approach. Especially in the realm of rather new and still insufficiently explored research contexts, case studies are likely to provide accurate and valuable theoretical insights (Eisenhardt and Graebner, 2007; Feagin, Orum, & Sjoberg, 1991) and are helpful to gather rich, in-depth data (Anteby, Lifshitz, & Tushman, 2014; Bluhm, Harman, Lee, & Mitchell, 2011; Yin, 2009). Furthermore, Welch, Piekkari, Plakoyiannaki, &

Paavilainen-Mäntymäki (2011) emphasize that case study research also contributes to contextualization and thus helps to illustrate and communicate theory. Although we investigate a rather novel phenomenon, our main objective is not to set up a radically new theory, but to advance existing theory (Lee, Mitchell, & Sablynski, 1999; Bluhm, et al., 2011; Graebner, Martin, & Roundy, 2012). Therefore, especially systematic combining (Dubois and Gadde, 2002) is an appropriate procedural method to reach our research objective. In contrast to grounded theory (Glaser, 1992; Glaser and Strauss, 1967), that mainly focuses on the process of data collection and theory discovery without taking prior research into account (Eisenhardt and Graebner, 2007; Langley, 1999), systematic combining places emphasis on theory development. It is characterized by a systematic matching of empirical data and literature (Dubois and Gadde, 2002). Hence, an abductive logic is employed that integrates inductive and deductive reasoning (Durand and Vaara, 2009). Therefore, it allows for an integration of existing literature and new empirical insights. Systematic combining is also utilized by other researchers (e.g. Erkama and Vaara, 2010; Edvardsson, Holmlund, & Strandvik, 2008; Harryson, Dudkowski, & Stern, 2008) who emphasize the benefits of this method.

8.4.2 *Data collection*

We pursued a purposeful sampling strategy (Denzin and Lincoln, 2005; Patton, 2002) to select a sample that fits our predefined criteria: (1) the CWS under research needed to be in business for at least two years to avoid startup effects. (2) The CWS needed to be located in major cities with at least 250.000 inhabitants as we wanted to eliminate ecosystem inequalities. (3) We looked for an equal number of independent and company-internal led CWS to allow for a comparison between both types of CWS. (4) We only included CWS in our analysis that allowed us to access the provider as well as the customer side as we wanted to gather objective information on value co-creation determinants. matter. Those criteria guarantee similar features, which raises the probability that differences and similarities are of general relevance and allow for theorizing (Gerring, 2007).

We base our analysis on unique, self-collected, primary data that fulfilled the above-mentioned criteria. Our cross-country sample includes twelve CWS (six independent CWS and six company-internal CWS). In each CWS, we interviewed one provider and one user. Additionally, in four company-internal CWS the collected data on the user-side

implied the need for further investigation. Consequently, in each of these four company-internal CWS we interviewed a second user. Thus, for the twelve CWS we have a total of 28 interviews.

The interviewed CWS are located in Germany and the USA. We chose these countries for specific reasons. The concept of coworking was first developed in the USA and from there spread all over the world. Investigating the early roots of the coworking spaces allows to analyze the first one in the lane of the whisper game. Second, Germany was an early follower and adopted the idea to support the slacking entrepreneurial activities. It is interesting to see if adopting a system with the same goal is easily possible and transferrable in a new context.

We used semi-structured interviews to get a wide range of both, past- and present-oriented accounts from people who are experiencing the CWS phenomenon. The interview guideline we use was developed out of theory. All interviews took place between October 2016 and November 2017. The initial interviews that lasted about 1.5 hours were conducted face to face whenever possible. Additionally, we conducted interviews via telephone as we approached each interviewee several times. To guarantee anonymity, we use pseudonyms for the respondents and coworking spaces.

In the course of the study we carefully revised the initial interview guideline, concentrating on emerging themes (Glaser and Strauss, 2009Glaser and Strauss (2009); O'reilly, 2012). Analyzing the data did not necessarily follow the data collection in a linear way but was rather a recursive process, as data collection and data analysis overlapped with each other – a way of proceeding that is in line with Eisenhardt (1989).

In a second step, we supplemented the interview data with internal and external archival data such as e.g. press coverage or company internal documents to allow for data triangulation with the aim of delimiting a possible retrospective bias.

8.4.3 *Data analysis*

Our data analysis is based on a two-step coding procedure as described by Gioia, Corley, & Hamilton (2013) that we applied to the synthesized data of both data sources. Following a thorough transcription process, we used an open coding technique, sticking close to the words originally used by the informants whenever possible (in-vivo codes). Otherwise, we summarized the statement in a simple descriptive phrase (first order codes)

(Strauss and Corbin, 1998; Van Maanen, 1979). To begin with, we grouped the data in first-order concepts according to underlying basic concepts. Then we looked for similarities and differences between the categories using axial coding in order to condense the first order concepts into second-order themes. Only after this task had been completed, we conducted an extensive literature analysis that allowed us to go back and forth between literature and emergent theory and thereby to support confidence in the findings as well as to re-sharp our emergent theory in confrontation with conflicting literature (Eisenhardt, 1989). This process was again iterative in nature; constantly cycling between data, emerging patterns and relevant literature resulted in a synthesis embedded in both, the collected data and theory developed in the literature. Last, we made use of selective coding to further condense related themes into overarching dimensions (Strauss and Corbin, 1998).

In order to further enhance the trustworthiness of our data, we took several steps including careful management of our data (contact records, interview transcripts, documents). This includes that one member of the research team took an external role as devil's advocate with the aim of enhancing objectivity and keeping the higher-level perspective crucial for informed theorizing (Eisenhardt, 1989; Gioia, et al., 2013; Nemeth, Brown, & Rogers, 2001).

8.5 Results

The results of the coding process are displayed in table 8. 1. We decided to jointly present the provider and customer perspective as we focus on value co-creation in the CWS understood service ecosystem that encompasses both parties. The codes emerged from the data analysis during the employed open coding procedure. Additionally, we combined the results into a conceptual model (Figure 8. 1).

Table 8. 1 Coding results

1st order concepts	*2nd order themes*	*Aggregate dimensions*
▪ **Degree of homogeneity/heterogeneity of the individual social backgrounds** ▪ **Ability to overcome social boundaries; lack of a feeling of superiority/inferiority** ▪ **Need for displaying social status (e.g., by wearing expensive clothes or jewellery)** ▪ **Perspective on gender and /or cultural equality** ▪ **Openness to share (personal) information with others** ▪ **Homogeneity/heterogeneity of private interests (e.g., politics, sports, hobbies)** ▪ **Age structure of CWS users**	*Existence and acceptance of social differences*	**Social compatibility**
▪ **Individual personal characteristics (shy, outgoing)** ▪ **Degree of embeddedness in other social structures (e.g., strong family ties, established social relations stemming from non-work contexts)** ▪ **Fear of being used by others; existence of former negative experiences in social interaction** ▪ **Amount of self-confidence** ▪ **CWS-triggered offering of opportunities for social connection**	*Openness to socialization*	
▪ **Educational background of CWS users in terms of industry background and qualification level** ▪ **Focus of the CWS (industry focus vs. openness cross-industry users)** ▪ **Change rate of CWS users; long-term vs. short-term usage of the CWS** ▪ **National/international focus; CWS diversity regulations (e.g., definition of a specific work language)**	*Homogeneity / heterogeneity of knowledge base*	**Knowledge base characteristics**
▪ **Existence of a knowledge management system** ▪ **Degree of formalization; independence of work vs. embeddedness in quasi-company structures** ▪ **CWS offering of tutorials or specific learning programs; active management of the knowledge base of the CWS users** ▪ **Documentation of CWS knowledge**	*Establishment of knowledge management system(s)*	
▪ **Ability to work independently** ▪ **Cultural background; influence of cultural standards** ▪ **Perception of individual achievements** ▪ **Ability to ask for help** ▪ **Experience with collaborative work** ▪ **Perspective on knowledge protection/ intellectual property rights** ▪ **Degree of mutual trust between CWS users**	*Attitude toward voluntary interaction*	**Work behaviour**
▪ **Need for supervision vs. intrinsic motivation to achieve results** ▪ **Degree of performance readiness of CWS users** ▪ **Existence of joint goals vs. focus on individual goals** ▪ **CWS support for creating specific `project-teams`** ▪ **Degree of pre-defined tasks**	*Goal orientation*	

Our results point to the insight that value co-creation in CWS is heavily determined by the CWS structure (I3: *"It depends, how we set up our coworking space. Depending on*

what we offer and how we offer it, users can co-create value. We see this with our different coworking spaces that we have all over the country." and I14: *"The users tell us what they need so that they can actually work together. They need our support, our frame that we create with our coworking space for their work."*). Most importantly, social differences seem to play a role in this realm. Our data shows that differences in the social background of CWS users and also between the CWS users and the CWS management seem to cause a lack of acceptance of the other partners (I7: *"But when it comes to trusting and accepting each other, users here always need people that are similar. It is not that opposites attract, it is much rather that equals stick to equals, at least at the beginning."* and I5: *"Eventually, people like the diversity. But for starting the interaction, people need similarities to start on."*). This delimits the willingness to cooperate and results in negative effects on value co-creation. This insight is interesting as it contradicts the idea that a higher divergence in CWS has a positive effect on interaction – an aspect that needs further clarification. According to our data, at least a certain degree of homogeneity seems to be necessary to make CWS work properly.

Second, social interaction capabilities need to be highlighted as value co-creation is a dynamic process that takes very often place in highly complex settings. Our data supports the insight that CWS are only suitable for people with at least a certain openness against socially interacting with others. Communication seems to be the main driver of CWS value co-creation (I13: *"You will not find any introverts here. Everyone is outgoing and talkative. Now that you mention it, most of us [coworkers] don't really favour rules or contracts."*. And I27: *"You can see that when focussing on the interaction. At some point, everyone talks to everyone, especially in the evenings."*). Therefore, CWS attract a certain type of person and are not generally suitable for everyone. More formal structures that provide guidance and security will, therefore, most likely not completely be replaced by CWS. CWS are a new form of work and a new opportunity to jointly create value – but they are not a cure-to-all solution.

