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Corporate Venture Capital in the Digital Age

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Abstract

This doctoral thesis examines the phenomenon of corporate venture capital (CVC) in the digital age through three empirical studies. The first study draws upon affordance theory to shed light on how incumbent firms transfer digital technologies from entrepreneurial ventures to business units in the realm of CVC and open innovation (OI) relations. Based on a comparative analysis of 21 dyad-level CVC and OI cases, consisting of 12 pilot interviews, 40 case interviews, and archival data, we develop a process model of the inter-organizational transfer of digital technologies from an affordance theory perspective. By doing so, we provide first-hand insights into the peculiarities of digital technologies for inter-organizational technology transfer. The second study proposes an affordance-based model of opportunity evaluation to analyze how CVC managers consider digital affordances in their evaluation of ventures for investment. The analysis of experimental data of 864 decisions by 54 CVC managers from 44 CVC units and 34 industries provides evidence that CVC managers value powerful action potentials (i.e., digital affordances) grounded in the recombinability and reprogrammability of digital technologies. In addition, the results show that CVC managers differ in their evaluation of affordance-based investment opportunities as a result of their personal background (i.e., digital technology experience and entrepreneurial experience) and organizational background (i.e., CVC unit dependence on business units of the corporate parent). The third study integrates upper echelons theory with the attention-based view and contextual entrepreneurship reasoning to study the role of CEO humility for CVC investments as a response to the urgency for digital transformation. Employing multi-level analysis on a longitudinal sample of 373 CEOs from 198 firms and 35 industries in the time period of 2010 to 2019 (6,907 CVC investments over 1,597 firm-years), we find that CEO humility is positively related to the number of a firm's CVC investments. Moreover, we find that the relationship between CEO humility and CVC investments is strengthened in the context of the external urgency for digital transformation (i.e., emerging digital competition), whereas the internal urgency (i.e., business model dependence on information and knowledge) likely strengthens this relationship only for CVC investments in ventures related to the core business. Overall, the three empirical studies of this doctoral thesis contribute to theory and practice by providing unique insights into the phenomenon of CVC in the digital age, while advancing our understanding of corporate entrepreneurial decision-making, the role of affordances for inter-organizational partnerships, and the peculiarities of digital technologies for entrepreneurial activities.

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List of Abbreviations

AIC	Akaike's information criterion
CATA	Computer-aided text analysis
CE	Corporate entrepreneurship
CEO	Chief executive officer
CFI	Comparative fit index
CI	Confidence intervals
CTA	Company primary technology application
CVC	Corporate venture capital
GCV	Global corporate venturing
HLM	Hierarchical linear modeling
ICC	Intra-class correlation coefficients
LIWC	Linguistic inquiry word count
LTS	Letter to shareholders
OI	Open innovation
OLS	Ordinary least squares
PE	Private equity
R&D	Research and development
RMSEA	Root mean square error of approximation
SD	Standard deviation
SE	Standard error
SIC	Standard industry classification
SRMR	Standardized root mean square residual
VC	Venture capital
VIF	Variance inflation factors
VPC	Variance partitioning coefficients
WTI	Willingness to invest

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CHAPTER 1

General Introduction

Corporate venture capital (CVC) investments, namely minority equity investments in new ventures (Dushnitsky & Lenox, 2005), have become a promising source of innovation and growth for incumbent firms (Huang & Madhavan, 2021). While traditional venture capital (VC) investing focuses on prospective financial returns, CVC has established itself as a prominent corporate entrepreneurial activity aiming for the realization of both financial and strategic benefits (Chesbrough, 2002; Drover, Busenitz, et al., 2017; Dushnitsky & Lenox, 2006; Siegel et al., 1988). Extant research has examined important facets of CVC, including its driving forces, functioning, and outcomes for both corporate parents and portfolio ventures (Basu et al., 2018; Jeon & Maula, 2022). At the heart of the current understanding of CVC investing is its focus on spurring technological innovation (Gaba & Bhattacharya, 2012).

An emerging theme, which is yet largely unexplored, is the unfolding of CVC investing in the digital age—that is, in times of transformative changes that the ubiquitous access to digital technologies has brought about for firms, industries, and society (Menz et al., 2021). In this context, researchers have begun to study strategic implications of the inception of digital technologies into the business landscape (Furr et al., 2022; Hanelt et al., 2021). For example, studies have examined the role of digital technologies for transforming processes related to innovation (Appio et al., 2021), modes of organizing (Yoo et al., 2012), and entrepreneurship (Nambisan, 2017). In light of these developments, we are observing a shift of CVC investing—as an activity that centers on newest trends (Basu et al., 2016)—towards a digital focus (Rossi et al., 2020). The examination of CVC investing in the context of the peculiarities of the digital age provides intriguing possibilities for new theorizing. At the same time, due to its relevance for almost every industry, the digital context also offers an appropriate setting to advance our understanding of CVC investment dynamics and underlying theoretical lenses in general.

The aim of this doctoral thesis is to advance our understanding of the phenomenon of CVC in the digital age along three essential phases of CVC investing, including the (1) instigation, (2) evaluation, and (3) post-investment integration. To do so, this doctoral thesis employs an interdisciplinary and multi-method approach, reflected in three empirical studies.

The first study (chapter 2), titled "The Transfer of Digital Technologies from Entrepreneurial Ventures to Incumbent Firms: An Affordance Perspective," examines qualitative data to develop a model that illustrates the digital technology transfer process from entrepreneurial ventures to business units of corporate parents from an affordance theory perspective (Gibson, 1977; Majchrzak & Markus, 2013). The second study (chapter 3), titled "Evaluating Affordance-Based Opportunities: A Conjoint Experiment of Corporate Venture Capital Managers' Decision-Making," employs a conjoint experiment to analyze CVC managers' willingness to invest in digital ventures, thereby testing an affordance-based model of opportunity evaluation (Gibson, 1977; Haynie et al., 2009; Majchrzak & Markus, 2013; Wood et al., 2014). The third study (chapter 4), titled "Contextualizing Corporate Venture Capital: A Multi-Level Analysis of CEO Humility and the Urgency for Digital Transformation," draws upon longitudinal data and integrates upper echelons theory (Hambrick & Mason, 1984), the attention-based view (Ocasio, 1997), and contextual entrepreneurship reasoning (Welter, 2011) to examine the role of CEO humility for CVC investing in the context of the external and internal urgency for digital transformation (Firk et al., 2021).

Figure 1 provides an overview of the structure of this doctoral thesis, which includes research questions, underlying theories, methods, and the status of all three empirical studies. Additionally, Figure 2 illustrates the relationships examined by the three studies in the context of the framework proposed by Jeon and Maula (2022), which visualizes the setting of CVC activity under the consideration of different interfaces and ownership structures.

Figure 1. Structure of the doctoral thesis

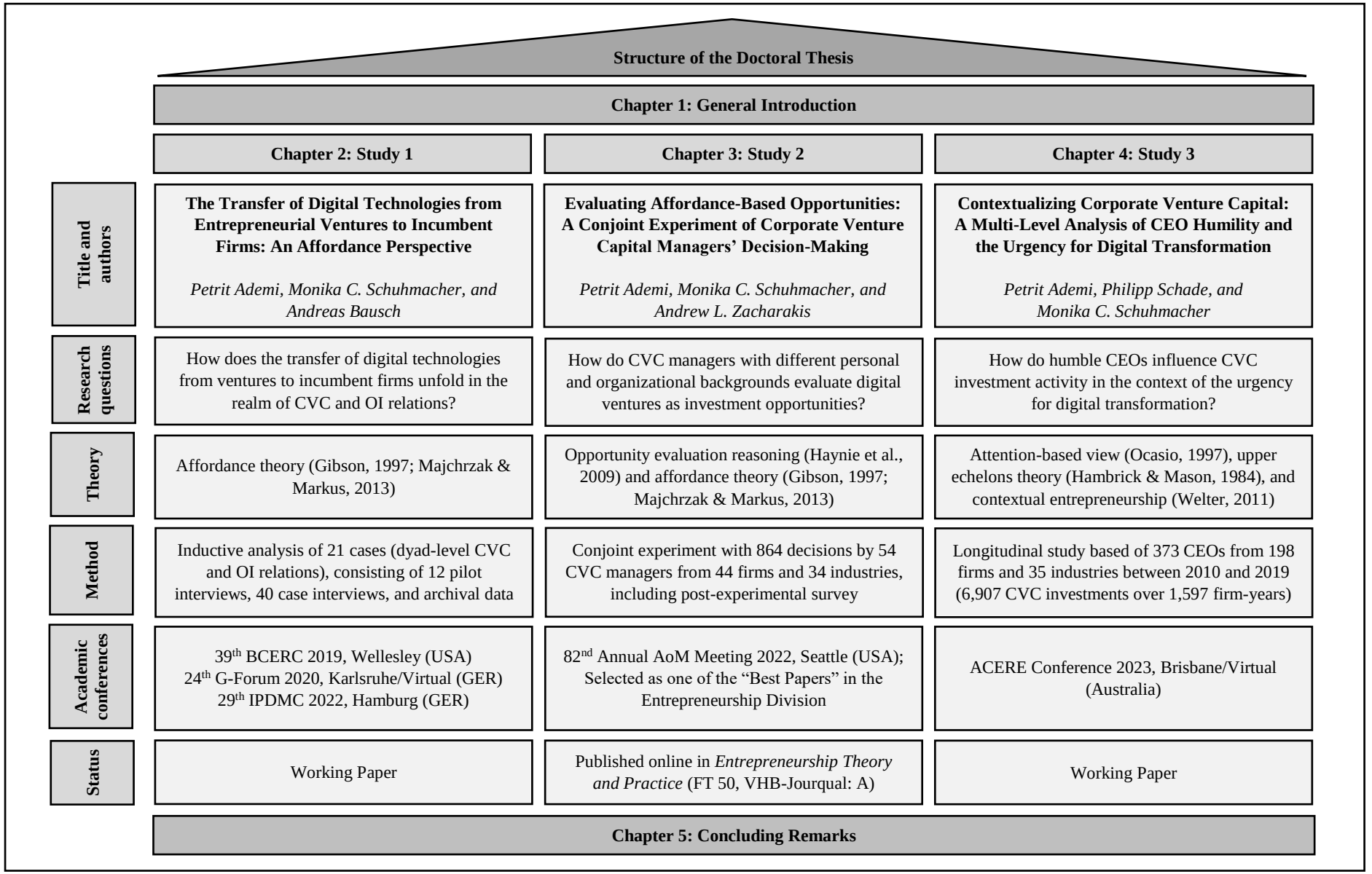
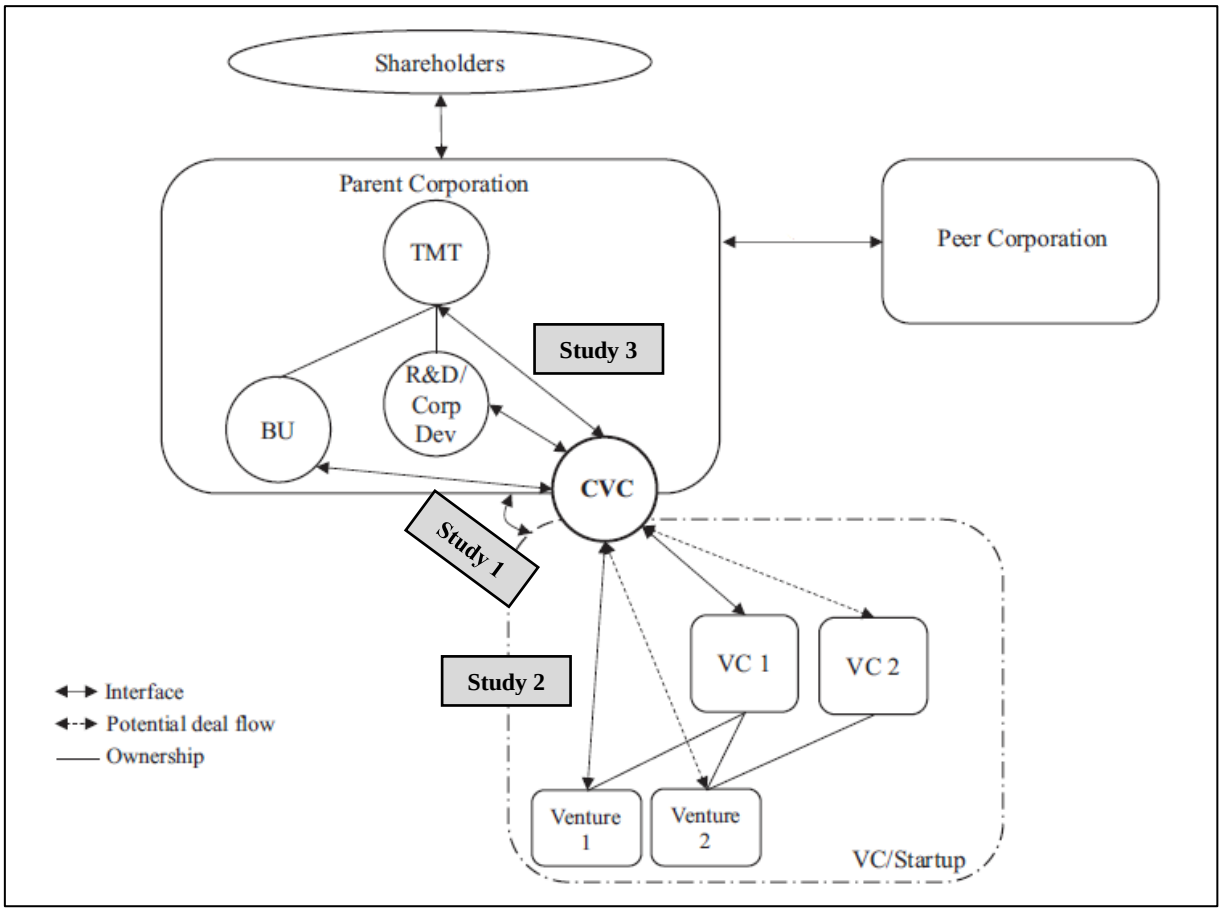


Figure 2. The three empirical studies in the CVC setting



Source: Adapted from Jeon and Maula (2022, p. 7)

The framework illustrates that CVC units function as intermediaries between the corporate parent organization, entrepreneurial ventures, and the VC market. As part of this complex setting, CVC units constantly face the tension to balance expectations from these multiple stakeholders with different interests and operating modes (Souitaris et al., 2012; Souitaris & Zerbinati, 2014). This doctoral thesis aims to shed light on three vital interfaces of CVC investing: the triad between the CVC unit, business units of the corporate parent, and entrepreneurial ventures (study 1), the link between the CVC unit and entrepreneurial ventures in the context of investment opportunity evaluations (study 2), and the link between the top management (i.e., CEO) and CVC (study 3).

CHAPTER 2

Study 1 – The Transfer of Digital Technologies from Entrepreneurial Ventures to Incumbent Firms: An Affordance Perspective

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Abstract

To access newest digital technologies, incumbent firms increasingly collaborate with entrepreneurial ventures through corporate venture capital (CVC) and open innovation (OI) relations. While research has advanced knowledge on inter-organizational learning benefits of both CVC and OI, we miss an understanding of how incumbent firms transfer digital technologies from ventures to own use contexts in the realm of such asymmetric relations. Understanding the unfolding of digital technology transfer is important since the adoption of external digital technologies can serve as an important ingredient of digital innovation development. Drawing upon affordance theory, we analyze the digital technology transfer process in 21 cases of CVC and OI relations. Based on our empirical insights, we develop an affordance-based model of digital technology transfer in the context of CVC and OI relations between incumbent firms and entrepreneurial ventures. Our study provides first-hand insights into the role of unique digital technology characteristics for CVC and OI relations and inductively advances affordance theory in the context of the inter-organizational digital technology transfer.

Keywords: affordance theory, corporate venture capital, open innovation, digital technology, technology transfer, qualitative research

2.1. Introduction

To ensure survival and growth in business environments where digitalization is emerging powerfully, incumbent firms are under pressure to embrace digital innovation (Amit & Han, 2017; Lanzolla et al., 2021; Menz et al., 2021). Digital innovation refers to "the creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology" (Nambisan et al., 2017, p. 224). While incumbent firms typically possess strong technological capital in their traditional fields of business, they oftentimes lack the resources and capabilities to spur the development of newest digital technologies as sources of digital innovation (Sebastian et al., 2017). To foster digital innovation while continuing the focus on their core businesses, incumbents turn to the search and transfer of digital technologies from external sources (Hanelt et al., 2021). An important strategic instrument for gaining access to digital technologies are collaborations with entrepreneurial ventures, which typically take the form of corporate venture capital (CVC) or open innovation (OI) relations (Weiblen & Chesbrough, 2015).

By fostering collaborations with entrepreneurial ventures, incumbent firms are able to learn technologically (Dushnitsky & Lenox, 2005). Prior literature has considerably advanced our understanding on how CVC and OI relations can function as a mechanism through which incumbent firms are able to absorb knowledge from entrepreneurial ventures (Wadhwa et al., 2016; Wadhwa & Kotha, 2006). However, while research agrees that partnerships with entrepreneurial ventures can spur innovation in incumbent firms (Huang & Madhavan, 2021), we lack knowledge on how incumbent firms transfer actual technologies from ventures to their business units. We understand the concept of *transfer* as the processes by which digital technologies move from one organizational setting to another (Autio & Laamanen, 1995). Advancing knowledge on the unfolding of transfer-oriented CVC and OI relations is particularly important in the digital context, as the integration of external digital technologies

with internal resources and capabilities is at the core of digital innovation development (Hanelt et al., 2021; Yoo et al., 2010). In this context, we formulate the following research question: *How does the transfer of digital technologies from ventures to incumbent firms unfold in the realm of CVC and OI relations*?

To address this research question, we employ an affordance perspective (Gibson, 1977; Majchrzak & Markus, 2013) and study 21 cases of dyad-level CVC and OI relations. An affordance is a possibility for action that results from both an (organizational) actor's capabilities and goals as well as the features of a technology (Nambisan et al., 2019). Thus, affordance reasoning accounts for the fact that action potentials are relational constructs, which do not arise exclusively from a technology, but—in fact—arise from the relation with (organizational) actors with different goals and capabilities (Majchrzak & Markus, 2013; Strong et al., 2014; Volkoff & Strong, 2018). In the context of our study, we argue that affordances for the incumbent firm arise from the relation between the venture's digital technology and mainstream business units. The consideration of use potentials through an affordance lens is particularly suitable to study the unfolding of the inter-organizational transfer of digital technologies, which are "intentionally incomplete" and "perpetually in the making" (Garud et al., 2008, p. 356), thus continuing to evolve even after their launch (Kallinikos et al., 2013; Lehmann & Recker, 2022; Nambisan, 2017).