We also see that the knowledge base gathered in the CWS deserves attention in the context of value co-creation. Interestingly, again too much diversity does not seem to be beneficial for fostering value co-creation processes. CWS users need to have a mutual basic understanding which calls for a management of CWS to ensure that they are more than a shared office space. Interaction requires at least a partly shared knowledge base. Too much homogeneity seems to be problematic – this allows for the assumption that an

optimal degree of knowledge diversity exists for CWS (I19: *"We continuously increase the member-diversity of our space. However, first new coworkers need to be integrated, especially by creating a common basic understanding of work ethics and a knowledge base so that everyone can talk about everything."* and I20: *"We* [coworkers] *enjoy the diversity. But sometimes you just want to talk to people who are like you, no discussing, just enjoy the victory of your favorite team."*). This insight is very interesting as it imposes a high challenge for CWS management. Being able to deal with this challenge may distinguish successful from unsuccessful CWS. Comparing independent and company-run CWS, both types of CWS fight different challenges. While company-installed CWS are very often too identical in terms of knowledge base, independent CWS face the problem of a very broad and very often not controllable knowledge base. Company-installed CWS are in a position to establish knowledge management systems and to systematically develop their knowledge base while independent CWS are affected by a lack of an institutional framework that ties their users together. Therefore, planned co-creation of value is very difficult to achieve in independent CWS. It more or less happens by chance in this context as an active management of knowledge is due to a high fluctuation of users and unsolved problems in terms of intellectual property rights nearly impossible.

Finally, the work behavior of CWS users deserves attention. Experience with collaboration and a certain amount of mutual, unconditional trust seem to be necessary preconditions for value co-creation in a CWS environment. Along with that, our data shows the importance of focusing on a specific goal. Value co-creation is more likely to happen when the CWS is designed to fulfil a specific goal – an aspect that may develop into a major drawback for independent CWS (I24*: "I personally like that we all work on similar topics. I think, we all benefit from this."* and I27: *"Having all these people around me that work in the same branch allows me to get deep insides into the topic. Before, I worked in a different space where I was able to work very efficient with support, but I also visited several spaces where that was not the case."*). However, our data allows for the assumption that this drawback is likely to be diminished when independent CWS are managed properly.

While analyzing our cross-country dataset we also looked for differences in the perception of certain topics. However, we did not find country-based differences.

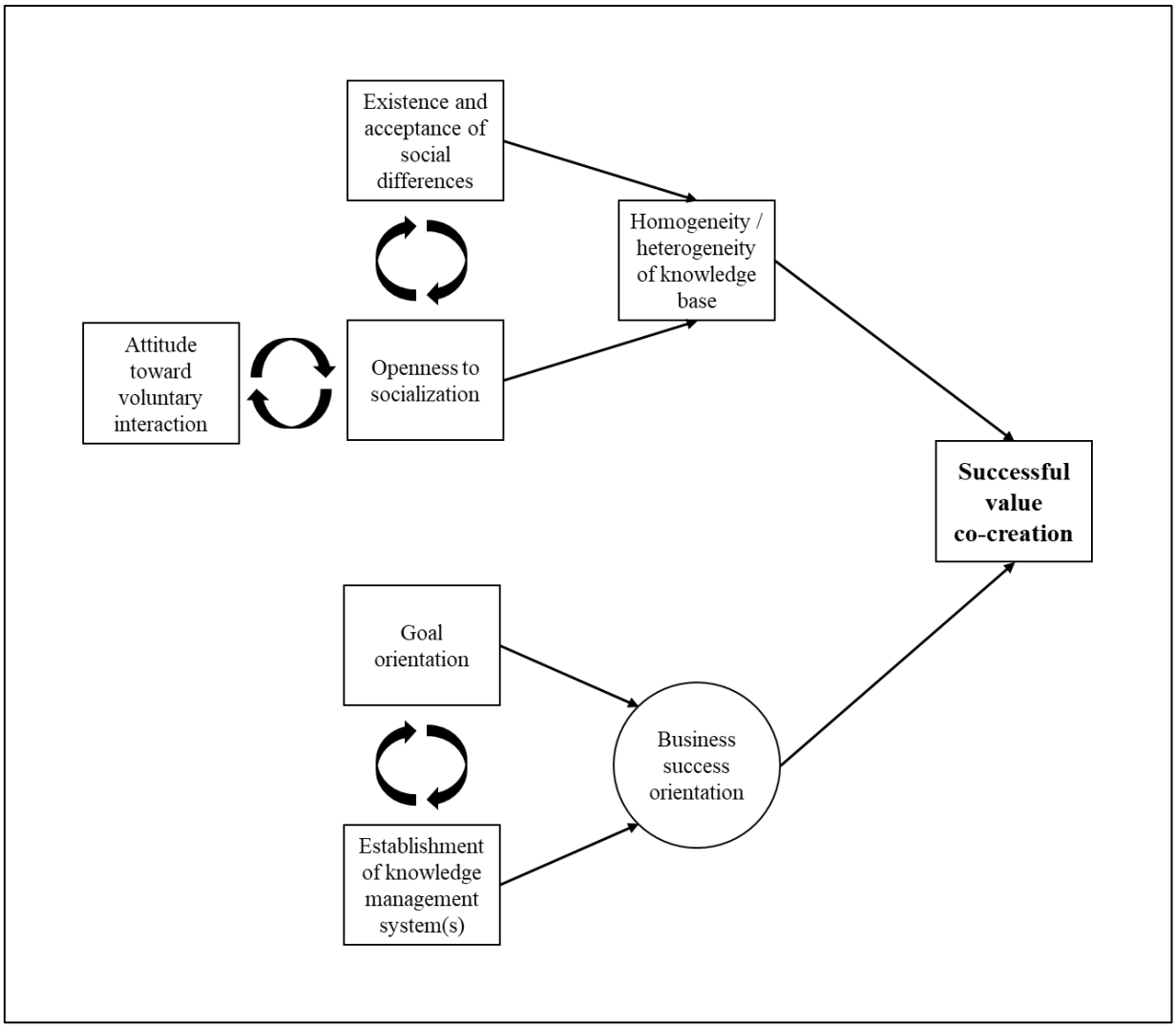

Figure 8. 1 Conceptual model of the results

8.6 Discussion

Following SDL literature (Vargo and Lusch, 2004, 2008) both parties – customers and suppliers – are seen as co-creators of value. However, the contribution of both parties remains unclear (Grönroos and Ravald, 2011). Our findings support the idea that value is very often co-created by different parties. However, especially in CWS, the roles in the co-creation process seem to be flexible; they are in contrast to prior findings not pre-defined. CWS users are very often coevally contributors and recipients in the process of value co-creation or at least switch their roles with regard to different projects. This shows that value emerges as a result of an ongoing evaluative act (Mattsson, 1991). In other words: value is an accumulating experience that arises during the process of resource and knowledge integration. In line with this finding, our data supports the widely ignored idea

first brought forward by Eiglier and Langeard (1975) that both parties – customers and suppliers – may trigger and control the value co-creation process and invite the other partner to join the process. Due to the changing roles of contributors, we also see that the value co-creation process in CWS is normally not straightforward but a result of phases of construction and destruction – an insight that is supported by findings from Echeverri and Skålén (2011). This finding is further supported by the idea of Schumpeterian innovation and the process of creative destruction (Schumpeter, 1942; Tripsas, 1997).

Another important aspect is the aspect of interaction. This aspect has mainly been recognized in the realm of buyer-seller relationships or network models (Hakansson, 1982; Snehota and Hakansson, 1995) and is considered a key construct (Grönroos, 2011). The core of interaction is an element of physical or virtual contact. Interaction, therefore, requires opportunities for different parties to mingle (Grönroos and Ravald, 2011). CWS provide such opportunities and are therefore starting points of value co-creation as long as the CWS users are willing and able to make use of the given interaction opportunities. The willingness is according to our data on the one hand influenced by the acceptance of the interaction partner which is a result of its social status – a finding that is supported by a study from Berger, Cohen, & Zelditch Jr (1972). The more social backgrounds are alike, the easier people seem to interact with each other. This may be a matter of trust as people a more likely to trust each other when there is a basic mutual understanding between them (Lewicki, McAllister, & Bies, 1998). This could explain why social background needs to be taken into account in the context of value co-creation. Interestingly, this quite old insight has up to now not found its way into literature. Our data show clearly the relevance of homogeneity of social status for interaction processes in the context of value co-creation. This is a clear contradiction to literature emphasizing benefits of diversity (Dahlin, Weingart, & Hinds, 2005; Richard, Devinney, Yip, & Johnson, 2009). We see that at least social diversity negatively affects value co-creation in CWS. However, we believe that this insight does not point to a call for homogeneity of social backgrounds in CWS, but rather to a need for an adequate diversity management as well as a need to create a distinct corporate culture.

On the other hand, prior experience needs to be taken into account. A positive/negative interaction experience is according to our data the second main influence factor for interaction. This insight is also supported by extant literature (Sonnentag, 2003). However, CWS may be affected by a self-selection bias as CWS users at least according

to our insights voluntarily enter these collaboration hubs – no matter whether we talk about independent CWS or company-created CWS – which may be a result of a basic openness to interaction. It may, therefore, be reasonable to assume that CWS users normally have at last basic positive collaboration experience. This puts even more emphasis on the social background issue as determinant of successful value co-creation outlined above.

We also learned that interaction is a dialogical process – a phenomenon that is also described by Ballantyne and Varey (2006). Talking to each other is a major precondition to value co-creation as maximum value only emerges if the interests of all involved parties are satisfied. Therefore, all parties should participate in the value co-creation process as the outcome of this process is interdependent on the actions of all involved parties (Botsman and Rogers, 2011). This holds especially true for CWS where interaction takes place on a temporary base.

Value co-creation is fostered by certain societal developments that are also of relevance for the recent rise of CWS. According to O'Hern and Rindfleisch (2010), the growing importance of value co-creation results from the widespread application for digital technologies that allows for short-term interaction between different parties, an empowerment of smaller business partners and especially form a need to overcome information asymmetries between suppliers and customers. We live in a world that is characterized by complexity and a growing specialization of jobs – this calls for an emphasis on the integration of work. Therefore, CWS may be one way to guarantee a holistic outcome of value creation process by means of value co-creation.