Overall, our findings reveal different phases along which the transfer of digital technologies from entrepreneurial ventures to business units unfolds. Here, we highlight the importance of what we term as *transfer affordances*—that is, action potentials arising from the prospective transfer of technologies from one organization to another (i.e., from the venture to the incumbent firm). We derive peculiarities of the digital technology transfer process and show how unique characteristics of digital technologies shape the unfolding of this process. Besides this general understanding of the transfer of digital technologies, our study provides three main

contributions. First, we advance knowledge on value adding through CVC and OI relations. Studying CVC and OI relations between incumbent firms and digital ventures (Von Briel et al., 2018), we outline the process of digital technology transfer. In this regard, we provide first-hand evidence that CVC and OI relations can serve as an important means to transfer newest digital technologies and spur digital innovation development in operational processes, customer experiences, as well as products, services and business models—the three building blocks of digital transformation (Fitzgerald et al., 2014). In this vein, our study adds knowledge to how CVC and OI relations can help to link digital technologies to business units, which can serve as an important performance indicator.

Second, with affordance theory, we introduce a new theoretical lens for understanding the complex relation between incumbent firms and ventures' digital technologies. By doing so, our study sheds light on the unfolding and sense making of the inter-organizational transfer of digital technologies. In this context, we introduce new types of affordances. Specifically, we identify digital technology transfer affordances that allow the pursuit of digital innovations related to the building blocks of digital transformation (Fitzgerald et al., 2014). Moreover, our findings extend the affordance theory by explaining processes related to making affordances actionable for actualization—a phase that we refer to as *affordance integration* in the context of the inter-organizational transfer of digital technologies (Strong et al., 2014).

Third, our study contributes to the emerging literature on digital innovation. Prior literature has developed important conceptual work on the foundations of digital innovation (Lanzolla et al., 2021; Lyytinen et al., 2016; Nambisan et al., 2018). Drawing upon this stream of literature, we unpack the unfolding of digital innovation empirically and exemplify how incumbents can redeploy digital technologies (Yoo et al., 2010; Yoo, 2013). Concretely, we explain how the inter-organizational transfer of digital technologies can facilitate the embracement of digital innovations by incumbent firms (Nambisan et al., 2017).

2.2. Theoretical background

2.2.1. Accessing newest technologies by partnering with entrepreneurial ventures

Literature has examined partnerships with entrepreneurial ventures as an important market for accessing new technologies (Ceccagnoli et al., 2018). Partnering with ventures allows the experimentation with new technologies (Keil, 2004; Keil, Autio, & George, 2008), and can spur innovation in both incumbent firms and ventures (Huang & Madhavan, 2021; Uzuegbunam et al., 2019). Extant research has thoroughly investigated innovation outcomes of CVC partnerships with ventures for incumbent firms (Basu et al., 2018). Concretely, prior studies show that the access to technological knowledge of ventures can positively influence innovation outcomes of incumbent firms, namely forward patent citations (Dushnitsky & Lenox, 2005; Wadhwa et al., 2016; Wadhwa & Kotha, 2006), backward patent citations and premarket approvals (Smith & Shah, 2013), and the introduction of pioneering technologies (Van de Vrande et al., 2011). In this context, prior literature has examined contingency factors that determine the success of technological knowledge transfer from the venture to the incumbent, such as R&D capabilities (Dushnitsky & Lenox, 2005) and corporate involvement (Wadhwa & Kotha, 2006).

Thus, the idea of *learning* from newest technologies of ventures to spur innovation is at the heart of extant research on relations between incumbent firms and new ventures (Basu et al., 2018). However, beyond learning from ventures, extant research largely neglects that incumbent firms may also *transfer actual technologies* from ventures to own use contexts. In the words of Orlikowski and Scott (2008, p. 434), the role of "technology is missing in action" in extant research on partnerships between incumbent firms and entrepreneurial ventures. Specifically in light of ever-increasing digitalization, recent studies point out the emerging strategic emphasis of incumbent firms on industry-agnostic digital technologies when searching for suitable investment targets (Rossi et al., 2020). In sum, despite insights on innovation

outcomes of partnerships with ventures from a learning perspective, we lack knowledge on how incumbent firms transfer digital technologies for the development of digital innovations in the realm of such relations.

2.2.2. The role of affordances for digital innovation

In today's times of pressing digital transformation (Lanzolla et al., 2021), digital innovation has become a crucial source of organizational renewal and competitive advantage for incumbent firms (Appio et al., 2021). While entrepreneurial ventures are considered forerunners in the fast-paced development of newest digital technologies (Kuester et al., 2018; Lehmann & Recker, 2022), incumbent firms oftentimes remain reluctant and incapable of succeeding with digital innovation development (Sebastian et al., 2017). To realize digital innovations, incumbent firms need to embrace digital technologies (Yoo et al., 2010), which describe "combinations of information, computing, communication, and connectivity technologies" (Bharadwaj et al., 2013, p. 471). Due to their generative character (Henfridsson & Bygstad, 2013; Kallinikos et al., 2013; Leonardi, 2011), digital technologies allow many possibilities for redeployment (Yoo et al., 2012).

The understanding about the strong redeployment potentials of digital technologies is well-reflected by affordance theory (Gibson, 1977; Majchrzak & Markus, 2013). The concept of affordances is defined as "the action potential or possibilities offered by an object (e.g., digital technology) in relation to a specific user (or use context) in innovation and entrepreneurship" (Nambisan et al., 2019, p. 3). The underlying assumption of this theoretical perspective is that action potentials are relational in their nature—that is, they arise as a function of both technological features and goals and capabilities of (organizational) actors (Strong et al., 2014). Specifically in the organizational context, researchers emphasize that there are "bundles of affordances that arise from the many potential uses of [a technology]" for an organization (Volkoff & Strong, 2018, p. 229). That is, organizations typically have many

potentials for action with a single technology (Majchrzak & Markus, 2013), and particularly with digital technologies, which create powerful *digital affordances* (Autio et al., 2018). For translating affordances into outcomes (e.g., digital innovations), it is critical to both recognize and, subsequently, actualize them (Henningsson et al., 2021). Affordance actualization refers to the separate process of conducting the concrete actions made possible through the relation between an (organizational) actor and a technology (Strong et al., 2014). For example, an autonomous drone enables the affordance (i.e., action potential) of transporting packages for actors such as postal service providers. The actual execution of the drone transportation (i.e., performance of the action), in turn, would represent the actualization of the affordance, potentially leading to an improvement of lead times in delivery services (i.e., outcome). Our understanding about affordance actualization is, however, very limited to date (Volkoff & Strong, 2018). First studies show that—in contexts of "rare events" such as the COVID-19 pandemic—the attention of the top management team is critical for the purposeful actualization of affordances (Henningsson et al., 2021). Additionally, researchers have introduced the term "affordance potency" to describe the importance of the strength of the relation between (organizational) actors and technologies for successful affordance actualization (Anderson & Robey, 2017). Moreover, as an extension of the affordance-actualization understanding, literature has also shown how specific experimentation actions (e.g., conceptual adaptation of Blockchain solutions) can represent a separate phase preceding actualization (Du et al., 2019). For the concrete actualization process, researchers have looked into concrete actions that actors undertake, such as—for example—the usage of specific data templates in the course of the implementation of electronic health record systems (Strong et al., 2014).

However, while extant work concentrates on the role of affordances mostly within single organizational settings, we lack knowledge on how affordances emerge and how they can be made actionable for actualization in the context of *inter-organizational transfer of technologies*.

We aim to address this theoretical gap by applying affordance theory to the context of CVC and OI partnerships between incumbent firms and digital ventures. More specifically, we study how affordances arising from the relation between incumbent firms and digital technologies from entrepreneurial ventures determine transfer processes. In Appendix A, we show the affordance-actualization framework from Strong et al. (2014) applied to our study context.

2.3. Research method

2.3.1. Design and sample

We employ a qualitative, inductive research approach to study how the transfer of digital technologies from ventures to incumbents unfolds in CVC and OI relations (Eisenhardt & Graebner, 2007). Specifically, we draw upon an inductive multiple case design, where each case affirms or disaffirms inferences drawn from the others (Eisenhardt, 1989; Yin, 1994). Multiple case designs have been used by prior studies on CVC and OI relations (Basu et al., 2016; Souitaris & Zerbinati, 2014), and are suitable to unpack dynamics present in technology transfer (Cunningham et al., 2017). We investigated each case at the dyad-level, collecting information from both the incumbent firm as well as from the respective digital venture. Dyad-level investigations are a suitable research setting as they allow thick descriptions of narratives and contrasting between cases, simultaneously capturing the perspective of both the incumbent firm and the digital venture (Kumar et al., 1993). In line with our inductive research approach, we applied theoretical sampling (Eisenhardt, 1989). We searched for CVC and OI relations between incumbent firms and digital ventures. We started by screening incumbent firms that actively engage in CVC and OI relations with digital ventures and vice versa through web search and search in the Thomson Reuters Eikon database. Typical keywords we used to identify relevant firms were “corporate venturing,” “external venturing,” “corporate venture capital,” “open innovation,” “start-up relations,” and “corporate-start-up collaboration.” To obtain maximum variation in observable characteristics (Miles & Huberman, 1994), we

collected data from incumbent firms and digital ventures operating in different industries. Further, we attended two corporate venturing fairs to engage in personal contact with responsible managers of firms we identified as relevant through our search and to identify additional firms engaging in CVC and OI relations. In addition, we invited managers of incumbent firms and digital ventures on the social network LinkedIn to participate in our study. There, in addition to the keywords we used for the web and database search, we also looked for "corporate venture capital manager," "open innovation manager," "start-up scout," "founder," and "venture business development manager." To incentivize participation, we provided a comprehensive benchmarking and best practices report on how incumbent firms use CVC and OI relations for the transfer of digital technologies. If the contacted person voiced a misfit for the interview, we followed a snowballing technique by which we asked these misfits to recommend other firm employees who would be potentially more familiar with the topic and could provide relevant insights (Easterby-Smith et al., 2012). To create a dyadic data set, we asked CVC and OI managers to forward the interview invitation to the respective digital ventures and vice versa. If this was not possible, we contacted respective managers directly through LinkedIn or E-Mail. We interviewed both managers from incumbent firms and digital ventures until we reached theoretical saturation (Strauss & Corbin, 1998) (see Table 1).

2.3.2. Data collection and sources

Pilot interviews. Before constructing the cases, we conducted 12 pilot interviews with managers from incumbent firms to gain an initial understanding about our topic of interest and refine our interview guidelines. Our interview partners provided a general overview of their activities and initial insights into motives for engaging in CVC and OI with digital ventures. Further, they elaborated on case examples of digital innovation projects that they conducted with digital ventures. After this step, we started to collect data for constructing cases.

Semi-structured interviews with incumbent firms and digital ventures for case compilation. For all case interviews, we followed two semi-structured interview guidelines (one for incumbent firms and one for ventures) to provide informants the opportunity to freely express their thoughts and perceptions on the given topic, without being too bound on pre-defined questions, which could narrow their elaborations (Easterby-Smith et al., 2012). In sum, we conducted 40 semi-structured expert interviews for case compilation (24 with managers from incumbent firms, 16 with managers from digital ventures). Managers from incumbent firms provided insights into motives for investing in digital ventures, the use potential that was associated with the digital technology of the venture, and the digital technology transfer. Counterparts of the corresponding digital ventures were able to explain characteristics and deployment fields of their digital technology and allowed us to question insights on the transfer objectives and process gained from respective incumbent firm managers. This approach helped us to gain a profound understanding of each case and mitigate informant biases (Miller et al., 1997). We took great care that all our interviewees represent key informants considered as being highly knowledgeable about the phenomena we study (Kumar et al., 1993). We transcribed all interviews verbatim, resulting in 1,021 pages of text. Overall, our case sample consists of 10 CVC and 11 OI relations between incumbent firms and ventures.

Archival data. To enrich informant statements, we supplemented our interview insights with archival information about each case, drawing on a variety of sources such as company websites, product descriptions, press releases, white papers, pitch decks, and YouTube videos (Jick, 1979). Putting all this additionally collected information together resulted in additional 145 pages of transcribed text. Archival data proved to be particularly helpful for understanding the characteristics and deployment fields of ventures' digital technologies clarifying the use case and further technical details. In the cases for which we did not have an interview from either the incumbent firm or the venture, we ensured that we have sufficient archival data.

Table 1. Case sample

No.	Dyad Case	Incumbent firm industry	Interviews: Incumbent firm	Interview: Venture	Archival data
1	Alpha-OI	Financial services	Innovation Manager; Head of Digital Solutions	CEO	2 x press articles; 2 x website; 1 x video
2	Beta-CVC	Forestry	Head of Digital Competence Center	Co-Founder & CEO	2 x press articles; 1 x website; 1 x video
3	Gamma-OI	Automotive	Open Innovation Manager	Business Dev. Manager	2 x press articles; 1 x website; 1 x video
4	Delta-A-CVC	Logistics	Global Innovation Manager		2 x press articles; 2 x website; 2 x video
5	Delta B-CVC	Logistics	Senior Manager Venture Development		2 x press article; 2 x website; 3 x video
6	Epsilon-OI	Healthcare	Director Digital Innovation	Co-Founder	2 x website
7	Zeta-OI	Advisory services	Head of Innovation; Innovation Manager	Account Manager	2 x white paper; 1 x press article; 1 x video
8	Eta-OI	Imaging	Senior Investment Manager	Founder	1 x website; 3 x video
9	Theta-CVC	Financial services	Investment Manager	Co-CEO	2 x press articles; 2 x website; 3 x video
10	Iota-CVC	Engineering	Open Innovation Manager	Customer Success Manager	2 x press article; 1 x website
11	Kappa-A-CVC	Technology	Investment Director; M&A and Cooperation Manager	Product Manager	2 x press articles; 2 x white paper; 1 x video
12	Kappa-B-CVC	Technology	Senior Strategy Manager	Co-Founder & CEO	2 x press article; 1 x website; 1 x video
13	Lambda-CVC	Automotive	Senior Manager M&A and CVC; Partnerships Manager		3 x press articles; 1 x white paper; 4 x video
14	My-OI	Insurance	Senior Innovation Manager	Founder & CEO	1 x press article; 2 x website
15	Ny-A-CVC	Postal services	Investment Director	Head of Strategic Partnerships	2 x website; 2 x videos
16	Ny-B-OI			Founder & CEO	2 x website ; 2 x video
17	Xi-OI	Railway	Innovation Relations Manager	Co-Founder	1 x pitch deck; 1 x website; 1 x video
18	Omikron-OI	Insurance	Head of Open Innovation		1 x press articles; 2 x website; 3 x video
19	Tau-OI	Electronics	Start-up & Venture Manager		1 x website; 1 x video
20	Ypsilon-OI	Semiconductors	Head of Start-up Co-operations & Partnerships	Co-Founder	2 x website
21	Phi-CVC	Automotive	Head of Venture Operations	Head of Business Development	4 x press article; 2 x website; 1 x video

Notes. The endings "CVC" and "OI" indicate the nature of the relationship between the incumbent firm and the venture within the dyad case (i.e., equity vs. non-equity-based). In the presentation of the results, we use the endings "Corp" and "Venture" for all dyad cases to highlight whether the source comes from the incumbent firm or the venture. All interviews were conducted in German or English. German interviews were translated into English.

2.3.3. Data analysis

Following Miles and Huberman (1994) as well as Strauss and Corbin (1998), we analyzed our data along three stages: (1) within-case analyses of each case, (2) cross-case comparisons of all cases, and (3) development of a conceptual framework. In Figure 3, we illustrate our data analysis. We first constructed narratives, providing thick descriptions for each case (Eisenhardt, 1989; Langley, 1999). Using the software program MAXQDA Plus 2020, we carefully examined each interview transcript and archival material to apply open coding. We grouped common statements into first-order codes. In the second stage, we moved from open to axial coding (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). Here, we consolidated first-order concepts into second-order themes. In the third stage, we aggregated common second-order themes into aggregate dimensions. In the last step, consulting extant literature on affordances, we developed a conceptual framework to depict interrelationships between the themes we derived from the data.

For example, we consolidated the first-order concepts about the interest of incumbent firms to search for "pre-defined digital technology focus fields," and "probing with ventures' digital technologies," to see how they work and "evaluate their potential for the future" into the second-order theme of "learning about specific digital technology domains." Then, we aggregated common second-order themes into aggregate dimensions. For instance, we aggregated the second-order themes of "nurturing the digital transformation agenda" and "learning about specific digital technology domains" into the aggregate dimension of "objectives of incumbent firms." In the last step, we developed a conceptual framework to depict interrelationships between the themes we derived from the data. We provide exemplary quotes for the identified constructs in Table 2. Importantly, throughout the analysis, we moved from an inductive to the abductive approach of *systematic combining* (Dubois & Gadde, 2002, 2014). Systematic combining refers to the "continuous movement between an empirical world

and a model world" (Dubois & Gadde, 2002, p. 554), with the major aim of confronting a theoretical framework with reality to "create fruitful cross-fertilization" for the "refinement of existing theories" (Dubois & Gadde, 2002, p. 559). Specifically, during data analysis, we moved back and forth between the affordance-actualization framework from Strong et al. (2014) and our empirical case insights. This approach helped us to theoretically anchor our findings, and thereby advance affordance theory through insights from the inter-organizational transfer of digital technologies.

2.4. Findings

Integrating affordance theory with the findings of our qualitative analysis, we develop a process model along which the transfer of digital technologies from entrepreneurial ventures to incumbent firms unfolds: the *(1) emergence*, *(2) recognition*, and *(3) integration*. The emergence of affordances describes actor (i.e., incumbent firm) and object-related (i.e., venture's digital technology) factors that evoke transfer affordances—that is, action potentials that result from the prospective technology transfer from the venture to the incumbent. Affordance recognition refers to the sensemaking of key actors (e.g., CVC/OI managers, business unit managers, or venture managers) regarding the identification of concrete transfer affordances arising from the relation between a digital technology and a use context within business units of the incumbent firm. The integration of affordances summarizes practices that actors employ to make transfer affordances actionable for usage and the actual realization of potentials (i.e., actualization). In the following, we explain our findings in detail and exemplify them with first-hand case insights.

Figure 3. Data analysis

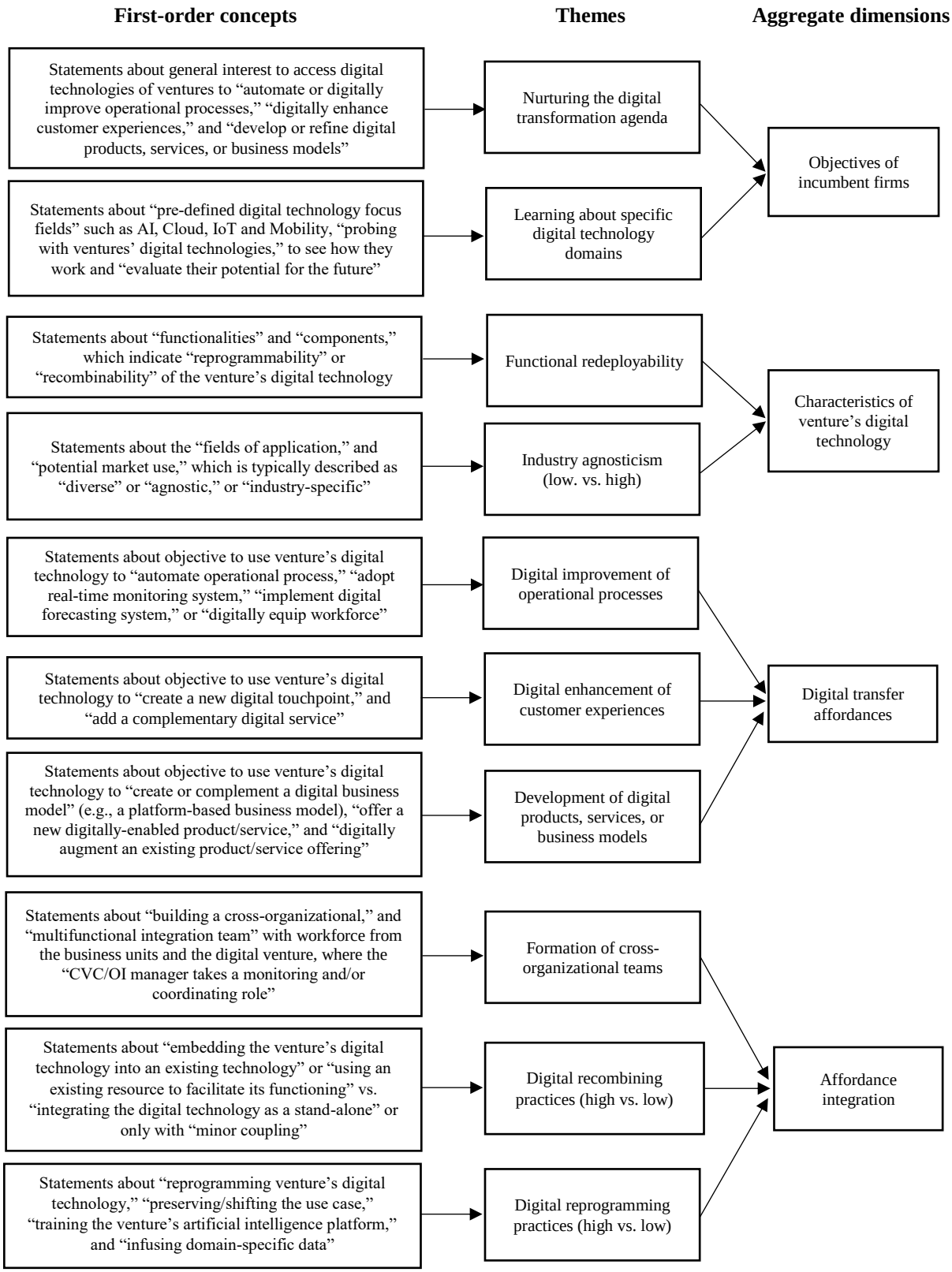


Table 2. Qualitative empirical evidence

Exemplary quotes	Themes	Aggregate dimensions
"Digitalization is our key focus. Everything we do in business innovation, and including the cooperation with start-ups, serves as a driver for the digital transformation of our mother ship. (…). The key criterion is that it has to enforce our core business and its digital transformation." **(M1, My-Corp)**		
"The development of a digital business model is (…) usually always a very strong component that we look at—regardless if it is a product, technological (…), or business model innovation of a start-up. For example also when it is about some kind of technological innovation or breakthrough innovation. Start-ups are very good when it comes to market these with some kind of a new business model. (…). Partly also internal processes. (…). That is not our search focus, but it also happens that we invest in start-ups that are useful for internal business processes at [Kappa-Corp]. Also customer experience in a broader, not narrower, sense. What does that mean? We do not look at CRM solutions… no. But for example data-driven models that help us to understand our [Kappa Corp]'s customers better and tailor solutions in a better way (…)." **(K1, Kappa-Corp)**	Nurturing the digital transformation agenda	**Objectives of incumbent firms** ***(Actor-related emergence of affordances)***
"We have once a strategic approach. That means that we have defined five key themes in which we want to cooperate with start-ups, because we believe that these topics are internally relevant, and we think that the market outside, the start-up market, has something to offer. (…). The most important search field is IoT (…). The second important topic is Data Analytics, Artificial Intelligence, Machine Learning. The third topic is Robotics and Automation (…). The fourth topic is customer experience, UX, UI, and the fifth topic is pricing, which we need particularly for platform approaches. (…). One may only think that these are very broad topics if you do not know [Delta-Corp], but in the context of the company, we know exactly what IoT means to us." **(D1, Delta-Corp)**	Learning about specific digital technology domains	
"Our search fields are on the one hand efficiency or technology-driven start-ups and collaborations in the fields of AI, Machine Learning, Big Data, and Blockchain, where we try to improve our core business. Beyond our core business its the search fields Mobility, Healthcare and Services for small- and mid-sized companies." **(O1, Omikron-Corp)**		

Table 2. Qualitative empirical evidence (continued)

Exemplary quotes	Themes	Aggregate dimensions
"Our approach was always to offer an intermediation platform, which is a virtual platform. Car owners can insert their cars there (…), and people are able to lease these cars through this platform. We ensure the intermediation and we also ensure the connectivity with the car through the hardware that we develop together with our suppliers. The hardware is built into the car and in this way it is possible that the car can be booked through our [Phi-Venture] platform and that the usage is billed. The best thing is of course that the car can be opened keyless through our platform, so that the hand-over of keys is not necessary. For the lessor, the entire process is very efficient, because everything is facilitated through the platform (…). For the renter, it is also very efficient, because he can facilitate everything through the platform (…)." **(P2, Phi-Venture)**	Functional redeployability	**Characteristics of venture's digital technology** ***(Object-related emergence of affordances)***
"We develop a software application at the end, especially for handicraft enterprises… to manage their business information, especially as there is strong demand for digitalization in the handicraft business, but the infrastructure for this is oftentimes lacking. (…). (…) A classical cloud software solution, consisting of a web application and of course mobile applications. It is closed in itself, so that the client can flexibly store important information like photos, PDF documents, notes etc. in a project structure, in a structured way. (…). (…) It is essentially only a support for the daily work (…) for documentary obligations." **(B2, Beta-Venture)**		
"Anybody making a high value, a high precision part with a long service life and low quantities. That is aerospace, a lot of high value and high precision parts, (…), aerospace is very big, energy, oil, gas, power, nuclear, and then (…) transportation, that is high-end cars or (…) rail, they got a lot of low quantity high precision parts. (…) Then medical, so medical which is not a main target focus today, but we are keeping our eye on it, because we think also that is high value, high precision, extremely low quantities and a high need for traceability." **(K2, Kappa-B-Venture)**	Industry agnosticism (low vs. high)	
*"We are in the process to expand it to the mobility sector and for this we must say that a very essential part of the solutions in this platform are industry-agnostic. That means, if we look at the back office, analytics, procurement, etc., than these are simply solutions that you can apply regardless of the industry. This also makes this platform so universally applicable."***(Z2, Zeta-Corp)**		

Table 2. Qualitative empirical evidence (continued)

Exemplary quotes	Themes	Aggregate dimensions
"Let's do predictive maintenance. This is a big topic for us. There we got to know a start-up. [Xi-Venture] (…) that develops sensors, which can be easily sticked to our train (…). They measure shocks, loudness, gauge… plenty variables… and can then determine: 'Hey, something is not okay with the train, it would be good to take it to maintenance.' (…). Classical predictive maintenance." **(X1, Xi-Corp)**	Digital improvement of operational processes	**Digital transfer affordances**
"We saw the potential to integrate [Alpha-Venture's solution] into our online and mobile banking platform. (…). I think there are several benefits or value added here. On the one hand, the bank has the value added that the client (…) can give us the permission to analyze and categorize their revenues. When we are able to do that, then we can show the clients also fields of demand or optimization potential. (…). (…) This is surely a value added for our customer. On the other hand, one can also openly say that there are also opportunities for the bank. (…). The interesting thing is that (…) this is not only a great gimmick for our online banking, or that the financial data can be structured for the client, but that we will be have to take into account this information for all advisory contexts in the future. (…). Suddenly, such a relatively simple function has an enormous impact on completely different processes at the end of the day." **(A2, Alpha-Corp)**	Digital enhancement of customer experiences	
"One example is [Ny-A-Venture], the drone delivery company. (…). When we wanted to explore the potential of autonomous and see what impact it would have on post-logistics or postal delivery business, we had a look at various partners. We asked them whether they had interesting start-ups as we knew there could be a link to this, and we started to work with [Ny-A-Venture]. So [Ny-A-Venture] was this drone delivery company. They had a very nice technology, but did not have any access to any Western European market because of the regulations. (…). So we used the position we had at [Ny-Corp] to go to the regulator and convince the regulator to let us (…) deliver blood samples. (…) We saw that we could convince the regulator to let us fly to save lives. So to deliver blood and pills faster and more reliably. (…). So, we have a historical business of logistics for hospitals and it's a very commoditized business, and now—when we are in competition with other providers—we can say: 'Ey, you know what, we also do drone deliveries.' And it's completely de-commoditizing." **(N1, Ny-Corp)**	Development digital products, services, or business models	

Table 2. Qualitative empirical evidence (continued)

Exemplary quotes	Themes	Aggregate dimensions
"The [unit] within [Kappa-Corp] actually organized and actually did project management from the [Kappa-Corp] perspective (…). We had calls with very different divisions. (…). What was great was the [unit] helped us navigate that, introduced to the correct people, set-up, helped us to collect requirements and licenses. There was weekly calls with both divisions, but then again [unit] guy was on those calls and helped to organize them." **(K2, Kappa-B-Venture)**	Formation of cross-organizational integration teams	**Affordance integration**
"From [Iota-Venture] side we have a sales guy and a technical guy. (…). [In] the relationship with [Iota-Corp] (…), the CEO and CTO of [Iota-Venture] are involved. We have our advocate (…) wo has a I don't really know his role, but he is like a technical leader within [Iota-Corp], but he is not in a specific business unit, but he is in like a CTO office. He introduces us to different business units that may be mature enough to adopt our solution. (…) In [Iota-Corp's] case we are working with a senior data scientist I would say or senior engineer, who actually is going to use our product." **(I2, Iota-Venture)**		
Low: *"The actual technology is quite simple. It is a website and it is a stand-alone website. It does not receive feeds from… it is not integrated with anything. It is very much a stand-alone website, web-based database. So, it is quite simple in that respect."* **(Z3, Zeta-Venture)**	Digital recombining practices (low vs. high)	
High: *"To be precise, the guys are… I am not 100% sure, if they are already integrated in our security cameras. In every case, they are in the process of doing this (…). [The algorithms] simply allow us to identify whether there is a critical situation… whether one has to raise an alarm or ask any operator to take a look at the video stream again."* **(I1, Iota-Corp)**		
Low: *"Yes, there were some adaptations and modifications necessary, but this worked out very well, so that we were able to adapt [the technology] perfectly. (…). I would say more like technical things. The use case was already—and very strongly—in our minds."* **(C1, Gamma-Corp)**	Digital reprogramming practices (low vs. high)	
High: *So it's just a very classic deep learning problem that you are solving there. These are the classic neural networks that you want to train and program and then apply. The original driver was: 'Oh, this is a great technology, we have to do something with this'."* **(I1, Iota-Corp)**		

2.4.1. The emergence of affordances: Incumbent and venture factors

We identified factors from both the incumbent firm (actor) and the venture's digital technology (object) that evoke transfer affordances for incumbent firms, and thus, characterize the emergence of affordances (Majchrzak & Markus, 2013). Concretely, we identified specific objectives that incumbent firms follow by engaging in CVC and OI relations with digital ventures, and characteristics of ventures' digital technologies that enable their transfer to use contexts of business units of the incumbent firm. According to affordance logic, affordances arise from the *relation* between an (organizational) actor and an object or a technology (Majchrzak & Markus, 2013). Hence, before affordances can be recognized, they have to emerge from the relation between the actor (i.e., incumbent firm) and the object (i.e., the venture's digital technology). Specifically, while objectives lead to incumbent firms pursuing specific affordances for realizing goal-directed outcomes, characteristics of digital technologies enable/constrain the emergence of affordances from a functional view.

2.4.1.1. Objectives of incumbent firms

From the actor perspective, the affordance theory suggests that actors' objectives serve as important determinants of affordances (Majchrzak & Markus, 2013). We find that incumbent firms follow particularly two overarching objectives in the context of their engagement in CVC and OI relations with digital ventures: *nurturing their digital transformation agenda* and *learning about specific digital technology domains*. Understanding these objectives is important as they lead incumbent firms to pursuing specific affordances with the transfer of digital technologies from ventures.

2.4.1.1.1. Nurturing the digital transformation agenda

Extant research generally suggests that incumbent firms are interested in the strategic potential of ventures (Basu et al., 2016; Souitaris & Zerbinati, 2014). We observe the nurturing of their

digital transformation agenda as an important objective of incumbent firms when engaging in CVC and OI relations. This objective describes the focus of incumbent firms on the identification of ventures with suitable digital technologies, which can be linked to business units of the corporate parent for redeployment. In this context, the transfer of digital technologies contributes to the realization of digital transformation aspirations. For example, our respondent from Delta-Corp, a worldwide operating logistics company, elaborated on their objective to nurture the internal ecosystem of Delta-Corp with new digital business models from ventures:

"(…). What we do is a digital business. We invest exclusively in start-ups, which offer a digital product. We would not… I daresay… invest in manufacturers of sensors or producers of bike sharing bicycles. We invest exclusively in almost pure digital business models. So it is not only a touchpoint… it is our job to deal with this field. In this context, we are of course responsible for bringing new digital technologies and business models from… I would say… the cosmos outside [Delta-Corp] into the internal ecosystem of [Delta-Corp]." – **(D2, Delta-Corp)**

Similarly, an innovation relations manager from Xi-Corp, a railway transportation company, explained their objective to nurture business units with digital technologies of ventures to enhance customer experiences and optimize operational processes:

"We started the top program "digitalization" two years ago. It was started by the CEO, where different projects and sub-projects were launched… with a team that looks at what we can do with digitalization. What is going on there? This project is now more or less integrated with the business line. We are continuing from there (…). We have few potentials, especially for customer touch points, digital channels, what we can improve there, to digitalize our supply chain, the internal processes (…). We do a lot with start-ups. We collaborate actively with four or five by now. We have a team that deals with start-ups, and I am essentially part of it (…). We try to link the start-ups internally to our business units and see where they can use those best." – **(X1, Xi-Corp)**

Here, digital technologies serve as an important ingredient for the realization of digital transformation aspirations that incumbent firms look for in their prospective relationship-formation with entrepreneurial ventures.

2.4.1.1.2. Learning about specific digital technology domains

CVC and OI activities serve as a window on new technologies (e.g., Benson & Ziedonis, 2009; Keil, Autio, & George, 2008), which can help incumbent firms to learn about newest technologies and evaluate their potential (Maula et al., 2013; Schildt et al., 2005). For this purpose, incumbent firms rely on specific digital technology domains (Basu et al., 2016). In light of the ubiquitous relevance of digital technologies (Yoo et al., 2010), we observe that incumbent firms increasingly focus on learning about specific digital technology domains. The following quote from an investment manager of Theta-Corp, a financial services company, illustrated their interest in learning about a number of pre-defined digital technology domains:

"Our investment focus is not only directed at FinTechs, but rather on tech. We deal with 12 core technologies, which were pre-defined as the technologies that will have the greatest impact on banking and financial industries in the next 5 to 10 years. Logically, the first to mention here is Blockchain and Distributed Ledger Technology, where we have a very large and strong team (…). The other fields are Big Data, Machine Learning, AI. (…)." – **(T1, Theta-Corp)**

In this vein, incumbent firms aim to tap into newest digital technologies that may disrupt traditional businesses (Rossi et al., 2020). We observe that digital technology transfer projects serve as mechanisms for evaluating the potential of emerging digital technologies and learn from them through concrete use cases. Importantly, we do not identify differences in the digital transformation objectives, both with respect to nurturing the digital transformation agenda and learning about specific digital technology domains, based on the form of the incumbent-venture partnership (i.e., CVC vs. OI relation).

2.4.1.2. Characteristics of ventures' digital technologies

From the object perspective, affordance literature argues that the materiality (characteristics) of objects enables or constrains affordances for external actors (Majchrzak & Markus, 2013). We identify two overarching characteristics of ventures' digital technologies that enable or constrain, and thus determine, affordances for incumbent firms: *functional redeployability* and

industry agnosticism. While functional redeployability refers to the general potential of a digital technology for reuse, industry agnosticism describes the array of industry contexts where the digital technology can be deployed. Although both characteristics are interrelated, they differ in the means by which they determine affordances. A digital technology can exhibit great technical redeployability, but lack flexibility in terms of its deployment in industrial contexts and vice versa. Thus, we find that both the functional redeployability and the industry agnosticism of a venture's digital technology function as enablers or constrains of affordances for incumbent firms.

2.4.1.2.1. Functional redeployability of digital technology

We observe that the functional redeployability of the venture's digital technology has an important enabling/constraining function for the emergence of affordances for incumbent firms. Indeed, incumbent firms are interested in digital technologies of ventures that can be redeployed to own use contexts—be it for expanding market offerings or for internal operational use. The functional redeployability of digital technologies indicates the degree to which incumbent firms are technically able to reuse the digital technology in own use contexts. The redeployability of digital technologies arises from their unique characteristics, such as reprogrammability and recombinability (Kallinikos et al., 2013), which make them transferable and adaptable for incumbent firms. For example, the Co-CEO of Theta-Venture explains the functionality of their natural language generation solution:

"*(…) We see ourselves as an automation services provider in the field of content. (…). We take structured data and produce text, so if it was written by real humans. Automatically. (…). The advantage of using this technology is—in the concrete example [of soccer]—that we are able to produce a match report for every existing soccer game once the data is available. That is, to give you a number, approximately 70,000 to 80,000 reports per weekend once the solution is completely rolled out."* – **(T1, Theta-Venture)**

The natural language generation solution of Theta-Venture is a good example for a reprogrammable digital technology with a broad functionality. Based upon intended automation

goals, incumbent firms can reprogram the natural language solution to produce automatically generated text for other types of content, such as product descriptions or financial reports. Beyond standalone redeployability, we also find cases of digital technologies, where the redeployability is characterized by the potential for recombinability. The co-founder and CEO of Kappa-B-Venture explains:

"My company is dedicated to enabling distributed digital manufacturing. (…). So my company makes software that addresses issues in three different areas. One is digital security. To make sure that so many can't steel or modify your part all the way down to an integrity. Making sure that when it is now manufactured in a dozen of different places, thousands of miles or kilometers away by somebody who has never manufactured before, its made exactly how you would like and what matters, so there is this kind of repeatability and standardization. Then finally traceability. Because now when a part fails or you need to do digital logistics, you need to be able to track things such as how is the supplier doing, or which supplier made a particular part and possibly trace it all the way back to its digital life. So [we] address those three areas: security, standardization and repeatability, and finally traceability." – **(K2, Kappa-B-Venture)**

As becomes evident, Kappa-B-Venture's digital manufacturing solution exhibits a high potential for recombinability, which can elicit affordances for incumbent firms regarding the reuse of the digital technology in combination with existing digital or physical components (Wang, 2022).