Our study shows that CWS are for sure not a cure-to-all solution to challenges of modern work life. However, they depict a new type of (service) ecosystem that allows for a flexible, temporary or long-term integration of collaborators that fuel value creation processes with specific knowledge. However, CWS users and also providers need to be equipped with a set of basic interaction capabilities and a mutual openness to new experiences as they depict a precondition for making CWS work as hubs of value co-creation.

8.7 Conclusion

Our study shows based on decent empirical insights preconditions for and determinants of value co-creation in CWS. We uncover the importance of compatible, at least partly homogeneous social backgrounds of CWS users as precondition for successful participation in value co-creation. The results of our study also support the importance of socialization in the context of value co-creation. We, therefore, enhance the up to now limited insights on the social construction of value (Edvardsson, Tronvall, and Gruber, 2011).

Furthermore, we point to the relevance of intertwining knowledge of CWS users and the importance of managing the knowledge base present in CWS as means to allow for successful value co-creation. Our findings allow for the assumption that knowledge diversity has an inverted u-shaped effect on value co-creation – an insight that calls for further (quantitative-empirical) research.

We also highlight that individual work behavior needs to be taken into account in the context of CWS-based value co-creation. This leads to the insight that working in a CWS may only be beneficial for persons with certain personal characteristics which calls for a deeper analysis of the linkage between CWS design and management and value co-creation performance.

In general, our study broadens the understanding of CWS as innovative hubs of value co-creation in a highly individualized world where the two growing ambivalent needs of independence and community need to be balanced. We, therefore, contribute to value co-creation and also service management literature. By showing that CWS can be understood as (service) ecosystems, we also enrich this literature stream.

In terms of managerial aspects, we enhance the by now very often one-sided perspective that value co-creation is mainly triggered by companies. We show that value co-creation is a process that links different actors. These actors change their roles over time and may be providers and also recipients of value which calls for a new way of managerial thinking. As roles are likely to change over time, it is important to treat contributors to value creation processes equally and to approach them at eye level. Our findings also show the need for an adequate management of CWS as this is a precondition for them becoming frameworks for value co-creation. Even though in many CWS value co-creation by now mainly happens by chance, future challenges call for an active design of value co-creation

processes that involves especially the establishment of a clear focus of the CWS and also setting up entry and probably also exit barriers to be able to control the knowledge availability and knowledge flow within the CWS.

Naturally, we admit that our study is not free from limitations. As we approach a very new phenomenon, we can only provide first insights as relevant longitudinal data on CWS is by now not available. We decided to approach CWS through a value co-creation lens which is from our point of view reasonable and well-explained, but for sure only one way to understand the functioning of CWS. In addition, our sample consists only of CWS located in big cities which makes it somewhat difficult to transfer our findings to smaller environmental settings. As we rely on qualitative data, our findings are not generalizable in a statistical sense. However, we are confident that they are analytical generalizable and therefore can serve as background of future studies dealing with this research field. Further research regarding the SDL could for example elaborate on the starting-points, cycles, or ownership of the co-creation process. We encourage future researchers to take on where we have left off and hope for interesting future conceptual as well as qualitative- and quantitative-empirical insights on the interesting topic of CWS-based value co-creation. There is for sure still much to discover!

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Chapter 9: Coworking Spaces: Empowerment for Entrepreneurship and Innovation in the Digital and Sharing Economy

With Ricarda B. Bouncken, Martin Ratzmann, and Sascha Kraus (2020).

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9.1 Abstract

Freelancers, entrepreneurs, new ventures, but also incumbent firms increasingly use coworking spaces (CWS). The alignment of work-space and social space can facilitate organizational empowerment supporting individual work satisfaction. Our mixed-methods study of 363 respondents from CWS in 26 cities in the USA, Germany, and China identifies configurations of institutional patterns on work satisfaction associated with a sense of community, autonomy, participation, linkage multiplicity and mutual knowledge creation. High work satisfaction can occur in three different configurations related to a) agility housing, b) knowledge housing, and c) social housing. Our findings contribute to how incumbent firms and CWS can influence work satisfaction and empower towards innovation and entrepreneurial performance.

9.2 Introduction

Freelancers, entrepreneurs, new ventures, but also employees of incumbent firms increasingly use coworking spaces (CWS) which offer an office work-space combined with a social space (Bilandzic & Foth, 2013). Through this alignment, CWS can facilitate joint work, creativity, knowledge exchanges, work satisfaction and ultimately lead to increasing innovation and entrepreneurship (Bouncken, Brem, & Kraus, 2016a; Capdevila, 2014; Moriset, 2014; Spinuzzi, 2012). Besides the potential of CWS to create a sense of community (SoC) (Spreitzer, Garrett, & Bacevice, 2015; Garrett, Spreitzer, & Bacevice, 2017), the mechanisms through which these institutions create advantages are mostly unclear yet.

CWS form a relatively novel institution in which the social and tangible context imprints thinking, behavior, and outcomes of users (Greenwood et al., 2010; Toubiana, 2019). Institutionalizations develop in the context of social interaction as well as of spatial and organizational settings of the provider. While operating in the CWS, users influence other users. They develop and manifest specific patterns through institutionalizations (Lok, 2010; Lok & Willmott, 2018). Institutional patterns influence what providers and users consider as

appropriate action within the spatial institution of a CWS. However, patterns might not necessarily have only positive effects on users, e.g. on their work satisfaction (Toubiana, 2019), but also negative ones.

Hence, the purpose of this article is to analyze institutional patterns in CWS and how their configurations relate to work satisfaction. We, therefore, chose a two-step mixed-methods analysis (Kallmuenzer et al., 2019; Woodside, 2014). In the first step, we conduct a qualitative study with 9 users and 5 providers to generate an understanding of important characteristics for work satisfaction in CWS. The results from our interviews guide and enrich our theoretic development based on the institutional theory. After the identification of characteristics, we derive configurations towards high or low work satisfaction based on quantitative survey data from 363 users in 57 CWS by using a necessary condition analysis (NCA) (Dul, 2016) and a fuzzy-set qualitative comparative analysis (fsQCA) (Ragin, 2008).

We identify institutional patterns in CWS related to SoC, participation, autonomy, linkage multiplicity, and mutual knowledge creation with individual work satisfaction as the outcome variable. Patterns, especially of participation, autonomy, linkage multiplicity correspond to the organizational empowerment concept of hierarchical organizations (Matthews, 2003). These patterns show the importance of empowerment in and through contemporary work-spaces expedited in the digitalizing economy. Configurations shown by the NCA and fsQCA analysis relate to high individual work satisfaction (three) vs. low satisfaction (four). Higher work satisfaction occurs in configurations that can be characterized by a) agility housing, b) knowledge housing, or c) social housing.

Our research has theory and phenomenon implications. We contribute to institutional theory with respect to emerging patterns and their configurations in a non-hierarchical spatial work setting (DiMaggio & Powell, 1983; Greenwood et al., 2010). More broadly put, our results bring understanding to localized patterns and their configurations that facilitate organizational (Matthews, 2003) and psychological empowerment (Spreitzer, 1995) that advance work satisfaction and thereby potentially also innovation and entrepreneurship. Likewise, our findings on CWS inform empowerment, innovativeness, and entrepreneurship by a phenomenon (CWS) of the modern sharing-economy and digitalized world (Bouncken & Reuschl, 2018).

9.3 Theoretical Background

9.3.1 *Phenomenon: CWS*

The open offices of the IT firms, such as especially those in the Silicon Valley, but also the smooth social interaction in public libraries inspired the establishment of the CWS concept (Bilandzic & Foth, 2013; Schopfel, Roche, & Hubert, 2015). Generally, CWS offer an interior to support informal social interaction greater than traditional office concepts (Fuzi, 2016; Schopfel et al., 2015). At the core, CWS provide infrastructure and dedicated space to facilitate professional and social interaction that enables knowledge exchange, creativity, and innovation processes (Bouncken & Kraus, 2016; Gandini, 2015; Reuschl & Bouncken, 2017; Gerdenitsch et al., 2016; Spinuzzi, 2012). Especially the common social spaces of cafeterias, lounges, and bars of CWS expedite serendipitous networking, knowledge exchange, collaboration, innovation as well as individual work satisfaction (Gandini, 2015; Reuschl & Bouncken, 2017). Not surprisingly, CWS differ one to the other. Some CWS have more space dedicated to common, joint and open offices, while others rather concentrate on single offices, event space, or community areas.

CWS can follow multiple purposes, they can aim towards attracting start-ups and new ventures and thus share characteristics with incubators. Other CWS have a focus on open offices for company employees to allow more personal interaction while also reducing costs compared to single and dedicated company offices. Owners of CWS might be specialized coworking-providers or public institutions, but also incumbents. Most CWS are set up at attractive locations within major cities, but increasingly CWS exist in more rural areas catering to rural entrepreneurs (Fuzi, 2016). The high diversity in CWS regarding strategy, location and set-up challenges current research seeking to identify global success factors of CWS.

9.3.2 *Theoretic Approach: Institutionalization of CWS*

Institutional theory broadly defines an institution as a set of rules that govern the behavior of actors (Selznick, 1996). The multiple schools of institutional theory (Mahoney & Thelen, 2010) cover institutional arrangements that range from legal-formal institutions (e.g. political or history institutional theory) to cognitive constructions and patterns (e.g. social constructive institutionalism). Especially sociological institutionalism concentrates on shared informal and

tacit conventions that regulate the behavior of humans (Schmidt, 2008). Institutions require at least a partially shared understanding of individuals. Institutional organization theory explains why institutions emerge and spread occurring as somewhat similar institutions (DiMaggio & Powell, 1983). The attractiveness of institutional models is affected by institutional patterns and socialization processes which inform routines and taken-for-granted institutionalized practices (DiMaggio & Powell, 1983).

CWS are about the alignment of social interaction and work allowing multiple, flexible, and autonomous knowledge exchanges between users who might work alone but also in teams temporarily or long-term (Bilandzic & Foth, 2013; Capdevila, 2014; Spinuzzi et al., 2019; Garrett et al., 2017; Gerdenitsch et al., 2016). The interior of CWS should allow office work, but also promote openness to social interaction, participation in the work-spaces, and its teams, using knowledge in and from different contexts and engaging in a mutual creation of knowledge. Institutional patterns emerge by formal and informal organization of the space and behavior of the users. Over time behaviors become shared and institutionalized and thus will channel behavior in CWS.

9.4 Modeling the Main Institutional Patterns in Coworking spaces

In the first step of our analysis, we followed a qualitative interpretivist approach and aimed to develop an understanding of the CWS phenomenon by appreciating its uniqueness and its interaction within the context. We aimed to generate deep insights and connect these insights to theory (Dyer Jr & Wilkins, 1991). Following Stake (1995), we concentrated on understanding subjective meanings in the social world, here CWS, inquiring how individuals acknowledge the existence of these meanings, and how they understand them. We explore the CWS characteristics of individual work satisfaction and combine insights with current literature. We apply empirical data from open qualitative interviews, carried out in four CWS, with five CWS providers and nine users in 3 cities within Germany (Table 9. 1). The mixture of corporate and open CWS were selected as information-rich sites that enable in-depth understanding of context and characteristics. We interviewed providers as well as users to study work satisfaction from multiple perspectives. The interviews bring an in-depth understanding of relevant characteristics in CWS. We asked users which aspects of the CWS had the biggest impact on their work satisfaction. We asked the providers what characteristics they believe were relevant for improving their user's work satisfaction. We conducted the interviews in six

months, and each lasted between 25 and 55 minutes. In the analysis, five relevant characteristics emerged which were mentioned by the 14 interviewees.

Table 9. 1 Sample of initial qualitative interviews

Interview	CWS	Role	Location	Gender	Age	Job	Type
D1	Open CWS1	Provider	Munich	Male	36	CWS manager	Privat
D2	Open CWS1	User	Munich	Male	28	Employed	Privat
D3	Open CWS1	User	Munich	Male	41	Self-employed	Privat
B1	Open CWS2	Provider	Berlin	Male	23	CWS Manager	Privat
B2	Open CWS2	User	Berlin	Male	38	Manager	Privat
B3	Open CWS2	User	Berlin	Male	29	Manager	Privat
B4	Open CWS2	User	Berlin	Female	30	Operations Manager	Privat
M1	Open CWS3	Provider	Munich	Female	33	CWS Manager	Privat
M2	Open CWS3	User	Munich	Male	48	Coach	Privat
M3	Open CWS3	User	Munich	Male	28	Freelancer	Privat
C1	Corporate1	Provider	Bayreuth	Male	52	Facility Management	Corporate
C2	Corporate1	Provider	Bayreuth	Female	35	Consultant	Corporate
C3	Corporate1	User	Bayreuth	Male	41	Employed	Corporate
C4	Corporate1	User	Bayreuth	Female	30	Employed	Corporate

9.4.1 *Sense of Community Logic*

CWS have the potential to bring about a SoC (Butcher, 2013; Garrett et al., 2017; Spinuzzi et al., 2019). The SoC emerges within a specific tangible environment, specifically the interior of the CWS, its location (e.g. a quarter of a city; Durante & Turvani, 2018), the rules set by the CWS provider, the personnel and the moral sets of the CWS, the user base of the CWS and their social interaction. For example, a specific local-regional community in which the space is located will go along with certain logics (Lee & Lounsbury, 2015).

SoC was mentioned in every interview as relevant for work satisfaction. Some coworkers expressed that SoC is of especially high relevance. Interviewed B2 told us: *"Working alone at home or always working from home with two people is of course also stressful in the long run- that's why we were happy to find a CWS where we also get in contact with other people."* Contrary to this positive approach to SoC, CWS provider D1 informed us that they had a productivity focus that did not support SoC: *"We want people to be able to work together cleanly and very focused and professionally and that's all, and that's exactly what's important, so our approach is reduced to just this aspect".*

The location and the size of the space might influence the development of the SoC. CWS might connect to but also depart from the values and ideals of the local community. Yet, the SoC might not sufficiently describe the specifics of CWS that might trigger performance and work satisfaction of CWS users. The CWS provider will have set rules in the specific tangible and service environment of the space which also influence the behavior of users. Coworking is directed at fluid and porous structures where users can move quickly and easily across team boundaries and use their tacit and explicit knowledge seamlessly in and outside of teams (Dibble & Gibson, 2017). This relates to the other key characteristics of openness and autonomy, easy participation, linkage multiplicity, and mutual knowledge exchange.

9.4.2 *Linkage multiplicity*

The open architecture of CWS allows to easily enter social exchanges (Garrett et al., 2017). The architecture and open social atmosphere might allow users to team up using multiple linkages. The presence of individual and team-based work in CWS permits work in several overlapping teams parallel or sequentially. Becoming part of teams, changing between teams, and the fluidity of loose boundaries might allow pursuing own ideas, using own skills, and to step into various multi-person shared knowledge creation processes.

Linkage multiplicity is one of two characteristics that were mentioned in every interview as highly relevant for work satisfaction. Interviewee D2 described the importance of multiple linkages in the following statement: *"We always work with different people. These co-operations also happen on a contractual basis. We give each other suggestions, help each other, work for projects with another team, but remain independent and responsible."*. From the provider perspective, B1 gave us the following information on the importance of linkages: *"Users take advantage of this proximity (in the CWS) to talk about their business model with other coworkers, give each other tips or enter into co-operations. We are quite diversified here. We have IT-people, company founders, management consultants, designers, web designers, all in one CWS"*.

Moving between teams allows contributing to diverse knowledge exchanges while applying own knowledge and absorbing complementary knowledge. Using the own knowledge better and having easier access to complementary knowledge might increase work satisfaction. The degree to which individuals can use their skills and knowledge while pursuing own ideas will relate to high work satisfaction. Still, the instability of team relationships and the high risks of

losing key ideas or sharing proprietary knowledge might bring high tensions that reduce work satisfaction. Being involved in shared and mutual knowledge creation processes might reduce those tensions because of the recursive knowledge creation. The SoC, thus the belonging, and participating in the space also might compensate the tensions of diverse and fluid ties within and across teams.

9.4.3 *Openness and Autonomy*

Traditional firms build hierarchies and functional differentiation (e.g. managers vs. floor personnel, marketing vs. engineering) and impose further homogenizing forces by formal and informal factors (e. g. organizational rules, informal networks, collaboration in joint projects). CWS are set up to break with these rigid structures in order to facilitate interaction dynamics of users in CWS that differ from traditional work contexts.

Our qualitative interviews indicate that most coworkers have freedom and autonomy on their performance metrics and work structure as they are either freelancers or entrepreneurs. Interestingly we find that by incumbent employed CWS users also have high autonomy in structuring their work. Interviewee C1 who works in a corporate CWS told us the following: *"There are corporate goals. The individual goals of the divisions are oriented towards these. The result is the only important factor. How I get there doesn't matter. I don't get any guidelines".*

The 'typical' form of CWS by dedicated coworking-providers offers high openness to membership and users' termination of their membership and with high degrees of autonomy of users (mentioned also by all open CWS providers). This openness to outsiders might not exist for CWS that are created by incumbent firms to provide a new space for work of company employees (mentioned by C1). Yet, even those incumbent spaces might open barriers to allow an easy integration in the space which avoids the organization's hierarchy systems. Instead, users have autonomy in working individually, in teams, and engage in permanent or fluid relationships. They might choose their own goals instead of goals set by authorities. Users might structure tasks on their own priorities and competencies. Performance will be less monitored by others or superiors. The autonomy might improve empowerment and work satisfaction (Zangaro & Soeken, 2007). Yet there are also challenges because the autonomy might overburden users. Social interactions, joint values, etc. might help to cope with the greater levels of autonomy in the space.

9.4.4 *Participation*

Generally, CWS have open social spaces that facilitate social interaction of users. They might bring opportunities to meet and to identify areas for joint projects or tasks. Yet, CWS will vary according to the easiness at which new users feel "at home" and can access social relationships. Even if users feel welcome and at ease, they might not participate in a closer social interaction and knowledge exchange. In our interviews, users referred to the ease of participation when first joining a CWS. For example, Interviewee D3 told us this story about joining a CWS for the first time: *"I was looking for connection and at some point, I just came to the CWS and then it was on the first day that one of the coworkers asked me if I wanted to go out and play frisbee. From that moment on I was in and I got to know so many people, who have helped me personally and professionally. I gained a very important network."*. Interviewee C3, who is working in a corporate CWS made the following statement specifying the importance of easy exchange and participation on his well-being: *"Through the participative exchange with colleagues, I am more motivated and more satisfied"*.

These examples indicate one of the core principles of CWS – open participation leading to community, motivation, empowerment (Spreitzer, 1995) and satisfaction. CWS users might work individually and isolated in CWS if they choose to; yet, this is not the guiding idea of the term "co". Hence, CWS need patterns in which the not formally integrated users become involved in the social and work environment of the space.

Feeling easily at home, participating in social and in knowledge exchange might relate to a greater participational level in a CWS. Greater participation might improve work satisfaction, but it might also overstretch the social needs and obligations of users. Potentially other social factors, joint values, the SoC and the simpleness to enter but also leave groups again might form specific patterns that improve individual work satisfaction.

9.4.5 *Mutual knowledge creation*

CWS offer the opportunity for individuals to transfer, acquire, and assimilate knowledge of explicit and implicit components (Bouncken & Aslam, 2019). Compared to acting alone, the exchange of knowledge among CWS users allows greater synergies, and thus also less complicated, and more effective work. The social and architectural context, especially of open

interior of work and social spaces facilitates open and autonomous interaction among CWS users for knowledge exchange and learning (Bouncken, Aslam, & Qui, 2020; Parrino, 2015). Actors might start with some informal confabulation, then extend this to exchange of information, helping, working for each other and then potentially even moving into joint work-, team-, project-, and firm-relationships in which they exchange knowledge.