2.4.1.2.2. Industry agnosticism of digital technology

Extant research evidences that technological relatedness between incumbent firms and venture—traditionally captured by the numeral distance of standard industry classification (SIC) codes—can spur the transfer of technological knowledge from the venture to the incumbent firm (Van de Vrande & Vanhaverbeke, 2013; Wadhwa & Kotha, 2006). In the digital technology context, we find that the industry agnosticism of ventures' digital technologies serve as an important enabler or constraint of affordances for incumbent firms. Industry agnosticism is a particular result of the generative nature of digital technologies (Zittrain, 2006, 2008). As such, industry agnosticism enables affordances for incumbent firms operating in different

industries than the original industry of application of the digital technology, thereby challenging existing assumptions about industrial boundaries and technological relatedness. For example, the Founder and CEO of Ny-B-Venture highlighted the industry-agnosticism of their solution when talking about use cases:

"Everywhere where controlled logistics is required. Pharmaceuticals is very rewarding, since the regulator exerts pressure on temperature regulation. In the food sector, there is also a signal. Everything related to perishable goods. Regarding flowers, for example, everything is based on temperature. The construction of aircraft components… everywhere where I deliver components. Synthetic material components … that is also controlled logistics. I have topics around drop damages. Most damages in logistics are actually drop damages, where I have evidence for problems. Who did it? With drop sensors I can evidence that pretty easily. So overall: The field of application is huge. It is simply… the devil is in the detail. How do I get into an industry vertical? We focused on the Pharmaceuticals use case quite quickly, since there is—because of regulatory pressure—of course the willingness to pay." – **(N3, Ny-B-Venture)**

Drawing upon the industry agnosticism of digital technologies, incumbent firms are able to transfer digital technologies from ventures to own industry application fields, even beyond the ones that the digital venture originally intended (Yoo et al., 2010). However, digital technologies can also exhibit strong industry-specific focus, which may limit the emergence of transfer affordances for specific incumbent firms. For example, our respondent from Gamma-Venture explained the strong focus of their developer platform on the automotive industry:

"We deal with electric cars and provide a developer platform with APIs, bringing together carmakers and developers. One can essentially think of it as of Android or iOS, where there are specific developer programs, who then have (…) their APIs and can build [applications] with building blocks. Just that, in this case, the device on which the apps run is not a phone or a computer, but a car. Although the application can be hosted by a phone, a computer, or a cloud, which then can be connected with the car. That means that the car is the new developer platform." **– (G2, Gamma-Venture)**

In this concrete example, the focus of Gamma-Venture on solving a problem in the automotive industry (i.e., developer platforms) has—most likely—only helped in acquiring Gamma-Corp, or other automotive firms, as an incumbent firm partner. However, for incumbent firms

operating in other industries, this focus may actually limit the emergence of purposeful transfer affordances.

2.4.2. The recognition of digital transfer affordances

As affordances refer to use potentials and not actual uses, recent work debates the importance of recognizing affordances for their pursuit and actualization (Volkoff & Strong, 2018). However, because it is empirically challenging to capture use potentials, the understanding of affordance recognition remains an unexplored issue in prevailing literature. Exploiting the dyad-level setting of our research design, we identify specific affordances that emerge from the relation between incumbent firms and ventures' digital technologies (i.e., transfer affordances). Such affordances include, for example, the potential to automate calibration tools, the potential to add digital customer touchpoints, and the potential to introduce new digital services. Across all identified affordances, we find the following three thematic, overarching digital transfer affordances: *the potential to digitally improve operational processes, the potential to develop digital products, services, and business models, and the potential to digitally enhance customer experiences* (Fitzgerald et al., 2014; Warner & Wäger, 2019).

2.4.2.1. Digital improvement of operational processes

Increasing efficiency in the operational backbone is an important objective of digital transformation endeavors by incumbent firms (Sebastian et al., 2017). The operational backbone facilitates operational excellence, which determines the functioning of transactions and generates data for decision-making—two critical success factors of digital transformation. We find that incumbent firms consider the affordance of transferring digital technologies of ventures to improve operational processes digitally. For example, our respondent from Kappa-Corp explained the recognized possibility of transferring Kappa-Venture-A's deep

reinforcement learning platform for the specific affordance of automating the calibration of internal machining tools:

"We define—I would say—once a year, or throughout the year, certain strategic search fields. These could be, globally, artificial intelligence in machine tool manufacturing or in the machine tool industry, where [our CVC unit] essentially does the screening. (…). I think [Kappa-Venture-A's] original idea is a very broad use case for artificial intelligence applications, which goes beyond machining tools or the manufacturing industry. (…). [With their deep reinforcement learning technology], we saw: 'Okay, with a very narrow use case, we would be able to improve the calibration of our [machining tools] significantly' (…)." – **(K3, Kappa-Corp)**

Similarly, our respondent from Ypsilon-Corp elaborated on transferring Ypsilon-Venture's deep learning solution to automate the internal chip verification process:

"(…) We need a number of tests for the chips that we produce. Let's say 100 tests to verify if the chip works well or not. With this solution [the deep learning solution of Ypsilon-Venture] you can reduce the number of tests to—let's say— 20. So 20 tests instead of 100, that saves of course time in the testing. We will then be faster and more cost-efficient in chip testing. That would be an example for how a start-up helps us to improve our own operations." – **(Y1, Ypsilon-Corp)**

Thus far, we largely lacked concrete empirical evidence on the role of incumbent-venture partnerships for the optimization of internal processes. Most of research concentrates on general firm performance or innovation outcomes in this respect (Dushnitsky & Lenox, 2006; Huang & Madhavan, 2021). Our findings show that the context of digital technologies—and especially digital trends such as automation—can create purposeful opportunities for the realization of internal process improvements through partnerships with entrepreneurial ventures.

2.4.2.2. Development of digital products, services, or business models

To ensure competitiveness in the digital age, incumbent firms are urged to foster the development of digital products, services, and business models (Hanelt et al., 2021). We find that advancing digital innovations in these three fields serves as an important objective of incumbent firms when pursuing the integration of ventures' digital technologies. Hence,

incumbent firms evaluate digital technologies in light of their affordance to develop digital products, services, or business models. For instance, our respondent from Delta-Corp described how the digital platform of Delta-Venture allows the platformization of their freight forwarding business model:

"In freight forwarding, one acts as an intermediary between the sender and the freight carrier, that means between the person or organization sending a package or a pallet from A to B and the company that owns the truck, the container ship or the airplane. We are the intermediary and have—so to say—nothing to offer besides the mediation. That means that our business model is— in times of digitalization—extremely under pressure, because many digital platforms are trying to bring the sender and the freight carrier directly together and make the function of the intermediary obsolete. To do this, one needs many technological competencies. You have to be very well positioned in the fields of data analytics, machine learning, programming. [Delta-A-Venture] brought this. The second important [aspect] the UI/UX design and the customer experience, to have the customer experience end-to-end. We did this with [Delta-A-Venture] too. With this, we advanced the business model of [Delta-Corp]. (...). The new business model is that we are cannibalizing ourselves. With this platform, you don't need us for this type of transport anymore. Like with Amazon, all go to Amazon, no one goes to the retailer." **– (D2, Delta-Corp)**

Further, we find that incumbent firms recognize the affordance of transferring digital technologies of ventures to augment existing products or services with new digital features. The following quote illustrates this:

"Before start of our cooperation, the solution was presented to us as a superior artificial intelligence model for all sorts of use cases around video editing and video stream. (...). The use potential was originally that it could be a solution, a central solution, in all our product lines (...). It was about raising suspicious behavior or just flags from camera data. (...). It is about security cameras that are supposed to detect whether there is a break-in right now or whether there is a security breach etc., so that this data stream can be analyzed automatically and one can react to patterns accordingly. (...)." **– (I1, Iota-Corp)**

We also find evidence that incumbent firms recognize the affordance of transferring ventures' digital technologies to create new digitally enabled services. As our respondent from Epsilon-Corp exemplified:

"(...) [Epsilon-Venture] has a real time location systems technology based on ultra wide broadband, which is quite exciting for us since we do not have any expertise in this. (...). It is about positioning topics, which are exciting for our business with hospitals. With this, we could

see how our devices move and where they are. That is a huge topic for the management of movable devices, as for example ultrasound… to manage this in hospitals, because they oftentimes do not know where they are localized and where they are needed. It could also become something for localizing patients. We had first conversations about this (…). Together with them, we saw that this could be interesting to our field, also in radiology, because you can precisely localize things. Where things are exactly. With this technology, you could also monitor the breathing of patients for example. (…). This was very interesting for another business unit, where they needed a solution for a consulting approach. What they do—we have a consulting arm—is that they support hospitals in optimization of their processes and lead management. You could install this solution in hospitals—this can be done relatively quickly. I think you would need only one day for this. (…). The business case for this whole thing would be that they would install this, and they have the hardware and software to analyze it. We would—so to say—marry this with our consulting know-how. (…)." – **(EP1, Epsilon-Corp)**

Extant research has found that partnerships with entrepreneurial ventures—in the form of CVC relations—are negatively related to discontinuous strategic renewal, suggesting that CVC investments enforce existing business models rather than substituting them (Basu & Wadhwa, 2013). Our insights show that—in the context of aspirations for digital transformation—CVC and OI relations can foster digitally enabled renewal of existing business models, or the development of new digital business models.

2.4.2.3. Digital enhancement of customer experiences

The pervasiveness of the internet and thus, the emerging attention economy has changed customer preferences and expectations (Lemon & Verhoef, 2016). Consequently, incumbent firms are increasingly under pressure to alter their product and service offerings digitally and thereby facilitate novel customer interactions and experiences (Kannan & Li, 2017). Our study reveals that incumbent firms recognize affordances related to digitally enhancing the experience of their customers through the transfer of ventures' digital technologies. For example, our respondent from Delta-Corp explained that they recognized two types of affordances with the transfer of Delta-B-Venture's digital platform: the digital optimization of an internal operational process and the digital enhancement of customer experience:

"We invested in [Delta-B-Venture] and are driving two very concrete integrations. One for our internal travel management. Currently, it's the same at [Delta-Corp] as it is at every other company I know, that you take a taxi, then you take a picture of your taxi bill, hand it in, and somehow X weeks later you get the money as a travel expense reimbursement. With [Delta-B-Venture's] solution, this process is no longer necessary, because the whole thing is then charged to the cost center and the accounting department is helped out, because they no longer have to process thousands of taxi invoices per month. That is one side. The other side concerns our customers (…) that they are able to book the first and last part of their journey through [Delta-Venture- B's platform], which is then called [Delta-Corp's Shuttle]. So if Mrs. X travels from [City A] to [City B] by train and has then to go to the hotel in [City C] (…) then she is able to book the entire travel chain. Without having any problems when she arrives at the train station ... without having to line up for a taxi drive. (…). So [Delta-Venture- B's platform] is a beautiful add-on technology for us, which can be linked in like a puzzle piece, thereby drawing a coherent picture for our end-customers." – **(D2, Delta-Corp)**

This finding points again to a potentially important outcome of CVC and OI literature, which has been largely neglected by extant research and which can be further examined through metrics established in, for example, digital platform literature (Rietveld & Schilling, 2021).

2.4.3. The integration of digital transfer affordances

To realize goal-directed benefits, affordances have to be actualized (Henningsson et al., 2021; Strong et al., 2014; Volkoff & Strong, 2018). While affordances describe action or use potentials, actualization refers to the actual action or use that actors perform with the digital technology (Strong et al., 2014). Our interviews reveal that, in the context of the inter-organizational digital technology transfer, incumbent firms have to make affordances *actionable* before actualizing them—that is, incumbent firms have to apply specific *transfer practices* to be able to actualize affordances that emerged from the relation with the digital technology of the venture. Our data shows that incumbent firms employ three transfer practices that make affordances offered by digital technologies of ventures actionable for own use: *the formation of cross-organizational teams*, *digital recombining practices*, and *digital reprogramming practices*.

2.4.3.1. Formation of cross-organizational teams

Cross-domain collaboration is vital for digital innovation (Pershina et al., 2019). Across all cases, we find that incumbent firms and digital ventures build cross-organizational integration teams to transfer the digital technology. These teams include functional experts from the incumbent firm, employees from the digital venture and CVC/OI managers who have typically identified the digital venture, led negotiations, and linked it to business units prior to the transfer project. In this context, we discover that CVC/OI managers adopt a moderating role, facilitating the interaction between business units and the digital venture throughout the transfer process and oftentimes taking over project management. Moreover, employees from the digital venture and functional experts from business units of the incumbent firm typically take on the employment of transfer practices, which comprise technical implementation activities. Our respondent from Ypsilon-Corp explained:

"The project team (…) is from our business unit, and of course also from the side of the start-up. Then you define deliverables on both sites. (…). It is really predominantly the business unit, which manages this project. I consider myself more a moderator—in case there are any problems in the collaboration per se, but technically it happens in the business unit." – **(Y1, Ypsilon-Corp)**

Likewise, our respondent from Phi-Corp, an automotive trade company, described:

"In all investments held we have an operations manager who manages the interfaces and involves and includes the business units. It is basically a triad relationship: the start-up, my field through the operations manager, and the responsible person from the business unit, who facilitates these projects." – **(P2, Phi-Corp)**

While extant research has mostly concentrated on the search function of individual CVC and OI managers, this finding highlights their important role in the post-investment or post-relation-formation process.

2.4.3.2. Digital recombining practices

We find cases of transfer practices where incumbent firms apply digital recombining to make affordances actionable for actualization. Digital recombination refers to the transfer of a digital technology by coupling it with an existing and complementary (digital) technology (Lanzolla et al., 2021). Concretely, digital recombination can occur between digital and physical components, or between solely digital components of two actors (Yoo et al., 2010). As such, digital recombination reflects a "contingently obligatory relation" (Wang, 2022, p. 97), which describes the fact that the relation between two components is contingent on the combination, rather than predefined. Recombinability arises particularly from the data homogenization of digital technologies, allowing for transferability and combination of a digital technology with heterogeneous technologies and systems (Yoo et al., 2010). In this regard, we observe variation in the degree of recombining across our cases. For example, our respondent from Ny-B-Venture emphasized the extensive degree of recombination needed to realize the transfer of their digital technology into Ny-Corp's track-and-trace system:

"It took over a year. Essentially its about… you have an arsenal of systems… if you think about what happens there: starting with the scanning device of the mail carrier… there are so many systems involved. (...). Only the process to introduce such a solution as a bar code at [Ny-Corp] encompasses 172 systems. (…). It is completely integrated into the existing systems landscape of [Ny-Corp]. What we essentially do is that we have coupled [the solution] to the track-and-trace [system]." – **(N3, Ny-B-Venture)**

While we know from prior research that complementarity takes an important role in incumbent-venture partnerships (Basu et al., 2018; Röhm, 2018), it is important to highlight that the recombinability of digital technologies goes beyond complementarity by enabling incumbent firms to enhance traditional products and services digitally (Wang, 2022). However, incumbent firms may transfer digital technologies of ventures also as stand-alone solutions or only through minor coupling with other (digital) technologies. One respondent from Gamma-Venture explained the stand-alone transfer of Gamma-Venture's digital platform:

"A company can directly get our "development center," but it has to be branded. It is of course branded by [Gamma-Venture]. It should however look like [Gamma-Corp] (…). We have 160, 170 open APIs, which are of course not available in every automobile. So one has to first see which APIs the automobiles have, which ones we can use. (…). At [Gamma-Corp] it was about the competition, but the competition should [only] be a starting point. So that people can simply go to the [website] of [Gamma-Corp], practically like a developer program, and then permanently develop apps for [them]. (…)." – **(C2, Gamma-Venture)**

Notably, this example illustrates that—even when transferring digital technologies as stand-alone solutions—incumbent firms typically use their own brand when deploying them to the market (Uzuegbunam et al., 2019). Moreover, the integration of digital technologies as stand-alone solutions differs from pioneering solutions—that is, technologies that do not build on any prior knowledge (Van de Vrande et al., 2011). While such technologies are considered as entirely new, the stand-alone integration reflects only the fact that the technology is not coupled with an existing solution.

2.4.3.3. Digital reprogramming practices

An important transfer practice we identify is the reprogramming of digital technologies from ventures to make them actionable for actualization. Reprogramming refers to the degree to which incumbent firms assimilate the digital technology of the venture to new use contexts (Kallinikos et al., 2013). The possibility of assimilating the originally envisaged use case is an important peculiarity of digital technologies, where reprogrammability allows for adaptation and redeployment to new use cases (Yoo et al., 2010). For example, the co-founder of Ypsilon-Venture emphasized that their digital technology had to be reprogrammed to allow the transfer to Ypsilon-Corp's chip solutions:

"(…) Specifically for process handling—where human and machine work together—we built a kind of a hybrid platform that takes on such processes. (…). With [Ypsilon-Corp] there was a problem and we got data for it. We had to essentially develop our solution. Our base technology did not fit very well to this. (…). It was like: "okay we start with concentrating at the use case that the one [at Ypsilon-Corp] had prepared a case with a given problem. We started understanding it better and better, and the approach changed throughout the project. (…).

That's how it is oftentimes with machine learning projects… you have to adapt very quickly (…)." – **(Y2, Ypsilon-Venture)**

Similarly, the Co-CEO of Theta-Venture explained the requirements needed for reprogramming the digital technology as part of the transfer process to Theta-Corp's use context:

"Well, we essentially need two things. The first is raw data that are necessary for this. Then we need—we call them industry experts or insiders. In this case essentially an analyst who tells us on which basis of the constellation of data we can make what kind of statements, and which statements are relevant. That is, you need a model first. You need a data model. Which data to I have to put together to make what kinds of statements. (…). I always have to know: what can I say? Let's have an example: (…). Let's say a company has lost value. So the stock has lost value (…), then it is of course depends on the industry (…) whether we can talk about a "dramatic decrease." I need to define the threshold. (…)." – **(T2, Theta-Venture)**

However, the transfer of the digital technology may also not require extensive reprogramming. For example, our respondent from Xi-Corp described the little degree of reprogramming when employing digital-physical coupling of Lambda-Venture's digital technology:

"There was relatively little [adaptation needed]. They of course already had experience with another railway transport company… another train. (…). We decided together which train to take, which model, from which manufacturer. Depending on that, [Xi-Venture's] sensors have to be attached to different spots." **(X1, Xi-Corp)**

Due to their inherent flexibility for adaptation and redeployment (Kallinikos et al., 2013; Leonardi, 2011), the unique characteristics of digital technologies allow entrepreneurial ventures to continuously adapt their market offerings (Lehmann & Recker, 2022). With a partnering incumbent firm, digital ventures can—as our findings show—draw upon well-established capabilities and customer bases to spur the identification of use cases for their digital technologies.

2.4.4. Affordance actualization and digital innovation outcomes

Importantly, to realize goal-directed outcomes, digital technologies have to be used (i.e., actualized) after the inter-organizational transfer from the venture to the incumbent firm. For example, in the case of Kappa-Corp, the actual digital innovation outcome related to the

automatic calibration of machining tools can only be realized after actually using it. The mere process of performing actions after the successful transfer of the deep reinforcement learning technology reflects the actualization process. Since the scope of our study is limited to the digital technology transfer, our empirical investigation focuses on the inter-organizational dynamics present in the transfer process and thus excludes affordance actualization, which completes the integration. Recent studies have, however, elaborated on affordance actualization and the achievement of goal-directed outcomes (e.g., Henningsson et al., 2021). Under this consideration, we present our overall findings in a conceptual framework depicted in Figure 4.

2.4.5. Potential failures in the digital technology transfer process

The transfer of digital technologies from entrepreneurial ventures to incumbent firms is—of course—also subject to failures, which may occur at very different phases of this process. First, throughout the presentation of our empirical findings, we concentrated on *realized* CVC and OI relations to exemplify the digital technology transfer process. However, many CVC and OI relations between incumbent firms and digital ventures are not formed in the first place. In other words, incumbent firms and digital ventures may fail to match and create a concrete equity-based (i.e., CVC) or non-equity-based (i.e., OI) relation. Extant literature that focuses on the search phase of incumbent firms for entrepreneurial ventures examines a range of practices that incumbent firms use in their search for ventures (Basu et al., 2016). For example, despite having a promising technology, digital ventures may not fulfill market-related criteria of incumbent firms (i.e., traction, future vision, etc.). Similarly, digital ventures are oftentimes cautious when it comes to entering into thorough partnerships with incumbent firms due to misappropriation concerns (Colombo & Shafi, 2016; Dushnitsky & Shaver, 2009). Second, while incumbent firms and ventures can enter into a CVC or OI relation where promising transfer affordances between both parties can emerge, decision-makers may not recognize them. In fact, the recognition of affordances is a central, yet underresearched, phase in the affordance-

actualization framework (Henningsson et al., 2021; Volkoff & Strong, 2018). Experts within incumbent firms may lack the knowledge and skills to identify opportunities for redeployment of digital technologies. In fact, our case insights show that incumbent firms with expertise in their traditional fields of business regard the recognition of concrete opportunities arising from digital technologies as challenging. For example, the Managing Director of a CVC unit stated in one of our pilot interviews:

"Digitalization is indeed a completely different field. It is not that we say: "We add a new technology, let's invest in 3D printing technology now." Digitalization has rather own characteristics, own dynamics. Some may be comparable to classical technology investments. Many others are not. (…). That means that someone who is able to recognize and differentiate a good technology investment is, most likely, a priori not the best man for an opportunity in the field of digital. Here again it is the challenge to build up these competencies in the corporate, to a) implement digital technologies, and b) to evaluate potentials of digital technologies, which are brought to us through start-ups, or which we can find in start-ups." (**Managing Director of a CVC unit)**

Third, even if either the incumbent firm or the digital venture recognizes an affordance and finds it worth to pursue its actualization for realizing digital innovation outcomes, CVC and OI managers may fail to bridge the venture to business units. CVC and OI activity oftentimes lacks general legitimacy in the parent firm (Souitaris et al., 2012; Souitaris & Zerbinati, 2014), which can make business units reluctant to commit to digital technology transfer projects, making it difficult for CVC and OI managers to create links between with the digital venture.

Fourth, the digital technology transfer process can fail in the affordance integration phase—that is, the phase where affordances are made actionable for actualization through concrete integration practices. Concretely, from the perspective of the entrepreneurial venture, business functions of incumbent firms oftentimes lack the interest, or the awareness, to commit to the resources necessary for spurring the digital technology transfer project. As one of our venture respondents explained:

"(…) I think that very often it comes to the point, where everything is handed over to the [business] line, where one says: "Okay, now you have to talk to the ones who do this internally." There it always comes to problems. These can be of very different nature. That the

ones internally… that you have the feeling that they actually do not really want to. They rather have to, because the innovation unit has handed it over, or because there is not so much pressure on this. Because they may see it from a corporate perspective, and there you have years for the development of a product or project. (…). When it is about—let's say—incremental innovations, then you have a four-years timeline or so. That is not the topic for which you need a start-up, and that is not what we are actually for. Taking these things together, and then also different requirements, different views, then it always becomes difficult." **(Co-Founder, Epsilon Venture)**

On the other side, incumbent firms oftentimes realize that digital technologies developed by entrepreneurial ventures are very difficult to implement into the corporate parent context. As the Director of a CVC unit with whom we conducted a pilot interview explained:

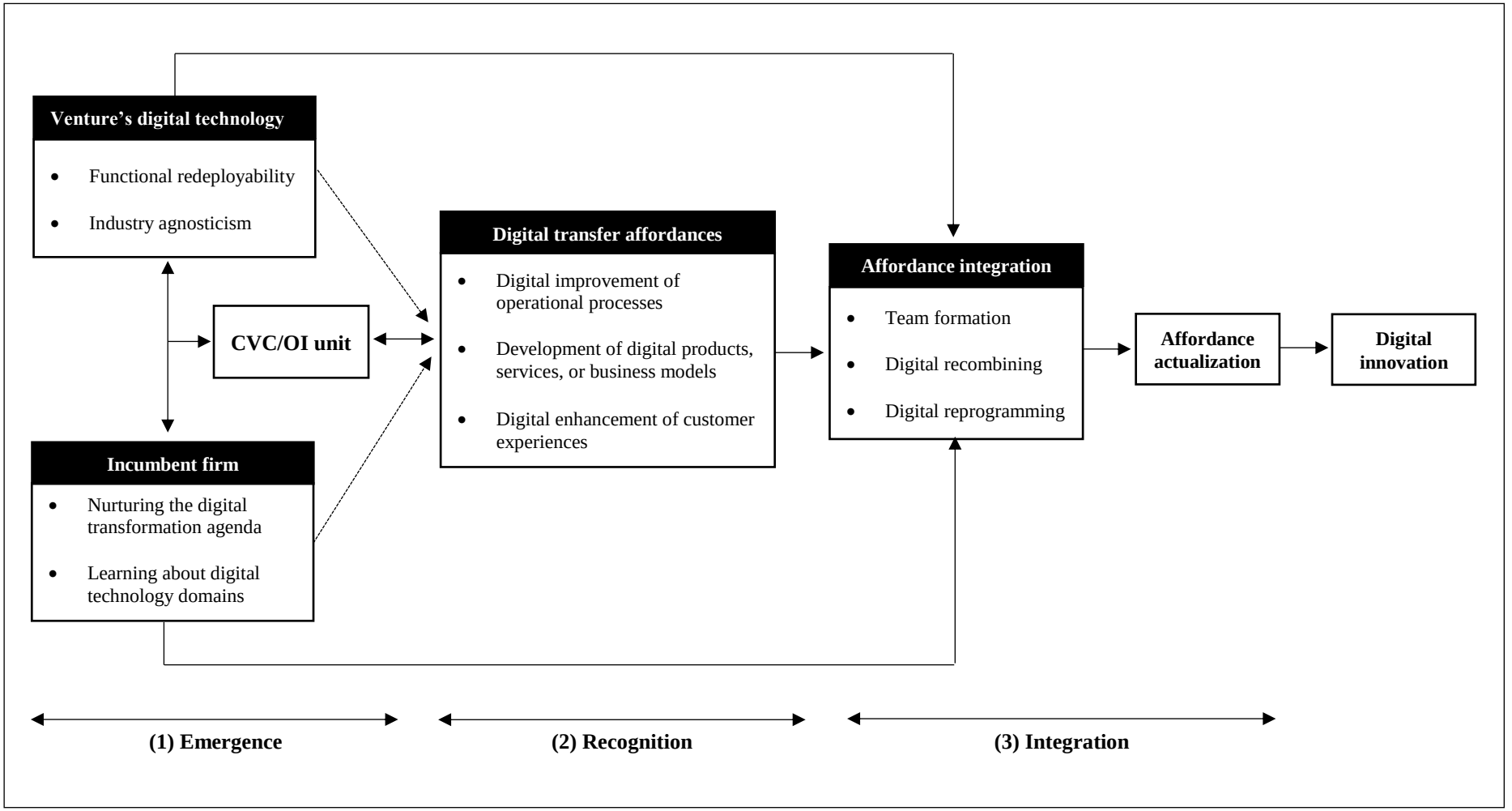
"We also do have a lot of ideas. This is not lacking… the ideation. What is lacking is the implementation of solutions, which can be linked to our business. A 10 to 20 employees company… is neither programmed in the manner to really be scalable or modularly implementable for customers across different brands, regions, worldwide… nor do they fulfil the respective IT security requirements, and they oftentimes lack compliance with the regulatory requirements… when it is about accounting processes. The topic of payment. Also, they are oftentimes not compliant with the data security regulations etc., with the entire topic of data privacy laws. Small companies simply can't do that. They are faster, but we cannot afford – as a big company – to offer such services and products to our clients." (**Director of a CVC unit)**

Fifth, although incumbent firms may provide the input necessary for affordance actualization, the performed actions do not necessarily have to lead to the envisioned digital innovation outcomes. That is, the digital technology transfer process can be realized successfully, yet not yield the promised digital innovation outcomes for the incumbent firm. As the Director of a CVC unit noted:

"The problem is—with all digital start-ups—that the envisioned cooperations were not realized or did not materialize. These were all wishes, ideas on power point—to exaggerate it a bit—which did not come through. That is why we actually have distanced ourselves from this, because the value-added was thin." (**Director of a CVC unit)**

Overall, while we concentrated on successful digital technology transfer cases to illustrate the entire process, it is important to note that the transfer of digital technologies is also prone to sources of potential failure in every phase of this process.

Figure 4. The unfolding of digital technology transfer in CVC and OI relations from an affordance perspective



2.5. Discussion

2.5.1. Contributions to research on value adding through CVC and OI

Our study makes important contributions to the understanding of CVC and OI relations. First, we add knowledge to value adding through CVC and OI by establishing an interdisciplinary link between CVC and OI research with digital technology literature. So far, existing literature has studied CVC and OI in general technological contexts. We theorize upon peculiarities of digital technologies and transfer affordances that emerge from CVC and OI relations with entrepreneurial ventures: the digital improvement of operational processes, the digital enhancement of customer experiences, and the development of digital products, services, and business models (Fitzgerald et al., 2014). In this vein, we show that CVC and OI relations can serve as valuable instruments for advancing digital transformation, which describes the "combined effects of several digital innovations" (Hinings et al., 2018, p. 52).

Second, prior research has drawn upon organizational learning perspectives to show that incumbent firms can spur innovation by building upon extant knowledge of ventures (Dushnitsky & Lenox, 2005; Wadhwa et al., 2016; Wadhwa & Kotha, 2006), but has not provided detailed explanations for the unfolding of the technology transfer process. In this regard, in-depth qualitative insights necessary for investigating how incumbent firms transfer technologies from ventures have not been easily accessible (Röhm, 2018). While incumbent firms pursuing CVC and OI relations publically promote some technology transfer cases, they keep the majority of them in secrecy. We took formidable efforts to collect this data. Thus, our study responds to explicit calls for in-depth case studies to examine dynamics within CVC and OI relations (Basu et al., 2016; Röhm, 2018). In this context, we add knowledge to CVC and OI relations as an important (corporate) entrepreneurial context of technology transfer (Audretsch et al., 2016). Moreover, we outline the role of CVC and OI managers as

entrepreneurial agents who do not function only as scouts in the search process, but also act as important moderators and facilitators in the value adding process of CVC and OI relations.

2.5.2. Contributions to digital innovation research

Our findings also contribute to digital innovation research. Prior work has provided conceptual foundations of digital innovation, emphasizing new theorizing on innovation processes and outcomes (Nambisan et al., 2017), unique digital technology attributes (Yoo et al., 2010), knowledge creation and sharing (Lyytinen et al., 2016), organizing logics (Yoo et al., 2012), and architecture vs. ecosystem perspectives (Nambisan et al., 2018). Drawing upon arguments of this stream of literature, we examine the emergence of digital innovation in incumbent firms empirically. Specifically, our study exemplifies how incumbent firms can use partnerships with entrepreneurial ventures to facilitate "new combinations of digital and physical components" (Yoo et al., 2010, p. 725). By doing so, we provide an empirical context for understanding the implications of unique digital technology attributes in the context of the inter-organizational transfer of digital technologies. By linking CVC and OI research with digital innovation literature, our study provides an empirical context for understanding how and "why the same digital [technology] (…) may lead to different innovation or entrepreneurial outcomes in different use contexts" (Nambisan et al., 2019, p. 4). Here, we observe that incumbent firms can follow multiple transfer affordances with the same digital technology—both simultaneously or sequentially.

2.5.3. Contributions to affordance theory

Our study contributes to affordance theory in multiple ways. First, by employing affordance logic to the inter-organizational transfer of digital technologies in CVC and OI relations, we identify contextual factors of affordances along three phases: the emergence, recognition, and integration of affordances. With regard to affordance emerging, we identify contextual

determinants of affordances in CVC and OI, reflecting incumbent firms' objectives and digital technology characteristics of entrepreneurial ventures. Further, our study sheds light on the process of affordance recognition. Prior work has elaborated on the importance of recognizing affordances as a precondition for their actualization (Strong et al., 2014). However, literature has noted that the understanding of affordance recognition remains an unresolved theoretical issue (Volkoff & Strong, 2018). Drawing upon our dyad-level research design, we asked respondents about specific use potentials that were recognized with ventures' digital technology. In this vein, we identified specific transfer affordances for the realization of digital innovation objectives (Fitzgerald et al., 2014). Moreover, with the integration of affordances, our findings advance the understanding of conditions necessary for affordance actualization. Affordance actualization refers to the actual use of the digital technology of the venture, which is the required action for realizing goal-directed outcomes (Henningsson et al., 2021). However, we observe that—in the context of the inter-organizational transfer of digital technologies—actors such as incumbent firms have to *integrate* affordances—that is, to make affordances actionable for actualization. Importantly, this phase differs from what Du et al. (2019) term as the *experimentation* phase preceding the actualization of affordances. While Du et al. (2019) examine the implementation of Blockchain technology in single organizational settings, we adopt an inter-organizational view on affordances arising from digital technologies. Here, while experimentation can serve as an objective, we find that organizational actors employ specific *transfer practices*—including the formation of cross-organizational teams as well as varying degrees of digital recombining and digital reprogramming—that incumbent firms employ to integrate affordances that arise from relations of their business units with digital technologies of entrepreneurial ventures. Additionally, our study highlights the role of CVC/OI units as facilitators of the affordance-actualization process between business units of incumbent firms and entrepreneurial ventures.

2.5.4. Practical implications

Throughout our interviews, we observed that incumbent firms do oftentimes have difficulties in articulating the value adding of partnerships with entrepreneurial ventures. For example, our respondent from Xi-Corp stated:

"That is of course always difficult to say: well, how many start-ups can we bridge inside… or something like that. (…) How many start-ups can we connect… how many projects we can launch? Essentially with our project-based approach. What then is important is to be able to illustrate that a little… like: okay, what did we bring about? What did the collaboration with the start-up bring to us… the fact that we have a project there? What is the effect on the end customer… on [Xi-Corp]? (…)." **– (X1, Xi-Corp)**

Our findings can help managers in positioning CVC and OI relations with new ventures as important instruments for digital innovation. Drawing upon our insights, managers should articulate digital innovation as a concrete value adding outcome of CVC and OI relations and foster the integration of their activities with business units of the corporate parent. The recognition of partnerships with new ventures as a driver of digital innovation can increase its legitimacy at the incumbent firm and thereby the allocation of corporate resources (Souitaris & Zerbinati, 2014). Further, viewing CVC and OI relations from an affordance perspective increases the awareness of incumbent firms and ventures on the transfer potential of digital technologies. Concretely, our findings can help incumbent firms in improving digital technology transfer by highlighting the importance of transfer affordances related to the three building blocks of digital transformation: the digital optimization of operational processes, the development of digital products, services, and business models, and the digital enhancement of customer experiences (Fitzgerald et al., 2014).

In this context, our findings suggest that CVC and OI managers should involve functional experts of business units in their activities from early on. Functional experts have the appropriate expertise for recognizing purposeful affordances that may arise from the relation between the incumbent firm and digital technologies from ventures. By doing so, CVC and OI managers can ensure that resources are only committed to those CVC and OI agreements with

digital ventures, which own digital technologies that exhibit purposeful action potentials for business units of the incumbent firm. Furthermore, prior studies have mainly examined the role of CVC and OI managers in the front-end process of collaborations with ventures, which includes scouting relevant ventures and negotiating collaboration agreements (Basu et al., 2016; Souitaris & Zerbinati, 2014). However, our results indicate that it is also important to involve CVC and OI managers in the later stages where the actual transfer of the digital technology happens (i.e., in the affordance integration phase). Concretely, our case examples show that CVC and OI managers can successfully facilitate digital technology transfer processes as project managers, who are able to build the bridge between the incumbent firm and the digital venture.

2.5.5. Limitations and future research directions

Our study has to be regarded under the consideration of its limitations. First, as we investigate a limited number of cases, it is possible that we missed some specific digital innovation objectives that incumbent firms follow with CVC and OI relations. However, in regard of extant literature, other digital innovation objectives should reflect one of the three digital innovation affordances, which we identified (Fitzgerald et al., 2014). Second, the qualitative nature of our study limits the informational value about digital innovation success of CVC and OI relations at a larger scale. Now, based on our insights, research can employ quantitative research designs to test the general effect of CVC and OI relations on the digital improvement of operational processes, the digital enhancement of customer experiences, and the development of digital products, services, and business models. Here, the investigation at the portfolio-level could provide interesting insights. Third, we concentrate on an affordance lens. While future studies can broaden the theoretical scope of our study, we trust that our application of affordance logic to the inter-organizational transfer of digital technologies in CVC and OI relations opens up future research directions in the context of other technology transfer settings. For example,

future research could adopt an affordance lens to provide a better understanding of technology transfer in university-industry collaborations (Fini et al., 2019), and entrepreneurial ecosystems (Autio et al., 2018). Fourth, we concentrate on partnerships between incumbent firms and entrepreneurial ventures in the form of CVC (i.e., equity-based) and OI (i.e., non-equity-based) relations. While we generally examine the unfolding of the digital technology transfer, which appears to be very similar between both organizational forms of partnership, we do not theorize on specific differences resulting from differing contractual arrangements. However, we find some indications that a CVC investment can be advantageous for intensifying the collaboration. For example, our respondent from Theta-Venture explained:

"The [CVC unit of Theta-Corp] has provided has with a great access to the finance industry, and into Theta-Corp too (…). Without the CVC investment, we probably wouldn't have hit so many different places in [Theta Corp] so quickly because we just wouldn't have been able to get in as quickly." **– (T2, Theta-Venture)**

Future research could theorize upon how differences in formal settings of inter-organizational relations between incumbent firms and entrepreneurial ventures can lead to variations in the unfolding of the collaboration and, ultimately, performance implications.