Our qualitative interviews showed the opportunity to mutually work on solutions and ideas in CWS which might turn into concrete projects. Interviewee D3 reported that he has encountered this situation multiple times. He described the current situation in the CWS as follows: *"With the colleagues that are active in a similar business field I openly discuss what I am doing and they also tell it and then we ask briefly how do you do that, or how do you think about it, or can you take a look at this? So we share experiences and find solutions."*

The knowledge exchange allows finding various solutions for coping better and faster with challenges and problems. Projects and tasks take advantage from a more easy access of diverse knowledge in the space. Individuals might experience the exchanges of knowledge and learning as demanding and even stressful, but the better and faster solution of problems, challenges, tasks, and projects might increase individuals' satisfaction in the workplace. Yet, knowledge exchange does not necessarily lead to improvements (Bouncken & Kraus, 2016), and might need other supporting factors. Learning is not independent from its social environment, especially the interaction within or across groups across individuals in the same social group (Bouncken et al., 2016a). Thus, there are variations of how mutual knowledge exchange relates to other patterns and individual work satisfaction. Different levels of shared SoC in the space and degrees of freedom openness to new members in the space or teams will influence the level of mutual knowledge exchange and the merits on work satisfaction.

9.4.6 *Empowerment*

Empowerment refers to organizations facilitating their employees' discretion and autonomy in performing their tasks and functions (Spreitzer, 1995; Zhang & Begley, 2011). Matthews (2003) describes organizational empowerment based on employees' control of workplace decisions, dynamic structural framework, and the fluidity in information sharing and significant differences by the number of included dimensions. From this perspective, it is more interesting to identify patterns as single characteristics and their consequences on individual work satisfaction.

9.5 Method

9.5.1 *Sample*

In a subsequent analysis step, a team of research assistants visited CWS in three different countries to collect data using a standardized questionnaire. The respondents completed the questionnaires in the presence of the research assistants who could clarify ambiguities. The questionnaire also gathered general information about the CWS (name of the CWS, city, country), personal information about the respondent (age, gender, profession, and experience in CWS). The remainder of the questionnaire was about the characteristics of the CWS. All in all, we collected questionnaires from 363 users in 57 CWS operating in 26 cities in the USA, Germany, and China. After omitting all questionnaires with missing values in relevant variables, our final sample consists of 328 observations. Most participants come from China (77.7%) and Germany (21.6%). About half (46.9%) of the participants are entrepreneurs, two-thirds (63.7%) are males, and the average age is 27.7 years (SD=6.3). Most participants work in teams (78.7%) with an average of 9 core-team members, and for a time of 16.4 months so far.

9.5.2 *Measures*

Our study employed a multi-item approach (Nunnally & Bernstein, 1994) on 5-point Likert scales. We carried out a principal component analysis by non-linear iterative partial least squares (NIPALS) algorithm of Wold (Noonan & Wold, 1977). Our outcome measure of individual work satisfaction reflects the work-related attitude (Diestel, Wegge, & Schmidt, 2014) on the fit between job requirements and individual talents and skills (Wang, Lawler, & Shi, 2010), the degree of agreement between the work and the ideal, and satisfaction about the working conditions (Guerra & Patuelli, 2014). The items are listed in Table 9. 2. Participation defines how easily new members can join and integrate into the existing community of a CWS (Colignon, 1987). Autonomy refers to members' degree of involvement in making decisions about their work (Ducharme & Martin, 2000), defining their own goals, work structures, and performance metrics (Rico et al., 2007; Hackman & Oldham, 1976). Linkage multiplicity explains members’ freedom to work individually or in more than one team consisting of the members of their choice (Colignon, 1987; Workman, 2005). SoC refers to users’ perception to be part of the community, having the opportunity to overcome social isolation and develop friendships with other members (Garrett et al., 2017). For mutual knowledge creation, we

adapted an existing scale for learning among individuals/members (Bouncken, Pesch, & Reuschl, 2016b).

To evaluate the reliability and internal consistency of our items, we apply item-to-component correlations and Cronbach's-Alpha (CR). The correlations between items and their accompanying components range from 0.78 to 0.90. The CR-values range from acceptable (linkage multiplicity, sense of community, and mutual knowledge creation) to very good (participation, autonomy, work satisfaction). Furthermore, we evaluate the average of the mono-trait correlations (which reflect the correlations of indicators within the same construct) and the hetero-trait correlations (which reflect the correlations of indicators across constructs measuring different phenomena) to support discriminant validity by the heterotrait-monotrait ratio (HTMT) with values lesser than 0.85 (Henseler, Ringle, & Sarstedt, 2015).

Table 9. 2 Measures of the constructs (N=328)

	Items	ISC [1)]	CR	MT	HT	HTMT
Participation	New participants can very easily make themselves feel at home here.	0.89				
	New participants can very easily join the knowledge exchange here	0.90	0.88	0.71	0.35	0.49
	There is easy social integration of new participants here.	0.90				
Autonomy	We have strong freedom in choosing goals - rather than authorities set goals.	0.92				
	We have high autonomy in how I/we structure work – rather than authorities.	0.90	0.89	0.73	0.30	0.41
	We autonomously develop or performance metrics – rather than authorities.	0.90				
Linkage multiplicity	Individual often work in several teams at the same time – rather than in a single team.	0.79				
	There are many linkages among teams here.	0.82	0.74	0.49	0.31	0.64
	There loose boundaries between groups/ teams / work-spaces here.	0.82				
Sense of community	Working here (workspace) allows me to become part of a community.	0.84				
	Working here (workspace) allows me to overcome isolation.	0.84	0.77	0.53	0.28	0.52
	Working here (workspace) allows me to build new friendships.	0.82				
Mutual knowledge creation	We mutually develop novel ideas/ insights/ products with others here.	0.87				
	We mutually find novel solutions by sharing knowledge with others here.	0.87	0.79	0.57	0.26	0.46
	We often solve problems by sharing knowledge with others here.	0.78				
Work satisfaction	All my talents and skills are used at work.	0.80				
	In most ways my work is close to my ideal.	0.89	0.80	0.57	0.28	0.50
	The conditions of my work are excellent.	0.83				

1) All correlations are statistical significance at the 0.01 level.
Item-to-component correlation (ISC), Cronbach's Alpha (CR), Monotrait (MT), Heterotrait (HT), and Heterotrait-Monotrait-Ratio (HTMT).

Table 9. 3 shows the correlations. The highest correlations are shown for linkage multiplicity with participation, linkage multiplicity with autonomy, SoC with participation, and autonomy with participation.

Table 9. 3 Correlations of constructs with workgroup size and usage intensity of CWS (N=328).

Variable	Mean	Std. Dev.	1	2	3	4	5	6	7	8
1. Workgroup size	8.93	12.97	1							
2. CWS usage intensity	18.62	7.67	0.09	1						
3. Participation	0.00	1.55	-0.01	-0.02	1					
4. Autonomy	0.00	1.57	0.06	-0.03	**0.42**	1				
5. Linkage multiplicity	0.00	1.41	0.11	-0.02	**0.52**	**0.51**	1			
6. Sense of community	0.00	1.44	0.08	0.07	**0.50**	**0.28**	**0.34**	1		
7. Mutual knowledge creation	0.00	1.46	0.02	-0.02	**0.33**	**0.28**	**0.34**	**0.34**	1	
8. Work satisfaction	0.00	1.46	-0.01	0.06	**0.37**	**0.34**	**0.42**	**0.35**	**0.35**	1

Bold values indicate statistical significance at the 0.01 level.
Because the standard deviation of workgroup size is greater than the mean, we using the ln(workgroup size + 1).

9.5.3 *Procedures*

For our analyses, we apply three different approaches: First, in fsQCA, we perform a necessity analysis of participation, autonomy, linkage multiplicity, SoC, and mutual knowledge creation with individual work satisfaction as the outcome variable. We identify which necessary causes allow the outcome to exist. Without the necessary causes, the outcome will not exist. Second, we continue with a necessary condition analysis (NCA) to calculate effect sizes of the characteristics on the outcome (Dul, 2016). A major difference between QCA and NCA is that NCA focuses on necessary determinants that are not automatically sufficient. QCA can focus on sufficient causes that are not automatically necessary (Kraus, Ribeiro-Soriano, & Schüssler, 2018b). A sufficient cause ensures the outcome existence (Dul, 2016). Third, to identify sufficient patterns of work satisfaction, we apply fsQCA to explore sufficient core and peripheral elements in relation to the outcome.

In all1 analyses, we use membership scores representing the extent to which a case is a member of a set. For the transformation of raw scores to membership scores, we use direct fuzzy-set calibration (Ragin, 2008a, 2008c). The anchor values of full membership are based on the 0.95 percentile. The crossover point of maximum ambiguity is based on the median and the full non-membership is based on the 0.05 percentile (Ragin & Fiss, 2008). After calibrating the fuzzy sets, we calculate the degree of membership of each case in each of the logically possible

[1] Aditionally, in the NCA we compare the results of effect sizes calculated by the sum of raw scores with the calibrated scores.

combinations and the distribution of cases across these combinations. To avoid that cases with a precise membership value of 0.5 dropped from the fuzzy set analysis, we added a constant of 0. 00001 to all conditions (Fiss, 2011).

9.5.4 *FsQCA necessity analysis*

To check for necessity before sufficiency, we assess whether the five patterns meet the necessary condition for the outcome variable. According to Schmitt, Grawe, and Woodside (2017), a consistency cut-off value of 0.80 specifies identifying necessary conditions. The consistency score of 0.80 would indicate that in most – but not all – cases, membership in mutual knowledge creation comes with membership in individual work satisfaction (Table 9. 4). With consistency scores of less than 0.75 indicating substantial inconsistency for participation and SoC with work satisfaction.

Table 9. 4 QCA necessity analysis for Participation, Autonomy, Linkage multiplicity, Sense of community, and Mutual knowledge creation for the occurrence of Work satisfaction

	Work satisfaction		~Work satisfaction	
	Consistency	Coverage	Consistency	Coverage
Participation	**0.746**	**0.722**	0.587	0.610
~Participation	0.597	0.574	**0.732**	**0.756**
Autonomy	**0.792**	**0.209**	0.651	0.626
~Autonomy	0.582	0.609	**0.697**	**0.782**
Linkage multiplicity	**0.782**	**0.738**	0.614	0.622
~Linkage multiplicity	0.599	0.591	**0.741**	**0.785**
Sense of community	**0.741**	**0.720**	0.571	0.596
~Sense of community	0.584	0.559	**0.732**	**0.753**
Mutual knowledge creation	**0.801**	**0.684**	0.650	0.596
~Mutual knowledge creation	0.527	0.584	**0.656**	**0.780**

~ = negated membership

9.5.5 *Necessary condition analysis*

We use a multivariate necessary condition analysis (NCA) approach for finding necessary ingredients of individual work satisfaction in CWS. Multidimensional ceiling combines the two-dimensional ceiling lines of the separate conditions. If necessary conditions are correlated, multivariate NCA will identify each as necessary, although correlated necessary conditions may have the same underlying meaning (Dul, 2016). The effect size can be compared with "relevance" (Goertz, 2006), and "coverage" (Ragin, 2006; 2008b) for the importance of a

necessary condition. We use continuous linear ceiling regression techniques with free disposal hull (CR-FDH). We find significant but very small effect sizes for participation, sense of community, and autonomy. The effect sizes are marginal higher when calculated with raw data, but the level of significance is equal (Table 9. 5).

Table 9. 5 NCA for participation, autonomy, linkage multiplicity, sense of community, and mutual knowledge creation for the occurrence of work satisfaction.

	Ceiling zone	Observations (ceiling zone)	Accuracy	p-accuracy	d_{raw}	p	d_{calib}	p
Participation	0.011	2	99.4%	0.004	**0.076**	**0.011**	**0.012**	**0.026**
Autonomy	0.001	0	100.0%	0.007	**0.007**	**0.071**	**0.002**	**0.061**
Linkage multiplicity	0.002	0	100.0%	0.010	0.007	0.165	0.001	0.138
Sense of community	0.012	1	99.7%	0.008	**0.056**	**0.086**	**0.013**	**0.083**
Mutual knowledge creation	0.000	0	100.0%	0.012	0.010	0.744	0.000	0.726

Notes: Effect sizes (d) calculated with raw-data and calibrated data and reported for the straight-line function (CR-FDH). P-values are estimated with 1000 sample reputations.

Estimated with raw data, none of the characteristics are required to reach 50 percent of the observed work satisfaction. For a higher level of satisfaction (70%) a minimum value of participation and sense of community are required for work satisfaction to occur. For highest work satisfaction (100%), all five characteristics are required on a minimal level. With calibrated data, for a 60 percent-probability of membership in work satisfaction a minimal value of participation is necessary. For 70 percent-probability of membership in work satisfaction minimal values of participation and sense of community are necessary. To reach a 100 percent-probability of membership in work satisfaction, minimal values of all five characteristics are necessary.

9.5.6 *Patterns of sufficient core- and peripheral configurations*

The previous analysis focused on the necessity of participation, autonomy, linkage multiplicity, SoC, and mutual knowledge creation for work satisfaction. In the next step, we present sufficient configurations of these causes. The theoretical truth table refers to 32 possible logical combinations (2k) of these causal conditions (k=5). For identifying generic patterns, we choose a relatively high frequency cut-off value of eight cases. The 18 most common combinations of conditions that pass this restriction retain 80 percent of cases.

We apply consistency and coverage metrics to assess the necessity and sufficiency analyses (Ragin, 2008b). Consistency measures relate to the degree to which cases having the specified effect also exhibit causal or constructive characteristics. In other words, it measures the proportion of members of the subset who are members of the superset. Consistency is to set relationship what the p-value is for statistical inference. The higher the consistency, the stronger the set relationship. In general, we look for set-theoretical relationships with consistencies greater than 0.88. Coverage measures how much a consistent subset "covers" the superset. In the case of "necessary" causes, coverage can be interpreted as the degree to which the cause "is relevant" to the effect (Ragin, 2008b). With the fsQCA approach, theoretically, a condition (A) is necessary for an outcome (Y) if in each case the degree of membership in the outcome is consistently less than or equal to the degree of membership in A ($Y \leq A$). Condition A is sufficient to Y if across all cases the degree of membership in condition A is consistently less than or equal to the degree of membership in Y ($A \leq Y$; Wind, 2017).

The results of the set-theoretic consistency assessments for the eighteen combinations meet the frequency threshold (a frequency of at least eight cases that are more in than out of each combination). The consistency scores range from 0.199 to 0.887, indicating a substantial spread in the degree to which the subset relation is satisfied. The maximizing of parsimony in the truth table result in three configurations for membership in work satisfaction and four configurations for non-membership in work satisfaction.

Individual work satisfaction can be caused by 1) SoC in the absence of participation, 2) participation with linkage multiplicity, or 3) in absence of autonomy with linkage multiplicity and mutual knowledge creation. The absence of participation, autonomy, linkage multiplicity, or mutual knowledge creation can be sufficient causes of negated work satisfaction. Additionally, the intermediate solution offers these core configurations in patterns complemented by peripheral conditions (Table 9. 6).

Table 9. 6 Parsimonious solution of fsQCA configurational analysis.

	Work satisfaction			~Work satisfaction		
Frequency cutoff = 8; Consistency cutoff = 0.88	Con	Cov	UCov	Con	Cov	UCov
~Participation*Sense of community +	0.80	0.44	0.09			
Participation*Linkage multiplicity +	0.81	0.65	0.25			
~Autonomy*Linkage multiplicity*Mutual knowledge creation	0.84	0.40	0.03			
~Participation				0.76	0.73	0.03
~Autonomy				0.78	0.70	0.03
~Linkage multiplicity				0.79	0.74	0.03
~Mutual knowledge creation				0.78	0.66	0.03
Solution	0.77	0.81		0.68	0.93	

~ = negated membership

The first configuration from the parsimonious solution is included in an intermediate solution which is complemented by mutual knowledge creation (P3 in Table 7). It indicates a more social-driven work satisfaction. The second configuration from the parsimonious solution is complemented by autonomy, it shows satisfaction related to dimensions of workspace permeability (P1). In the last configuration from the parsimonious solution, no complementarians are shown (P2).

In summary, the QCA necessity analysis shows that mutual knowledge creation is necessary but not sufficient for individual work performance. Mutual knowledge creation is included in two patterns of individual work satisfaction. In combination with linkage multiplicity and negated autonomy, or as a complementary condition of SoC with negated participation. With an effect size of zero in the NCA, mutual knowledge creation does not prove to be a necessary condition. The absence of mutual knowledge creation fails the necessity analysis for negated individual work performance by showing a consistency of less than 0.80. The configurational analysis supports the absence of mutual knowledge creation as sufficient but not necessary for negated individual work performance.

Furthermore, the NCA shows that participation, autonomy, and SoC are necessary for work satisfaction. The configurational analysis further shows that participation aligned with linkage multiplicity and autonomy is sufficient for work satisfaction. The absence of participation is sufficient for negated work satisfaction, but in a pattern with SoC and mutual knowledge creation, negated participation is sufficient for work satisfaction.

The absence of autonomy is a core condition for negated work satisfaction, but a peripheral complementary condition of work satisfaction, when participation and linkage multiplicity are present. Furthermore, in the presence of linkage multiplicity and mutual knowledge creation,

the absence of autonomy is a sufficient core condition for work satisfaction. The absence of SoC is not present in configurations for negated work satisfaction, but the presence of SoC is a sufficient core condition for work satisfaction in the absence of participation, complemented by mutual knowledge creation.

Linkage multiplicity was not relevant in the necessity analysis and NCA but is a sufficient core condition in the configurational analysis. The absence of linkage multiplicity is sufficient for negated work satisfaction. The presence of linkage multiplicity is included in two patterns of individual work satisfaction. With participation and complemented by autonomy as well as in the presence of mutual knowledge creation and the absence of autonomy, linkage multiplicity is sufficient for individual work satisfaction.

9.6 Discussion

The purpose of our study is to analyze institutional patterns in a spatial work setting in the digital and sharing economy (Richter, Kraus, & Syrjä, 2015; Bouncken & Reuschl, 2018; Kraus, Roig-Tierno, & Bouncken, 2019). Our theorizing and open qualitative interviews revealed main patterns in CWS: SoC, autonomy, participation, linkage multiplicity and mutual knowledge creation. The combination of NCA and fsQCA on additional quantitative survey data shows three configurations relating to high work satisfaction levels: a) agility housing (P1), b) knowledge housing (P2), and c) social housing directed patterns in CWS (P3 in Table 9. 7).

Table 9. 7 Intermediate solution with configurational patterns for membership in workspace satisfaction, respectively non-membership in workspace satisfaction (N=328).

	Work satisfaction			~Work satisfaction			
Frequency cutoff = 8; Consistency cutoff = 0.88	P1	P2	P3	N1	N2	N3	N4
Participation	●		⊗	⊗			
Autonomy	•	⊗			⊗		
Linkage multiplicity	●	●				⊗	
Sense of community			●				
Mutual knowledge creation		●	•				⊗
Consistency	0.84	0.84	0.85	0.76	0.78	0.89	0.78
Raw coverage	0.60	0.40	0.39	0.73	0.70	0.74	0.66
Unique coverage	0.26	0.05	0.06	0.03	0.03	0.03	0.03
Solution coverage		0.75			0.93		
Solution consistency		0.80			0.68		
Solution PRI		0.61			0.51		

Note: Core causal conditions are present ● or absent ⊗ and complementary causal conditions are present • or absent ⊗.