CHAPTER 3

Study 2 – Evaluating Affordance-Based Opportunities: A Conjoint Experiment of Corporate Venture Capital Managers' Decision-Making

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Abstract

We integrate opportunity evaluation reasoning with affordance theory to develop a nuanced theoretical model of action orientation in entrepreneurial decision-making. We test our model with a conjoint experiment of 864 decisions made by 54 corporate venture capital (CVC) managers evaluating digital ventures for investment. Our findings provide evidence that CVC managers value two sources of digital affordances: the recombinability and the reprogrammability of digital technologies. The results show that CVC managers individuate affordance-based investment opportunities based on their personal and organizational background. We contribute to a fine-grained understanding of action potentials in the evaluation of opportunities and advance affordance theory through a cognitive judgment perspective.

Keywords: affordance theory, conjoint experiment, corporate venture capital, digital technology, opportunity evaluation

3.1. Introduction

The understanding of opportunity evaluation—that is, the decision of "whether or not a specific set of circumstances represents an opportunity for me or my firm" worth pursuing (Wood & Williams, 2014, p. 576)—is central to entrepreneurship literature. In fact, the evaluation of an opportunity as attractive for its pursuit has been conceptualized as the decision that precedes entrepreneurial action (McMullen & Shepherd, 2006; Shane & Venkataraman, 2000).

The belief of actors about opportunity attractiveness depends fundamentally on the assessment of anticipated outcomes resulting from the prospective exploitation of the opportunity (Haynie et al., 2009; Tumasjan et al., 2013). Under this consideration, an important stream of research has employed the resource-based view (Barney, 1991), studying how entrepreneurial agents evaluate opportunity characteristics that potentially give rise to future resource gains (Haynie et al., 2009; Wood & Williams, 2014). However, while the resource-based view has considerably advanced our understanding about the anticipated gains in future-oriented opportunity evaluations, it does not provide sufficient explanation for concrete *action potentials* arising from opportunities (D'Oria et al., 2021; Kraaijenbrink et al., 2010). Thus, as Wood and McKelvie (2015, p. 271) point out, "we are in need of greater specificity about what actions entrepreneurs think about as they develop future-oriented cognitive representations of the possible effects of taking action." Advancing the understanding about action orientation in opportunity evaluation decisions is crucial as entrepreneurial activity is ultimately an *action-formation process* (Autio et al., 2013; Schade & Schuhmacher, 2022).

Affordance theory offers an intriguing lens to examine *action orientation* in the evaluation of opportunities. Affordances refer to action potentials that arise from the relation between an object (i.e., technology) and a goal-oriented actor (i.e., individual or organization) (Gibson, 1977; Nambisan et al., 2019; Strong et al., 2014). Fundamental to affordance theory is the understanding that the action potential of an object does not arise exclusively from its

technological features, but rather from its *relation* to an actor (Majchrzak & Markus, 2013). To achieve goal-directed outcomes, affordances have to be realized—a process that is understood as "affordance actualization" (Strong et al., 2014). While scholars have studied the emergence of affordances and processes associated with actualizing affordances (e.g., Henningsson et al., 2021; Malhotra et al., 2021), we lack an understanding of how individual actors deem affordances as worthwhile to pursue their actualization and translate them into concrete outcomes. Integrating opportunity evaluation reasoning with affordance theory, we theorize that entrepreneurial agents assess affordances as decision cues in their opportunity evaluation. Specifically, building upon the future-oriented judgment perspective (Haynie et al., 2009), we theorize that entrepreneurial agents consider *outcomes of prospective affordance actualization* (i.e., outcomes of acting upon affordances). That is, entrepreneurial agents envision and assess the potential benefits arising from the successful actualization of affordances after opportunity exploitation. The judgment of whether an opportunity is attractive to act upon is an interpretive process that depends on the cognitive representations of entrepreneurial agents (Gruber et al., 2015; Mitchell & Shepherd, 2010; Williams & Wood, 2015)—a phenomenon that Wood et al. (2014) refer to as *opportunity individuation*. Accordingly, we reason that entrepreneurial agents differ in their evaluation of affordances based on their personal and organizational background as two major influences on their cognitive judgment process (Shepherd et al., 2015).

We test our theorization by examining investment opportunity evaluations of corporate venture capital (CVC) managers. Thus far, research has extensively studied antecedent factors (e.g., Anokhin et al., 2016; Basu et al., 2011; Gaba & Meyer, 2008) and innovation benefits of CVC investments (e.g., Dushnitsky & Lenox, 2005; Smith & Shah, 2013; Wadhwa & Kotha, 2006). However, fewer studies have investigated how CVC investment decisions are made. Specifically, we lack knowledge on how CVC managers—acting as corporate entrepreneurial agents (Basu et al., 2016; Dokko & Gaba, 2012)—evaluate ventures as investment

opportunities. In essence, a CVC investment opportunity represents an opportunity for the pursuit of a corporate entrepreneurial activity, allowing incumbent firms to collaborate with new ventures and thereby infuse entrepreneurial inventions and abilities into business units of the corporate parent (Sharma & Chrisman, 1999). Therefore, we theorize that CVC managers evaluate *affordances* arising from the relation between their corporate parent and the venture's technology to determine the attractiveness of an investment opportunity. In light of the ever-increasing and industry-agnostic aspirations for digital transformation (Amit & Han, 2017), we examine *digital affordances* (Autio et al., 2018; Henningsson et al., 2021)—that is, affordances arising from the redeployment potential of digital technologies—as structural components of opportunity characteristics. In fact, affordances theory has been described as *native* to digital technologies (Nambisan et al., 2019), and has therefore mostly been applied to the context of digital entrepreneurship to date. We examine two specific technological characteristics as sources of digital affordances that CVC managers potentially consider in their evaluation of investment opportunities: the recombinability and the reprogrammability of ventures' digital technologies (Kallinikos et al., 2013; Nambisan, 2017). Recombinability describes the capacity of a digital technology to be combined with other digital and physical artifacts of the CVC parent to produce synergies and new opportunities (Nambisan, 2017; Yoo, 2013). Reprogrammability refers to the potential of a digital technology to be modified and thereby repurposed to new use cases for the CVC parent (Kallinikos et al., 2013). Due to the flexible redeployability arising from these characteristics (Leonardi, 2011), we contend that how CVC managers envision the prospective outcomes of future digital technology adoption is central to their evaluation of investment opportunities. Linking affordance theory with arguments from opportunity individuation literature, we argue that CVC managers evaluate digital affordances differently as a result of their digital technology experience (Gruber et al., 2015), entrepreneurial experience (Walske & Zacharakis, 2009; Warnick et al., 2018), and CVC unit's

dependence on business units (Souitaris & Zerbinati, 2014). We test our hypotheses using a conjoint experiment of 864 evaluation decisions by 54 CVC managers from 44 CVC units and 34 industries (Shepherd & Zacharakis, 1999). To examine differences among CVC managers, we complement our insights with data from a post-experimental survey capturing information on their personal and organizational background.

Our study offers four contributions. First, we propose an *affordance-based model of opportunity evaluation*. Concretely, our theorization and findings suggest that entrepreneurial agents base their opportunity evaluation decisions on the consideration of affordances (i.e., relational action potentials) as structural components of opportunity characteristics. Our affordance-based theorization provides a nuanced understanding about specific action paths that entrepreneurial agents envision upon prospective opportunity exploitation. This insight is essential for the profound understanding of action orientation in entrepreneurial decision-making (Wood & McKelvie, 2015). Second, we advance affordance theory through a *cognitive judgment perspective*. Building upon opportunity individuation literature (Wood et al., 2014), we theorize and find that actors evaluate affordances differently depending on how they cognitively envision and assess outcomes resulting from prospective affordance actualization. This advancement is central to affordance theory, as it can explain why some affordances are actualized and produce concrete outcomes while others are never pursued (Strong et al., 2014; Volkoff & Strong, 2018). Third, we translate *recombinability and reprogrammability*—two affordance-enabling characteristics introduced by information systems (Kallinikos et al., 2013) and digital entrepreneurship literature (Nambisan, 2017)—into a concrete empirical setting. We find support that these digital technology characteristics indicate technological attractiveness for CVC managers. Recombinable and reprogrammable digital technologies create powerful action potentials that allow both high task specialization and scalability (Giustiziero et al., 2022), which CVC managers value positively in their evaluation decisions. Fourth, by

employing the first experimental study with CVC managers, we contribute to the *individual-level understanding of CVC investing*. To date, extant research has largely overlooked the role of CVC managers mainly due to limited access to primary empirical data (Drover, Busenitz, et al., 2017). Investigating CVC investment decisions in real-time, our study sheds light on individual-level differences in the evaluation of ventures as CVC investment opportunities.

3.2. Theory and hypotheses

3.2.1. Opportunity evaluation from an affordance theory perspective

The evaluation of the attractiveness of an opportunity for its pursuit has been understood as a future-oriented judgment of "what will be" after prospective opportunity exploitation (Haynie et al., 2009). Extant entrepreneurial decision-making research has investigated opportunity evaluations along two overarching themes (Williams & Wood, 2015): the environment of the opportunity (i.e., environmental decision cues), and the opportunity itself (i.e., opportunity decision cues). Considering the opportunity environment, researchers have mostly examined the importance of industry-related factors surrounding an opportunity, such as firm entry and exit rates (Wood et al., 2014). Regarding the opportunity itself, an important body of work has employed resource-based theorizing to investigate the attractiveness of characteristics such as value, rarity, and inimitability (Haynie et al., 2009), or resource efficiency and novelty (Wood & Williams, 2014). However, beyond the anticipation of resource benefits, a central theme in opportunity evaluation decisions is *action orientation* (Wood & McKelvie, 2015). Given the understanding of entrepreneurial activity as an action-formation process (Autio et al., 2013; Schade & Schuhmacher, 2022), we argue that the consideration of concrete *action potentials* arising from the future opportunity exploitation is crucial in determining its attractiveness.

We draw upon affordance theory to develop a nuanced understanding of action orientation in opportunity evaluation decisions. Originally introduced by Gibson (1977), affordance theory has entered into academic conversations on human-computer-interactions

(Norman, 1999), information systems (Henningsson et al., 2021; Majchrzak & Markus, 2013), and most recently digital entrepreneurship (Autio et al., 2018; Nambisan, 2017; Nambisan et al., 2019). An affordance describes the "action potential or possibilities offered by an object (e.g., digital technology) in relation to a specific user (or use context) in innovation and entrepreneurship" (Nambisan et al., 2019, p. 3). In other words, an affordance is "what an individual or organization with a particular purpose can do with a technology" (Majchrzak & Markus, 2013, p. 832). Affordances may be nested in other affordances, support other affordances, or even depend on other affordances (Strong et al., 2014). Importantly, affordances refer only to the *potential*, not to the actual use of action potentials (Volkoff & Strong, 2013). Thus, Strong et al. (2014) propose the distinction between affordances (potentials) and actualization processes (realization of potentials). While affordances refer to action potentials arising from an actor-technology relation, actualization describes the process through which actors translate affordances into concrete actions that produce goal-directed outcomes (Volkoff & Strong, 2018). To date, however, affordance theory does not inform us as to how actors assess affordances regarding their attractiveness for actualization. Shedding light on the decision to pursue affordances is critical because affordances might exist and be recognized by actors but not deemed as attractive for actualization. Integrating affordance theory with opportunity evaluation reasoning, we propose that affordances can serve as structural components of opportunity characteristics, which are relational and action oriented in themselves. Resultantly, we reason that entrepreneurial agents value action potentials arising from an opportunity under consideration. In other words, they assess potential actions they can perform in the realm of an entrepreneurial opportunity. Consequently, we posit that the attractiveness of affordances depends on the consideration of outcomes resulting from prospective actualization (i.e., anticipated benefits of *acting upon affordances*). That is, entrepreneurial agents evaluate

affordances as worthwhile for actualization when they consider them to create attractive action paths (Wood & McKelvie, 2015).

3.2.2. CVC managers as corporate entrepreneurial agents

CVC investing is an important corporate entrepreneurial activity that allows incumbent firms to access promising technologies from new ventures and strengthen entrepreneurial abilities of their business units (Sharma & Chrisman, 1999). Incumbent firms typically organize their CVC investment activities in structurally separated units, equipped with CVC managers as corporate personnel in charge of scouting, evaluating, and selecting entrepreneurial ventures for investment (Dokko & Gaba, 2012). In their facilitating role, CVC managers have a "bird's-eye view" on the investment relation between their corporate parent and the entrepreneurial venture (Weber, 2009). They hold responsibility for negotiating investment deals and coordinating activities among actors involved in pre- and post-investment phases (Weber et al., 2016). In other words, CVC managers serve as "entrepreneurial agents in pursuit of effective search and integration" (Basu et al., 2016, p. 149). To ensure legitimacy within their corporate parent (Souitaris & Zerbinati, 2014), CVC managers have to facilitate interactions between business units and ventures that spur innovation and value creation (Dushnitsky & Lenox, 2005; Titus & Anderson, 2018). Under this consideration, we contend that CVC investment opportunities represent opportunities for new product/service development and market entry, which reflect classical corporate entrepreneurial activities (Sharma & Chrisman, 1999). Thus, we conceptualize investment decisions as judgments by CVC managers about pursuing corporate entrepreneurial opportunities for their firm.

3.2.3. Digital affordances and the evaluation of CVC investment opportunities

Given their technology-accessing mandate, we argue that CVC managers value digital affordances arising from the relation between their firm and unique digital technology

characteristics, such as reprogrammability, data homogenization, and self-reference (Kallinikos et al., 2013; Yoo et al., 2010), in their consideration of ventures as investment opportunities.

Reprogrammability describes the capacity to be "accessible and modifiable by (an object) other than the one governing their own behavior" (Kallinikos et al., 2013, p. 359). In this vein, reprogrammability allows the de-coupling between form and function and thus the adaptation of digital technologies for a variety of use contexts (Autio et al., 2018). For example, the company Retresco offers a natural language generation solution that uses data to automatically produce text, which has been reprogrammed to a wide range of uses, such as the automatic generation of product descriptions, insurance reports, and traffic news (Retresco GmbH, 2022). Data homogenization refers to the representation of digital data in bits and bytes, thus disentangling content from medium and enabling the transfer and combination of digital data with heterogeneous technologies (Kallinikos et al., 2013). As such, data homogenization enables the recombinability of digital technologies, that is, "the ability to associate with and build on other digital artifacts or components" (Nambisan, 2017, p. 1038). A well-known example is Google Maps, which has been coupled with digital cameras, connected cars, and other platforms to combine web mapping insights with complementary information for generating new visualizations through "mash-ups" (Yoo, 2013). Self-reference implies that the realization of digital innovation requires only the access, not necessarily the ownership, of digital technologies (Yoo et al., 2010). A prominent example of self-reference is the Internet, which serves as digital infrastructure necessary for developing online platforms. As such, self-reference creates network effects that spur the diffusion—or generativity—of digital innovations (Autio et al., 2018). While we study the importance of reprogrammability and recombinability for CVC managers' evaluations, self-reference is inherently reflected in the inter-organizational transfer of digital technologies.

As a result of these characteristics, digital technologies may offer "uniquely powerful affordances" (Yoo, 2013, p. 231), which CVC managers will value in their evaluation of ventures. Examining investment opportunity evaluations as future-oriented judgments, we theorize that digital affordances determine CVC managers' anticipation of outcomes along three themes: the support of business units for investment sponsoring and post-investment collaboration (Basu et al., 2016); the innovation and market-related benefits following prospective affordance actualization (Dushnitsky & Lenox, 2005; Dushnitsky & Yu, 2022); and, resultantly, the consequences for the legitimacy of CVC investing (Souitaris et al., 2012). By doing so, we conceptualize affordances as building blocks of theoretical mechanisms that explain CVC managers' evaluation of investment opportunities (Bygstad et al., 2016).