Our study contributes to institutional theory and to the phenomenon of CWS that permits studying localized institutionalizations. Previous research on institutional logics has focused on conceptually explaining its underlying concepts and formational processes (Lee & Lounsbury, 2015; Lok, 2010). This study is one of the first to empirically investigate the content and configurations. Our results support a macro-organizational view of empowerment which assumes a gestalt (configurational) understanding of factors towards empowerment (Matthews, 2003). Previous research on hierarchical organizations proposes three factors linked to the organizational facilitation of empowerment: 1) dynamic structural framework, 2) control of workplace decisions, and 3) fluidity in information sharing. CWS might specifically contribute to the psychological empowerment to individuals and so push innovation and entrepreneurship further (Spreitzer, 1995). CWS might work as an organizational setting to influence psychological empowerment of individuals. Further, the institutionalizations in CWS allow the organizational facilitation of organizational empowerment.

The agility housing pattern is related to openness to new members, multiplex relationships, fluid structures, where users might step into more work-related permeability in CWS. The openness, fluidity, and porousness point to organizational aspects of work in CWS. It has relationships with a permeability concept that has been used for the porousness of institutional supply chain arrangements between firms (Jacobides, MacDuffie, & Tae, 2016). Here it relates to agile and permeable organizational structures between individuals who might be freelancers, start-up entrepreneurs, or employees from the same company. The pattern relates more directly to the tasks and work than to the more general context of localized spaces. In addition, the openness to new members, multiplex relationships and fluid structures especially point to the organizational facilitation of organizational empowerment (Matthews, 2003). The agility housing pattern could thus also be considered as the organizational empowerment pattern in CWS.

The knowledge housing directed configuration relates to the importance of knowledge sharing and communities of practice in previous research (Brown & Duguid, 1991). Direct personal exchanges allow “socialization” (Nonaka, 1994) transferring tacit knowledge and creating mutual knowledge (Bouncken et al., 2016b). Individuals seem to enjoy stepping into processes of exchanging, receiving, and creating knowledge with others in the shared spaces. The knowledge creation processes might be related to specific tasks but also to a general learning experience of the individual. Thus, this configuration relates to the context of work but also to the work itself that might form further advantages for innovation and entrepreneurship.

The social housing directed configuration in CWS corresponds to the SoC as the core of CWS in previous research (Garrett et al., 2017). Users develop SoC by collectively endorsing a vision of community that both unifies the individual to the collective while allowing enough autonomy for members to customize the vision to their particular needs (Garrett et al., 2017). While some members become active participants in the community, others might prefer a more passive style of membership. Yet, the social home improves work satisfaction. The SoC might not be associated with the joint work, projects, or ventures. Instead, it is based on reducing social isolation often present in modern digital media relationships. Thus, the social context influences the context of work(-satisfaction) in the space rather than the actual work.

At last, our research also finds that CWS not always support work satisfaction. Presumably, the high autonomy and the few formalities in a CWS might bring more degrees of freedom of opportunistic behavior and dark personalities (Bouncken, Aslam, & Reuschl, 2018). The noise in a space and also frequent and hardly avoidable social interaction might also overburden individuals. In addition, the new open work forms might not always feel good for everyone (Leclercq-Vandelannoitte & Isaac, 2016) and might require a new understanding of work and management (Ivaldi, Pais, & Scaratti, 2018). In addition, the multiple knowledge exchange possibilities might include high risks of unintended knowledge leakage. Thus, the typical openness and exchange in CWS might not necessarily drive individual performance or work satisfaction, even decrease it. Likewise, exchanges within or among fluid teams might lead to an overburden that reduces work satisfaction. While the results indicate that users' individual work satisfaction is always due to patterns of multi-causal characteristics, the lack of work satisfaction is always explained by the lack of single characteristics.

Besides the multi-sources of our empirical study, there are some limitations. First, we do not know what certain practices the CWS use to influence the patterns. For strategic and operational planning of spaces, it would be interesting to understand how they can influence patterns. Second, the patterns and configurations might relate to different personalities or targets of users. Future studies might venture into these questions. We especially encourage studies on identifying personalities of CWS users also including not only the positive personality traits, but also "dark personalities" of Narcissism or Machiavellianism (Bouncken et al., 2018; Kraus et al., 2018a). Further, the effects of CWS on the ventures process gaining of legitimacy (Täuscher, Bouncken, & Pesch, 2020) appear to be promising.

Our research thus shows on what patterns CWS providers might focus when they aim to increase work satisfaction. CWS of incumbent firms might aim at more work- and task-related

factors, such as on providing a knowledge or a agile housing. CWS with a stronger focus on entrepreneurship might focus on knowledge housing patterns. Independent CWS in urban or rural settings, e.g. by non-profit organizations, might have a focus on the social housing and the connection to a local community.

Future research might further consider a qualitative pattern matching approach to study the phenomenon of coworking. Pattern matching is based on comparing theoretical patterns with observed patterns and especially useful for phenomenon-based research (Sinkovics, 2018). This approach has been successfully used in strategic and global management studies (Bouncken & Barwinski, 2020; Gatignon & Capron, 2020).

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Chapter 10: Conclusion

10.1 Summary and Contribution

This thesis set out to investigate how the current digital transformation is affecting the organization and management of firms and ecosystems. Over the course of eight research articles, this thesis explores and explains the phenomenon of digitalized ecosystems from an ecosystem and firm-level perspective. The papers in part one address the ecosystem level, explaining how the different actors relate to and collaborate with each other. The second part takes a firm-level perspective and explores the dynamics of managing (a) digital transformation in small and medium-sized firms as well as (b) an increasingly diverse workforce. Part three dives even deeper and analyzes coworking spaces as local ecosystem hubs for innovation and empowerment at the individual and firm-level. This section first summarizes and shows the overall contributions of this thesis before explaining the individual contributions of each research article in its setting.

Overall, this thesis shows that the introduction of digital technologies has multiple effects on firms and their environment. First of all, the ecosystem perspective (Adner, 2017; Autio et al., 2018; Jacobides, Cennamo, & Gawer, 2018) helps to understand the open environment (Henfridsson et al., 2018) in which firms are currently operating and creating value. With innovations becoming more complex (Powell, Koput, & SmithDoerr, 1996), so do the actors required to create them (Corsaro, Cantù, & Tunisini, 2012). The emergence of ecosystems depicts a shift from closed to open structures of collaboration. While firms are forced to operate in open and less defined environments, compared to a traditional value chain (Porter, 1985), this thesis shows that they still have some choices to define their collaborative boundaries by choosing the specific innovation ecosystem they become a part of. The choice of closing the collaborative boundaries by entering an ecosystem appears to be of strategic importance for firms. While the ecosystem itself offers one form of boundary, the category can take up a similar role. Research article two introduces the concept of a shared digital identity, which is formed within the 3D printing category and creates an ingroup based on a sense of community, enthusiasm, being part of something special, and common values and norms within the category. Identification with the technology at the category level appears to be stronger than the individual level interests at the firm-level. These observations lead to the assumption that when facing open landscapes for value creation (Henfridsson et al., 2018), the ecosystem or even the category can become new boundaries, replacing the traditional value chain. In

summary, the first three research papers enhance our understanding of the importance of boundaries for firms and how ecosystems and categories can fill this need.

The second and third parts of the thesis, focusing on the firm-level, show the challenges and opportunities of managing digitalized ecosystems. Digital technologies introduced remote work possibilities (Garrett, Spreitzer, & Bacevice, 2017) and break down prior boundaries of traditional value chains, offering possibilities for global collaborations (Manyika et al., 2016). This development does not only offer opportunities but also challenges. While fully digitalized business models, remote work, and access to a global workforce are often viewed positively, this thesis shows that both internal processes and open work structures require careful considerations and management at the firm level to generate benefits. Research paper four highlights the importance of the managers' dynamic managerial capabilities in keeping up to date and, most notably, using their internal and external network. Research paper six also shows the importance of external sources when seeking ideas and inspiration, which are becoming increasingly important to generate new business options and thereby contribute to long-term success and firm survival (Yoo, Henfridsson, & Lyytinen, 2010).

This thesis further contributes to our understanding of the impact of opening up boundaries and engaging with different and diverse actors (a) in the workforce in general (research article five) and (b) within coworking spaces (research articles seven and eight). These three articles show that there is no single solution that fits all needs when dealing with the setting of work environments and the composure of teams. While diversity can negatively impact job satisfaction, an optimal degree of it can support value co-creation in open work structures. Workforces and work environments require careful construction and management, especially with the boundaries of the traditional value chain no longer applying to the modern working environment. When different configurations lead to empowerment and work-satisfaction in coworking spaces, diversity management will also require specific solutions according to the individual requirements.

The first research paper (included in part one) characterizes the 3D printing ecosystem as highly dynamic, with technologies, market structures, and involved actors constantly changing. Actors in these ecosystems display multifaceted vertical, horizontal, and lateral connections, which help them exchange the knowledge necessary to drive their business. These knowledge connections take place in close personal proximity but also through trans-local pipelines using digitalized technology to transfer knowledge between partners. The paper further identifies and characterizes two forms of knowledge related to 3D printing ecosystems: (a) technology

potential knowledge, aimed at developing the technology and (b) operational process knowledge, directed at operating 3D printers.

Building on the first paper, the second paper (also included in part one) deepens the analysis of knowledge exchanges in 3D printing ecosystems. Contrary to prevailing opinion, the paper shows that tacit knowledge is exchanged openly and even shared via digital mechanisms such as platforms. This effect is explained by the existence of a shared digital identity, which is conceptualized as the collective self-concept(s) of an in-group towards the creation, emergence, application, and development of digital technology built on a sense of community, enthusiasm, being part of something special, as well as common values and norms. This paper further develops a model that specifies how open knowledge exchanges accelerate digital technologies' emergence and facilitate global business opportunities.

The third research article adds to our understanding of how firms handle collaborations at the intersection with the ecosystem and the category. The article shows that firms make very specific and strategic decisions when choosing and entering an ecosystem. These decisions are driven by their specific strategy for the collaboration within the ecosystem. Depending on whether they choose a passive or radical approach to influence the ecosystem, they will differ in their choice. The article further shows that considerations of cognitive as well as normative legitimacy are relevant for firms when entering ecosystems in emerging categories.

The fourth research paper (included in part two) is the first to take a firm-level perspective and investigates the role of the managing director of small firms as an enabler of digital transformation. This paper points out, that the managing director needs to develop specific dynamic managerial capabilities before initiating a digital transformation of the firm itself. The paper highlights the importance of the general managers' social capital, the renewal of their own managerial cognition, and the development of organizational digitalization skills to go through a digital transformation. The paper further introduces a critical perspective on the pervasive goal to fully digitalize and change the firms' business model. The paper shows that a fully digitalized business model does not always have to be the goal for every firm. In industries that offer the opportunity to use direct customer contact to position themselves as high-quality service providers, this is a valid option.

Research paper five (included in part two) concentrates on the impact of diversity in the workforce and its impact on job satisfaction and productivity. The paper refines the model of the service-profit chain for the context of hospitals and shows that increasing diversity negatively influences the job satisfaction of employees and the overall perceived service quality.

The paper also indicates that the currently implemented diversity management methods do not counter this negative effect, disclosing an urgent need for research on diversity and the development of improved diversity management methods.

The third part takes a turn to investigate coworking spaces as new work structures, which are driven by the digital transformation of firms and society. In this setting, research article six focuses on coworking spaces as a setting for firms to conduct external search for knowledge, new ideas, and collaboration partners to produce innovative business ideas. The paper introduces the idea that ventures follow a lifecycle in their innovation search alternating between an external focus at an early stage and an internal focus once the business model is shaped. At this stage, firms often leave the coworking space and set up office in their own facilities to focus on productivity. Firms reach out to the coworking space once they reach a productivity stage and require new ideas for further innovation. The paper shows that early-stage ventures profit most from the rich opportunities for social interactions, information exchange, and collaboration in coworking spaces.

The seventh research paper (included in part three) concentrates on coworking spaces as service ecosystems and their potential to be hubs for value co-creation. The paper shows that value co-creation only occurs when there is an optimal degree of diversity regarding the coworking space users' social background and knowledge base. Coworking spaces, therefore, need to be carefully planned in order to enable innovative performance for their users.

The final research paper eight (also included in part three) introduces empowerment theory to coworking spaces. The results of the mixed-method analysis explain that coworking spaces can apply three different configurations to achieve work satisfaction. Coworking spaces can either focus on providing a setting with openness to new members and multiplex relationships, foster open knowledge exchange and sharing, or focus on endorsing a vision of community that unifies the users.

10.2 Avenues for further research

While this thesis aims to disentangle the multifaceted challenges of digitalized ecosystems and their management at different levels, the research articles involved in this thesis are still subject to some limitations, which provide directions and avenues for future research.

The idea of ecosystems traces back roughly 30 years to when Moore (1993) first introduced the idea of viewing firms as part of an ecosystem. While the idea has been around for some time, research in this field has recently started to pick up traction, with Bogers, Sims, and West

(2019) showing that most scholarly articles on the topic have been published only recently. Because of its flexibility, the ecosystem concept has been adapted to a wide range of different perspectives (Thomas & Autio, 2020). Consequently, this thesis could only explore some of the possible perspectives regarding the management of digitalized ecosystems. Therefore, a major output of this dissertation is to point out avenues for future research. The results of the eight research papers point to the following five major avenues for future research: (1) The effects of emerging digital technologies on the identity of individuals, groups, organizations, and ecosystems, (2) the creation of legitimacy within the ecosystem, (3) interactions and skills of individuals to complete a digital transformation successfully, (4) the management of increasingly global and diverse workforces, and (5) utilizing coworking spaces on the individual-, firm- and ecosystem-levels.

There is a growing tradition of research at the intersection of identity and information technology (Whitley, Gal, & Kjaergaard, 2014), with studies investigating the individual (Barrett & Scott, 2004; Polites et al., 2018; Craig, Thatcher, & Grover, 2019), the group (Boudreau, Serrano, & Larson, 2014; Goggins, Laffey, & Gallagher, 2011; Ren et al., 2012), the organizational level (Lindgren, Eriksson, & Lyytinen, 2015; Tyworth, 2014), organizational and individual levels (Bernardi, Sarker, & Sahay, 2019; Choi, Chengalur-Smith, & Nevo, 2015), and individual and the institution (Barrett, Sahay, & Walsham, 2001; Barrett & Walsham, 1999). First efforts have been made to study an individual level IT identity (Carter & Grover, 2015; Carter et al., 2020), and the impact of a digital transformation on the redefinition of an organizational identity (Wessel et al., 2021), and research paper two showing that the emerging 3D printing technology can create a shared digital identity at the category level (Bouncken & Barwinski, 2021). While these papers show the potential of digital technologies to affect individuals, groups, organizations, and ecosystems, not much is known about how this digital identity develops within an ecosystem and how the process can be actively guided. Further, it remains unclear which impacts the growing identification with digital technologies will have on organization and ecosystem structures and how it will ultimately influence the performance of the ecosystem and its actors.

Ecosystems bring together a multitude of heterogeneous actors who are interdependent regarding their contribution to the ecosystem (Beltagui, Rosli, & Candi, 2020). Suppliers provide technologies or materials which are central to one part of the value proposition while other actors deliver complementary products and customers might take an active role in influencing the ecosystems value proposition (Adner, 2017; Jacobides et al., 2018). Due to the

inherent novelty of innovation, ecosystems have a high demand for gaining legitimacy (Fisher, Kotha, & Lahiri, 2016; Täuscher, Bouncken, & Pesch, 2021). Although the need for empirical research on this topic has been recognized (Human & Provan, 1997), there is still a significant lack of research on this topic. Most recently, the topic of legitimacy in ecosystems has conceptually been addressed by Thomas and Ritala (2021), yet there is no empirical research investigating how the actors and the ecosystem itself create legitimacy. With the increasing importance of ecosystems, this avenue appears promising for future research.

In a digital transformation, firms undergo a fundamental change of business processes (Carlo, Lyytinen, & Boland Jr, 2012; Vial, 2019), business strategies (Bharadwaj et al., 2013), structure (Selander & Jarvenpaa, 2016), and culture (Karimi & Walter, 2016). Actively managing these processes might ultimately lead to a better transformation process (Verhoef et al., 2021). Currently, most studies consider the importance of firm-level dynamic capabilities in the transformation process (Soluk & Kammerlander, 2021; Soluk et al., 2021; Karimi & Walter, 2016; Yeow, Soh, & Hansen, 2018). While research paper four and Li et al. (2018) show the importance of the dynamic managerial capabilities and the managers' personal network for initially starting the transformation process. Further research should investigate the intersection between firm-level and personal capabilities of the managers. This research can provide important insights on how the two factors interrelate and which importance the interactions within one organization and the ecosystem have for the successful digital transformation process.

Digital technologies and increasing globalization (Manyika et al., 2016) lead to a situation in which firms face more complex management tasks and collaboration structures (Kapoor, 2018; Rong et al., 2010). Since the beginning of this trend, diversity management has become a new organizational paradigm sponsored by the interest of both scholars and practitioners (Gilbert, Stead, & Ivancevich, 1999; Lorbiecki & Jack, 2000). Due to limitations in current frameworks some scholars are demanding the rethinking of current practices and ideas (Dennissen, Benschop, & van den Brink, 2020; Koellen, 2019). Research paper five supports this approach indicating the shortcomings of artificially introduced diversity management mechanisms. Research in this direction could have major practical impact in a globalized world where workforce diversity and cross-culturally located ecosystems are increasing (Autio, Mudambi, & Yoo, 2021; Manyika et al., 2016; Nambisan, Zahra, & Luo, 2019). This may require firms to actively seek potential employees with diverse backgrounds (Yanbin, Latukha, & Selivanovskikh, 2020)

Coworking spaces are a phenomenon driven by the current digital transformation of businesses, ecosystems, and the general work environment (Bouncken & Reuschl, 2018). As a phenomenon coworking spaces have attracted increasing scholarly attention (Bouncken & Görmar, 2021; Bouncken, 2018; Bouncken & Reuschl, 2018; Gandini, 2016; Spinuzzi, 2012). Coworking research has covered coworking as a new form of knowledge work (Johns & Gratton, 2013), their impact on social structures and communities (Garrett et al., 2017; Tohmatsu, 2013), and as cluster for entrepreneurship (Fuzi, 2015). This thesis adds perspectives on how coworking spaces can function as service ecosystems (Görmar et al., 2021), support the innovation search of young and established ventures (Barwinski et al., 2020), and empower their users (Bouncken et al., 2020). The current research clearly shows that coworking spaces are more than just an isolated phenomenon and need to be considered in the broader perspective of the ecosystem. This is where they can become valuable hubs for value co-creation. Coworking spaces offer an additional personal layer to the ecosystem equation. The Covid-19 driven turn towards digital and remote work will further drive the importance of research in this avenue.

10.3 Concluding remarks

Since I focused my research on ecosystems (Adner, 2017; Adner & Kapoor, 2016; Jacobides et al., 2018), digitalization (Verhoef et al., 2021; Vial, 2019), and coworking spaces (Bouncken & Reuschl, 2018) I want to highlight the relevance of this research for other fields that might seem disconnected at first. Ecosystems offer a new perspective on collaboration, and due to the inherent modularity of actors, there is a strong potential for coopetition (Gnyawali & Ryan Charleton, 2018; Bouncken et al., 2015). Coopetition has also been found to impact the personal ecosystem-level within coworking spaces (Bouncken et al., 2018). With increasing importance of digitalization, the entrepreneurial process will become more digitalized (Kraus, Roig-Tierno, & Bouncken, 2019; Satalkina & Steiner, 2020), potentially making its management more inclusive and similar to the management of digitalized ecosystems. Research on coworking spaces as a tool for managing communities, innovation, and as a general future work structure, can give important stimuli to research on various fields. Especially the extension to entrepreneurial ecosystems (Spigel, 2015), coopetition (Bouncken et al., 2015), innovation, and learning in coopetition (Bouncken & Kraus, 2013; Bouncken & Fredrich, 2016).

Digitalized ecosystems provide a broad and rich field for scholarly research, as they are a multifaceted phenomenon driven by current trends of changing technologies, globalization, and increasingly complex innovations.

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