3.2.3.1. Recombinability of venture's digital technology

Prior research has found that CVC parents are more likely to gain positive innovation outcomes from investments in ventures that are technologically related to their business units (Basu et al., 2011). Technological relatedness improves social interactions between both parties (Maula et al., 2009), and increases the likelihood for forming subsequent strategic alliances (Van de Vrande & Vanhaverbeke, 2013). Recombinability is an action-enabling capacity that builds upon technological relatedness and allows associating a digital technology with multiple complementary artifacts for the creation of synergies (Nambisan, 2017; Yoo, 2013). As such, recombinability inherently indicates an action-oriented relation between the entrepreneurial venture and business units of the CVC parent. Importantly, recombinability implies *multiple* action potentials with different business units of the CVC parent. Recognizing this potential, CVC managers anticipate a greater likelihood of identifying and convincing business units to support the investment and engage in a later collaboration with the venture. Further, CVC managers anticipate that the actualization of affordances arising from recombinability (i.e., acting upon recombinability) enables digital innovations in core offerings or operations of

business units (Lyytinen et al., 2016), which is a central objective of CVC investing today. The combination of digital and physical artifacts is necessary for realizing digital innovations (Yoo et al., 2010). Recombinability enables the initial affordance of combining the venture's digital technology with multiple digital or physical artifacts from the CVC parent. As the "combining" affordance can be actualized in a variety of ways, CVC managers can anticipate various actualization outcomes. For example, recombination can enhance physical products and services through digital components (Wang, 2022), which ultimately helps increase demand for existing offerings of the CVC parent (Maula, 2007). Similarly, digital technologies from ventures can also be combined with operational tools of business units for optimization, for example, by incorporating automation capabilities into mainstream processes. With these envisioned outcomes, CVC managers expect to fulfill their mandate and thereby increase their legitimacy (Souitaris & Zerbinati, 2014). We hypothesize:

> **Hypothesis 1a:** *Greater recombinability of a venture's digital technology is positively associated with a CVC manager's willingness to invest.*

3.2.3.2. Reprogrammability of venture's digital technology

Extant literature suggests that CVC managers value technological usefulness when considering ventures for investment (Basu et al., 2016; Souitaris & Zerbinati, 2014). Reprogrammable digital technologies are valuable to the corporate parent of CVC units because they can be modified for various use contexts in different business units (Nambisan, 2017; Yoo, 2013). The powerful redeployment potential of reprogrammable digital technologies stems from their unique ontology, which allows modifications in their logical structure (Kallinikos et al., 2013). Concretely, reprogrammability enables the initial affordance of assimilating the venture's digital technology into multiple use contexts of business units. Like recombinability, reprogrammability creates an action-oriented relation between the venture under consideration and business units of the CVC parent firm. In comparison to recombinability, however, this action potential is not grounded on technological complementarity but rather on the potential

for assimilation by business units. Resultantly, CVC managers consider investing into ventures with reprogrammable digital technologies to be attractive for business units, both in terms of pre-deal investment support and post-deal resource commitment. With prospective affordance actualization, reprogrammability allows the generation of new digital offerings or operational tools for the corporate parent, which have the potential to substitute traditional ones (Keil, Autio, & George, 2008; Maula et al., 2013; Schildt et al., 2005). For example, reprogramming digital technologies to new use contexts can enable development of new digital products, services, and business models which have the potential to represent core market offerings or capabilities of the CVC parent firm in the future (Chesbrough, 2002). Exploration is a central objective of CVC investing, which CVC managers emphasize in their evaluation of investment opportunities. In this context, reprogramming can help create pioneering inventions, which research has identified as an outcome of CVC investments (Van de Vrande et al., 2011). We posit:

> **Hypothesis 1b:** *Greater reprogrammability of a venture's digital technology is positively associated with a CVC manager's willingness to invest.*

3.2.4. Individuation of affordance-based investment opportunities by CVC managers

Researchers have conceptualized opportunity evaluation as an *individuation process*, suggesting that "evaluation rules are person-centric, as individuals interpret what each cue-rule relationship means for them and for their businesses given their idiosyncratic characteristics" (Williams & Wood, 2015, p. 225). That is, the evaluation of opportunities is subject to individual interpretations of entrepreneurial agents. Accordingly, we propose that interpretive judgments of entrepreneurial agents about the worthiness of pursuing affordances for actualization through investment opportunities depend on their personal and organizational background. Concretely, we theorize on a cognitive judgment perspective on affordances, arguing that actors envision outcomes of prospective affordance actualization differently based

on cognitive frames that are influenced by prior experiences and current circumstances (Wood & McKelvie, 2015). Entrepreneurial decision-making research suggests that CVC managers are influenced by two sources in their individuation process. First, extant research has found that personal experiences accumulated during prior jobs influence the decision-making of venture capital (VC) investors (Franke et al., 2006), which most likely applies to the individuation process of CVC managers as well. Second, extant research highlights that actors differ in their organizational backgrounds, which presumably influences their decision-making too (Shepherd et al., 2015). Unlike independent VCs, CVC managers serve as corporate personnel of CVC units (Dushnitsky & Shapira, 2010), which are part of corporate parents that organize them differently in terms of structure and objectives—aspects that determine the mandate of CVC managers (Souitaris & Zerbinati, 2014). Thus, heterogeneity between CVC units can explain differences in CVC managers' individuation of investment opportunities.

3.2.4.1. Digital technology experience of CVC managers

We examine the digital technology experience of CVC managers as a task-specific type of personal background experience (Marvel & Lumpkin, 2007). CVC managers serve as technology scouts who often have long-standing experience of working with newest technologies from their prior educational and professional occupations (Dokko & Gaba, 2012). Research shows that individuals with technological backgrounds emphasize functional benefits of innovations (Dougherty, 1992), which leads them toward employing a product-centric view in their evaluation of entrepreneurial opportunities (Gruber et al., 2015). We argue that this mindset, alongside their ability to perform digital technology tasks, leads CVC managers with greater digital technology experience to pay particular attention to powerful digital affordances offered by recombinability and reprogrammability in opportunity evaluation decisions. We expect that CVC managers with greater digital technology experience are well aware of the benefits that the prospective actualization of digital affordances can generate for business units

and ultimately for the CVC unit itself. Their task-specific experience with digital technologies broadens the envisioning of potential use cases that arise from the recombinability and reprogrammability of digital technologies, beyond originally intended designs by the entrepreneurial venture (Garud et al., 2008). In this regard, digital technology experience increases CVC managers' salience of technological benefits resulting from prospective affordance actualization (Dushnitsky & Lenox, 2005). Moreover, their digital literacy is expected to lead to self-selection of tasks in which CVC managers can make use of their digital technology skills (Blau, 1999; Gruber et al., 2015), such as the affordance actualization process in the post-investment phase. While CVC managers act as facilitators between business units and ventures (Weber, 2009), their digital technology skills can help them to become more actively involved in the actualization process. In this vein, CVC managers anticipate to make a stronger contribution in the integration phase, which, together with the envisioned technological benefits, increases their legitimacy within the corporate parent. We hypothesize:

> **Hypothesis 2:** *The positive relationship between a) recombinability and b) reprogrammability of a venture's digital technology (digital affordances) and willingness to invest is stronger for CVC managers with greater digital technology experience.*

3.2.4.2. Entrepreneurial experience of CVC managers

Similar to VC investors, some CVC managers have founded a venture prior to joining a CVC unit and can therefore draw upon their personal entrepreneurial experience (Maula et al., 2005). As founders accumulate valuable experiences while starting a new business, entrepreneurial experience has been found to influence investment decision-making (Gruber et al., 2015; Walske & Zacharakis, 2009; Warnick et al., 2018). Researchers have shown that entrepreneurs favor opportunities that are novel and allow the most efficient use of resources (Wood & Williams, 2014). As novel and action-oriented characteristics, recombinability and reprogrammability inherently reflect the potential for efficient redeployment of digital technologies over time (Helfat & Eisenhardt, 2004). The multiplicity of affordances arising

from recombinability and reprogrammability creates a variety of actualization options over time, which increases entrepreneur CVC managers' confidence for a desired pathway following the investment decision (Mitchell & Shepherd, 2010). Continuously identifying relevant use cases is particularly important for digital technologies, which are typically generative and ever-evolving in their nature (Garud et al., 2008; Von Briel et al., 2018). CVC managers with entrepreneurial experience have an increased awareness that ventures typically fail when they are unable to design inventions that find applications in relevant markets (Artinger & Powell, 2016). Hence, greater entrepreneurial experience leads CVC managers to value market-related benefits resulting from the prospective actualization of digital affordances arising from a CVC investment (Dushnitsky & Yu, 2022). Specifically, entrepreneur CVC managers consider digital affordances as enabling potentials for successfully deploying and scaling inventions into existing or new markets (Huang et al., 2017). In addition, entrepreneurs typically adopt a more optimistic view on opportunities than individuals without entrepreneurial experience (Palich & Bagby, 1995). This optimism makes CVC managers more confident that the actualization of digital affordances successfully yields market-related benefits. We posit:

> **Hypothesis 3:** *The positive relationship between a) recombinability and b) reprogrammability of a venture's digital technology (digital affordances) and willingness to invest is stronger for CVC managers with greater entrepreneurial experience.*

3.2.4.3. CVC unit dependence on business units of the corporate parent

Beyond the personal background, CVC managers are likely to be influenced by their organizational background—as reflected in the setting of their CVC unit—when evaluating investment opportunities (Dushnitsky & Shapira, 2010; Shepherd et al., 2015). CVC units typically exhibit differences in their structure and objectives, as opposed to independent VCs which are relatively homogeneous in these respects (Drover, Busenitz, et al., 2017). CVC units differ particularly in their dependence on business units of the corporate parent, which is reflected in the extent to which approvals for final investment decisions are needed, and

relatedly, the mandated involvement of business units in the post-investment phase (Hill et al., 2009).

First, while some CVC units require business unit sponsors for financing investments, others are equipped with a dedicated investment fund (Strebulaev & Wang, 2021). With a sponsoring approach, business units are already involved in the due diligence process, provide concrete referrals, and take important positions in investment committees that have to sign-off deals brought forward by CVC managers (Souitaris & Zerbinati, 2014). With investments from a dedicated fund, CVC units are largely autonomous and are usually able to realize investments without extensive involvement of business units, who then typically garner only minor roles in investment committees. Second, in the post-investment phase, CVC units may either act mostly as independent advisors to investee ventures or their key mandate may be to spur technological collaborations with business units. The dependence on business units determines the extent to which CVC managers seek legitimacy from their corporate parent (Jeon & Maula, 2022; Souitaris et al., 2012). Research suggests that with greater dependence, CVC units emphasize technology-accessing objectives more strongly (Souitaris & Zerbinati, 2014). This equips CVC managers with a clear mandate to scout and source ventures with technologies relevant to business units (Basu et al., 2016). Given this mandate, we argue that CVC managers evaluate ventures offering technologies with great redeployment potential more positively. As digital affordances indicate powerful and action-oriented redeployment potentials, CVC managers expect that business units are more willing to support investments enabling that potential. Furthermore, CVC managers regard the prospective actualization as a means of successfully nurturing business units with new digital technologies, be it for seizing market opportunities or internal operational redeployment. We hypothesize:

> **Hypothesis 4:** *The positive relationship between a) recombinability and b) reprogrammability of a venture's digital technology (digital affordances) and willingness to invest is stronger for CVC managers from CVC units with greater dependence on business units of the corporate parent.*

3.3. Method

3.3.1. Metric conjoint experiment

We employed a metric conjoint experiment to capture CVC manager evaluations of investment opportunities (Shepherd & Zacharakis, 1997, 1999). Conjoint experiments allow real-time investigations of individual decision-making processes, overcoming methodological shortcomings of post hoc methods, which are subject to biases inherent in retrospective reporting (Zacharakis & Shepherd, 2001). In the last two decades, conjoint experiments have been established as an important methodology to study entrepreneurial decision-making in different contexts (Lohrke et al., 2010; Shepherd, 2011), including, for example, opportunity evaluation (e.g., Haynie et al., 2009; Wood et al., 2014), project terminations (Behrens & Patzelt, 2016), and VC financing (Lohrke et al., 2010). In the VC context, conjoint experiments have been proven to be helpful to decompose the criteria that investors use in their evaluation of ventures (Zacharakis & Meyer, 1998). For instance, researchers used conjoint experiments to analyze how VC investors evaluate business plans (Franke et al., 2006), the probability of new venture survival (Zacharakis et al., 2007), venture teams (Franke et al., 2008), founder passion (Warnick et al., 2018), and technological quality signals (Hoenig & Henkel, 2015).

While well established in entrepreneurship and VC literature, conjoint experiments have not found application in the CVC setting as of yet. Most extant research draws upon secondary data to analyze firm- and industry-level factors present in CVC investment dynamics (Jeon & Maula, 2022), thereby overlooking the role of CVC managers as key decision-makers. Therefore, researchers have called for an individual-level examination of CVC investment decisions, albeit recognizing the difficulty in gaining access to primary empirical data in this respect (Drover, Busenitz, et al., 2017). Like independent VC investors, CVC managers typically screen and evaluate a large number of ventures for each investment. In fact, the vast majority of refusals likely occurs after individual screening by CVC managers (Strebulaev &

Wang, 2021). In this regard, examining CVC managers' evaluation decisions has great potential to enrich CVC research by a fine-grained individual-level view.

3.3.2. Conjoint instrument design

We put CVC managers into the situation where they were evaluating a digital venture for an initial investment. To control for general investment criteria, we stated that each venture under consideration owns a novel digital technology that has generated interest for an initial investment and fits with the search fields, a growing market, and the geography in which their firm invests. In addition, we noted that each evaluation decision is made contingent upon a favorable due diligence outcome (Drover, Wood, & Zacharakis, 2017). We highlighted that each investment opportunity is equal in all aspects other than four characteristics: recombinability, reprogrammability, venture team experience, and the possibility of syndication with an independent VC investor. While we theorized on recombinability and reprogrammability, we included venture team experience and the possibility of syndication with an independent VC investor as control variables (Basu et al., 2016; Souitaris & Zerbinati, 2014).

As our metric conjoint design encompasses four attributes varied at two levels each (Shepherd & Zacharakis, 1999), a full fractional design requires respondents to evaluate 16 (2^4) profiles. Prior studies have found that lengthy conjoint experiments cause respondent fatigue, which negatively affects response quality (Reibstein et al., 1988). To ensure the feasibility of our experiment, we employed an orthogonal fractional factorial design, reducing the number of conjoint profiles from 16 to 8 (Hahn & Shapiro, 1966). In line with prior studies (e.g., Warnick et al., 2018), we included two detailed profiles with comprehensive descriptions of the decision attributes to introduce respondents to the evaluation tasks in advance. We excluded answers on these two profiles in our analysis. To mitigate potential order biases (Chrzan, 1994), we created three different versions of the conjoint experiment and also randomized the order of attributes per venture profile for each respondent. Moreover, to be able to analyze test-retest reliability,

we replicated all venture profiles (Aiman-Smith et al., 2002). In total, the respondents evaluated 18 venture profiles (two practice, eight summary, and eight replicated profiles). To ensure that our respondents understood the decision attributes, we asked them afterwards to classify two exemplary digital technologies as either highly recombinable or reprogrammable.

3.3.3. Sample

We invited 425 CVC managers to participate in our experiment. We contacted them through two channels. First, we used the professional social network LinkedIn. Second, we attended the Global Corporate Venturing (GCV) Digital Forum in January and July 2021 where we were able to connect with CVC managers. The GCV is a platform and data provider for the global CVC industry, which organizes several events for CVC practitioners every year (Global Corporate Venturing, 2021). Overall, 59 CVC managers (13.9%) participated. Our final usable sample consisted of 54 CVC managers from 44 CVC units and 34 industries. Five responses had to be dropped due to wrong answers on post-experimental understanding questions or very poor test-retest reliability (Holland & Shepherd, 2013). Our sample size is in the range of the recommendation by Shepherd and Zacharakis (1999), who propose that more than 50 respondents are typically sufficient.

3.3.4. Dependent variable—willingness to invest

The dependent variable is the CVC manager's willingness to invest in each investment opportunity (e.g., Murnieks et al., 2011; Warnick et al., 2018). After presenting each hypothetical investment opportunity we asked the respondents: "What is your willingness to invest in this venture?" Respondents indicated their willingness to invest on a 7-point Likert scale, ranging from 1 (low willingness) to 7 (high willingness).

3.3.5. Conjoint decision attributes (level 1)

We asked CVC managers to evaluate hypothetical investment opportunities based on four decision attributes: (1) recombinability of digital technology, (2) reprogrammability of digital technology, (3) venture team experience, and (4) possibility of syndication with an independent VC investor. We defined "low" and "high" levels for each characteristic based on prior definitions and consultation with experts (Table 3). Concretely, to ensure face validity of our experiment (Shepherd & Zacharakis, 1999), we conducted six semi-structured interviews with CVC experts who provided helpful insights into the formulation of the investment scenario, and the selection, labeling, and definition of our decision attributes.

Table 3. **Operationalization of CVC investment opportunity characteristics**

Characteristics	LOW level	HIGH level
Recombinability of digital technology	The venture's digital technology offers little potential for coupling it with complementary technologies from business units of your parent firm and other ventures of your portfolio to create synergies.	The venture's digital technology offers immense potential for coupling it with complementary technologies from business units of your parent firm and other ventures of your portfolio to create synergies.
Reprogrammability of digital technology	The venture's digital technology offers little potential for modifying and thereby repurposing it to other use cases for business units of your parent firm and other ventures of your portfolio.	The venture's digital technology offers immense potential for modifying and thereby repurposing it to other use cases for business units of your parent firm and other ventures of your portfolio.
Venture team experience	The venture team has little experience in successfully developing and commercializing new technologies.	The venture team has great experience in successfully developing and commercializing new technologies.
Possibility of syndication with independent VC investor	Despite the interest of other potential investors, it is not likely that an independent VC investor would join as a syndication partner for co-investing in this venture.	In the midst of the interest of other potential investors, it is very likely that an independent VC investor would join as a syndication partner for co-investing in this venture.

Notes. In Supplemental Appendix B, we present an exemplary detailed profile.

3.3.6. CVC manager variables (level 2)

To shed light on differences among CVC managers in their evaluation decisions, we administered a post-experimental survey to gather personal and organizational background data. First, we collected personal data on general demographics (*age*, *education*, and *gender*) and job experiences, including *tenure* (years), *digital technology experience* (years of working

with digital technologies), *entrepreneurial experience* (years been an entrepreneur), and *investing experience* (years in investing positions). Next, we obtained self-reported information on respondents' CVC units. We gathered data on the *CVC unit dependence on business units of the corporate parent* using the reversed "horizontal autonomy" scale by Hill et al. (2009). Further, we drew upon extant literature on CVC (Hill et al., 2009; Hill & Birkinshaw, 2014) and digitalization (Eller et al., 2020) to include three additional variables: *exploration objectives*, *exploitation objectives*, and *digital strategy objectives*. For all four latent constructs, we used the established scales from the originating articles. We present the exact measures, descriptive statistics, and correlation matrix of all CVC manager variables in Table 4.

3.4. Analysis and results

We used hierarchical linear modeling (HLM) to test our hypotheses (Aguinis et al., 2013; Raudenbush & Bryk, 2002). HLM can capture cross-level effects of (a) level 1: decision-making level and (b) level 2: CVC manager level. Thus, HLM allows not only the examination of the importance of decision attributes, but also testing individual-level differences (e.g., Murnieks et al., 2011; Shepherd, 2011). To account for potential CVC unit-level and industry-level effects, we included fixed-effects for CVC units and industries that have more than one CVC manager represented in our sample (Behrens & Patzelt, 2016). By fully replicating the decision tasks, we obtained two samples with 432 decisions each (main test and retest). We used the results from the pooled sample (864 decisions) for our analysis, as it captures all decisions by our 54 CVC manager respondents. Our sample shows a mean test–retest reliability of 0.866. Other conjoint studies have reported similar results [e.g., 0.813 (Drover, Wood, & Zacharakis, 2017), 0.72 (Holland & Shepherd, 2013), and 0.966 (Warnick et al., 2018)].

Table 4. **Measures, descriptive statistics, and bivariate correlations**

Variables and measures	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Average WTI	3.83	0.62	1.00											
(2) Age	38.24	9.32	–0.17	1.00										
(3) Education	2.70	0.57	–0.28*	0.32*	1.00									
(4) Gender	0.24	0.43	0.09	–0.01	–0.09	1.00								
(5) Job tenure	3.39	3.22	–0.01	0.30*	0.01	–0.24	1.00							
(6) Digital technology exp.	5.69	5.93	–0.03	0.34*	–0.03	–0.31*	0.48*	1.00						
(7) Entrepreneurial exp.	0.74	2.16	–0.14	0.06	0.07	–0.16	0.39*	0.27	1.00					
(8) Investing exp.	4.53	4.48	0.07	0.49*	0.10	–0.29*	0.74*	0.41*	0.35*	1.00				
(9) CVC unit dependence	5.19	1.54	0.24	–0.04	0.01	0.21	–0.27*	–0.21	–0.20	–0.23	1.00			
(10) Exploitation objectives	2.02	0.52	–0.27	–0.12	0.07	–0.06	–0.10	–0.14	0.11	–0.10	–0.12	1.00		
(11) Exploration objectives	2.87	0.38	0.02	–0.08	–0.09	–0.09	0.12	0.14	0.06	0.10	0.12	0.22	1.00	
(12) Digital strategy objectives	4.30	0.72	0.21	–0.19	–0.42*	–0.18	–0.03	–0.01	–0.00	–0.05	0.02	0.16	0.16	1.00

Notes. Matrix based on the full sample of 54 CVC managers. Bivariate correlations were calculated with grand-mean centered variables. Mean values and SDs were calculated with unstandardized variables for better comprehension. Gender: 1 = female, 0 = male. Education: 1 = no college degree, 2 = undergraduate degree, 3 = graduate degree, and 4 = doctoral degree. Of our respondents, 19 held an undergraduate degree (35.2%), 32 a graduate degree (59.3%), and 3 a doctoral degree (5.5%). Examples of digital technologies provided to CVC manager respondents for reporting years of experience in working with digital technologies included Big Data & Analytics, Blockchain, Cloud Computing, Internet of Things, Machine Learning, Mobile Technology, Social Media, Virtual Reality & Augmented Reality, and 3D Printing. Overall, 21 CVC managers had founded a venture, and among them, their average time of being an entrepreneur was 5 years. In our final sample, 29 respondents were from Europe (53.7%), 12 from North America (22.2%), 8 from Asia (14.8%), and 5 from Latin America (9.3%). To examine the adequateness of the four latent constructs (CVC unit dependence, exploitation objectives, exploration objectives, and digital strategy objectives), we conducted a confirmatory factor analysis (Supplemental Appendix C). WTI = willingness to invest. *$p < .05$.

We report the results in three steps. First, we report the HLM results for all main and cross-level interaction effects (Table 5), where the coefficients reflect the shift in willingness to invest in response to a one unit increase in the respective variables. Second, we report the predicted values of willingness to invest at "low" and "high" levels of the decision attributes (Table 6). In addition, we show the predicted values for combinations of the decision attributes with low (– 1 standard deviation [SD]), mean, and high (+ 1 SD) values of the moderators (Supplemental Appendix D). Third, next to the HLM results for the cross-level interaction effects, we follow Busenbark et al. (2022) and report the average marginal effects of the decision attributes in the presence of, again, low, mean, and high values of the moderators (Table 7).

3.4.1. Main effects

Our results provide evidence for the importance of recombinability (H1a, $\beta = 1.861$, $p < .001$) and reprogrammability of digital technologies (H1b, $\beta = 1.615$, $p < .001$) for CVC managers' willingness to invest. Results from the analysis of predicted values of willingness to invest reveal that CVC managers evaluated profiles with high recombinability most favorably (4.766 out of 7), showing an increase of 64.06% compared to venture profiles with low recombinability (2.905). Similarly, the predicted willingness to invest of venture profiles with high reprogrammability is 4.643, representing an increase of 53.38% in comparison to venture profiles with low reprogrammability (3.027). Our results also demonstrate the importance of the control decision attributes: venture team experience ($\beta = 1.425$, $p < .001$) and the syndication with an independent VC investor ($\beta = 1.157$, $p < .001$).

3.4.2. Differences among CVC managers in investment opportunity evaluations

We examined cross-level interactions to test moderating effects of CVC managers' digital technology experience and entrepreneurial experience, as well as their CVC unit's dependence on business units of the corporate parent (Aguinis et al., 2013).

Table 5. Results: HLM regression

DV: willingness to invest	Coefficient	SE	*p*-Value
Control variables			
Decision attributes			
Venture team experience	1.425***	0.127	0.000
Possibility of syndication with independent VC	1.157***	0.143	0.000
Personal background			
Age	–0.005	0.010	0.615
Education	–0.022	0.188	0.904
Gender (0 = male, 1 = female)	0.325	0.265	0.219
Job tenure	–0.047	0.039	0.228
Digital technology experience	–0.004	0.018	0.814
Entrepreneurial experience	–0.029	0.056	0.604
Investing experience	0.046	0.032	0.147
Organizational background			
CVC unit dependence	0.060	0.084	0.473
Exploitation objectives	–0.431***	0.155	0.006
Exploration objectives	0.320	0.197	0.104
Digital strategy objectives	0.085	0.111	0.444
Main effects			
Decision attributes			
Recombinability (H1a)	1.861***	0.127	0.000
Reprogrammability (H1b)	1.615***	0.111	0.000
Cross-level interaction effects			
Personal background			
Digital technology experience × recombinability (H2a)	0.027*	0.014	0.061
Digital technology experience × reprogrammability (H2b)	0.012	0.012	0.324
Entrepreneurial experience × recombinability (H3a)	0.125***	0.034	0.000
Entrepreneurial experience × reprogrammability (H3b)	0.072**	0.031	0.021
Organizational background			
CVC unit dependence × recombinability (H4a)	0.258***	0.078	0.001
CVC unit dependence × reprogrammability (H4b)	0.028	0.064	0.663
Constant	3.794***	0.126	0.000

Notes. N = 864 decisions (level 1), nested in 54 CVC managers (level 2). Level 1 variables are group-mean centered, and level 2 variables are grand-mean centered. SEs are cluster robust. Experience variables are winsorized at the 1% and 99% levels. CVC unit fixed-effects, industry fixed-effects, and decision round dummy (main test vs. retest sample) are included. The results are generally robust for the main test and retest sample. SE = standard errors. *$p < .1$; **$p < .05$; ***$p < .01$.

Table 6. Predicted values

Variables	Level	Predicted WTI	SE	*p*-value	95% C.I.	
					Lower	Upper
Recombinability	Low	2.905	0.101	0.000	2.707	3.104
	High	4.766	0.072	0.000	4.624	4.907
Reprogrammability	Low	3.027	0.088	0.000	2.853	3.201
	High	4.643	0.076	0.000	4.493	4.793

Notes. "Low" represents -0.5 and "high" represents 0.5 (group-mean centered). CI = confidence interval; WTI = willingness to invest.

We find modest support for the moderating role of digital technology experience on the relationship between recombinability and willingness to invest (H2a, $\beta = .027$, $p < 0.1$). Our results show that in the presence of high digital technology experience, the average marginal effect of recombinability is by 0.161 larger than in the presence of digital technology experience at its mean value (2.022 vs. 1.861), representing an increase of 8.65%. However, we do not find support for the moderating role of digital technology experience on the reprogrammability–willingness to invest relationship (H2b, $\beta = .012$, n.s.). We conclude that digital technology experience strengthens CVC managers' emphasis on recombinability.

Next, we find support for the moderating role of entrepreneurial experience on the relationship between recombinability and willingness to invest (H3a, $\beta = 0.125$, $p < .001$). The average marginal effect of recombinability is by 0.268 larger in the presence of high entrepreneurial experience than in the presence of entrepreneurial experience at its mean value (2.129 vs. 1.861), reflecting an increase of 14.4%. We also find support for the moderating role of entrepreneurial experience on the reprogrammability–willingness to invest relationship (H3b, $\beta = .072$, $p < .05$). The average marginal effect of reprogrammability increases by 0.155 in the presence of high entrepreneurial experience as compared to entrepreneurial experience at its mean value (1.770 vs. 1.615), showing an increase of 9.59%. In sum, our findings suggest that with greater entrepreneurial experience, CVC managers are more sensitive to both recombinability and reprogrammability when evaluating investment opportunities.

In line with our assumptions, we find support for the moderating role of CVC unit dependence on the relationship between recombinability and willingness to invest (H4a, $\beta = 0.258$, $p < .001$). The average marginal effect of recombinability increases by 0.393 in the presence of high CVC unit dependence as opposed to CVC unit dependence at its mean value (2.254 vs. 1.861), and thus by 21.11%. Yet, we do not find support for its moderating role on the reprogrammability–willingness to invest relationship, although the coefficient is positive

(H4b, β = .028, n.s.). Overall, our results indicate that greater CVC unit dependence on business units leads CVC managers to place more emphasis on recombinability in their evaluation of investment opportunities.

In Figure 5, we provide visualizations of the cross-level interactions, including both the predicted values of willingness to invest and the average marginal effects.

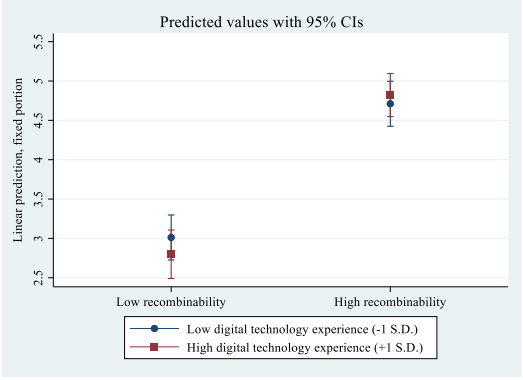
Table 7. Average marginal effects

Variables	Level	dy/dx	SE	*p*-value	95% C.I.	
					Lower	Upper
Recombinability in the presence of digital technology experience	Low	1.699	0.181	.000	1.343	2.054
	Mean	1.861	0.127	.000	1.611	2.110
	High	2.022	0.119	.000	1.788	2.257
Recombinability in the presence of entrepreneurial experience	Low	1.529	0.150	.000	1.297	1.888
	Mean	1.861	0.127	.000	1.611	2.110
	High	2.129	0.142	.000	1.849	2.409
Reprogrammability in the presence of entrepreneurial experience	Low	1.460	0.140	.000	1.184	1.736
	Mean	1.615	0.111	.000	1.397	1.834
	High	1.770	0.118	.000	1.538	2.003
Recombinability in the presence of CVC unit dependence	Low	1.467	0.144	.000	1.184	1.750
	Mean	1.861	0.127	.000	1.611	2.110
	High	2.254	0.199	.000	1.862	2.645

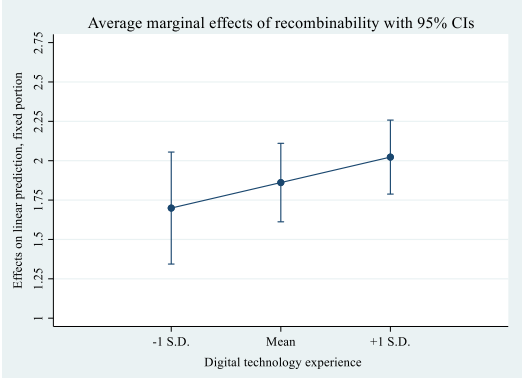
Notes. The different levels refer to respective values of moderating variables at 1 SD below the mean (low), the mean, and 1 SD above the mean (high). Level 1 variables are group-mean centered, level 2 variables are grand-mean centered. SEs based on the Delta-method.

Figure 5. Visualizations of predicted values and average marginal effects

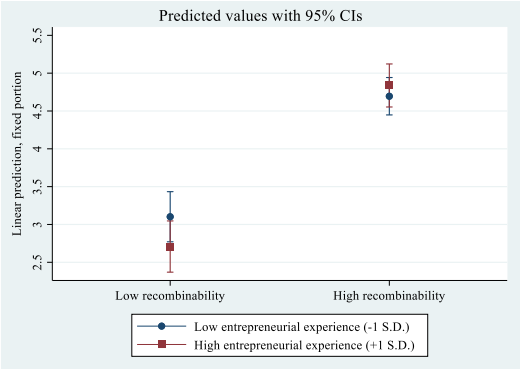
A. Predicted values:
Recombinability and digital technology exp.



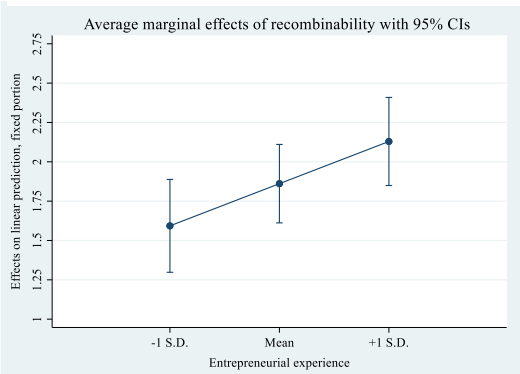
B. Average marginal effects:
Recombinability and digital technology exp.



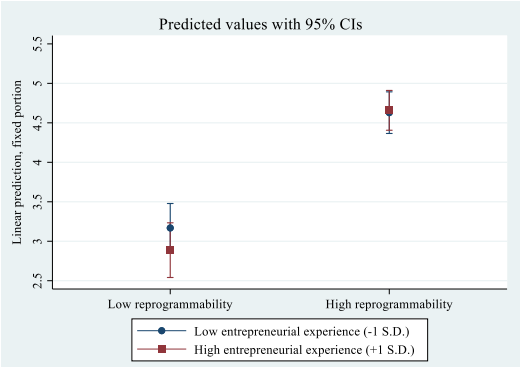
C. Predicted values:
Recombinability and entrepreneurial exp.



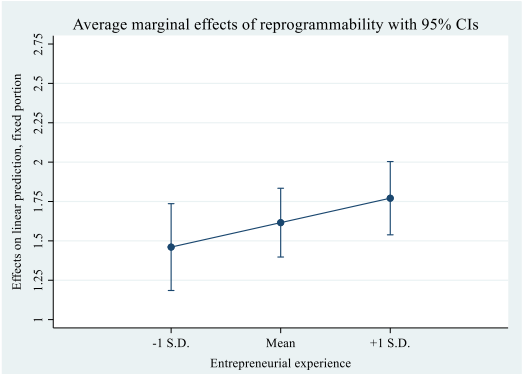
D. Average marginal effects:
Recombinability and entrepreneurial exp.



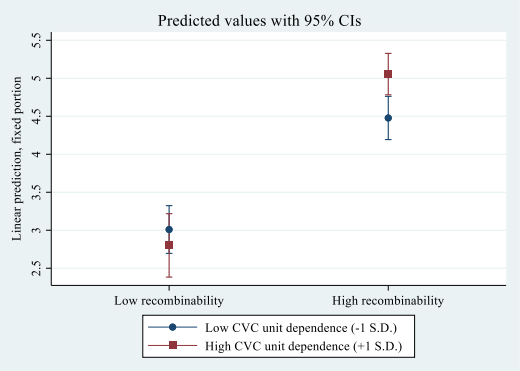
E. Predicted values:
Reprogrammability and entrepreneurial exp.



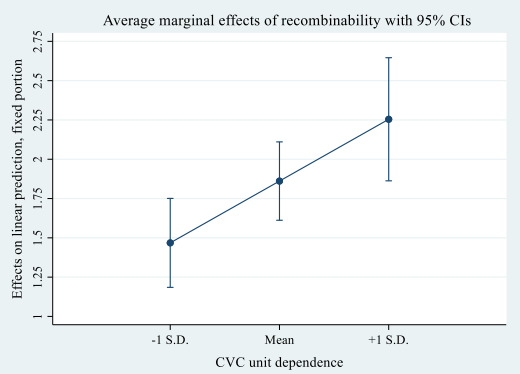
F. Average marginal effects:
Reprogrammability and entrepreneurial exp.



G. Predicted values:
Recombinability and CVC unit dependence



H. Average marginal effects:
Recombinability and CVC unit dependence



3.4.3. Robustness checks

We conducted four robustness checks with alternative variables and specifications (Table 8). First, we dichotomized digital technology experience and entrepreneurial experience, assigning the value of 1 if a CVC manager had more than 5 years of experience and 0 if not (e.g., Kleinert et al., 2021). The results remain robust (Table 8, Model 1). The moderating role of entrepreneurial experience is even stronger for both the relationships of recombinability (β =

1.394, $p < .001$) and reprogrammability ($\beta = 0.734$, $p < .05$). However, the moderating role of digital technology experience on the relationship between recombinability and willingness to invest, which is already modest with the year-based measure in the main analysis (Table 5, $p < .10$), is statistically not significant. Nonetheless, its direction remains positive, in line with our assumption ($\beta = 0.225$).

Second, we applied alternative measures to the experience-based moderating variables. Specifically, we replaced digital technology experience with an equally weighted composite score of digital transformation experience, reflecting job experiences within three domains of digital transformation (Fitzgerald et al., 2014): experience with digital business models, experience with digital customer experience management, and experience with digital operations management. The results indicate a similar effect ($\beta = .056$, $p < 0.1$). The results are also robust for the dichotomized digital transformation experience variable, and in fact become even more pronounced. Furthermore, we replaced entrepreneurial experience with a binary variable (1 if the CVC manager had founded a venture that turned out to be successful, and 0 if not). The results remain robust (Table 8, Model 2) and are even stronger for both the effects of recombinability ($\beta = 1.153$, $p < .001$) and reprogrammability ($\beta = 0.715$, $p < .001$).

Third, we replaced the self-reported measure of CVC unit dependence with an objective measure that takes the value of 1 if the CVC unit of the CVC manager invests off the balance sheet of business units, and 0 if the CVC unit owns a dedicated investment fund. The results remain robust (Table 8, Model 3) and the interaction between recombinability and CVC unit dependence is even stronger ($\beta = 0.736$, $p < .001$). Notably, the hypothesized interaction effect between CVC unit dependence and reprogrammability (H4b), which is not significant with the self-reported measure, receives moderate support ($\beta = 0.420$, $p = .055$).

Fourth, to account for a potential omitted variable bias at the individual-level (Oster, 2019), we ran an ordinary least squares regression with fixed-effects for the 54 CVC managers (level 2 variable). The results remain robust (Table 8, Model 4).

Table 8. Robustness checks

DV: willingness to invest	Model 1 Dichotomous exp. measures	Model 2 Alternative exp. measures	Model 3 Alternative CVC unit dep. measure	Model 4 OLS regression
Control variables				
Decision attributes				
Venture team experience	1.425*** (0.127)	1.425*** (0.127)	1.425*** (0.125)	1.425*** (0.132)
Poss. of synd. with independent VC	1.157*** (0.143)	1.157*** (0.143)	1.157*** (0.134)	1.157*** (0.149)
Personal background				
Age	–0.008 (0.010)	–0.012 (0.011)	–0.006 (0.013)	
Education	0.020 (0.180)	–0.006 (0.193)	–0.103 (0.166)	
Gender (0 = male, 1 = female)	0.440* (0.251)	0.391 (0.237)	0.379 (0.324)	
Job tenure	–0.036 (0.038)	–0.051 (0.036)	–0.028 (0.042)	
Digital technology exp.	0.215 (0.186)	0.027 (0.023)	–0.003 (0.026)	
Entrepreneurial exp.	–0.575 (0.428)	–0.207 (0.359)	–0.019 (0.060)	
Investing exp.	0.036 (0.027)	0.045* (0.025)	0.038 (0.043)	
Organizational background				
CVC unit dep.	0.088 (0.081)	0.066 (0.080)	–0.016 (0.275)	
Exploitation objectives	–0.353** (0.163)	–0.343* (0.177)	–0.297 (0.219)	
Exploration objectives	0.238 (0.204)	0.227 (0.228)	0.051 (0.275)	
Digital strategy objectives	0.083 (0.102)	0.068 (0.112)	0.236 (0.171)	
Main effects				
Decision attributes				
Recombinability	1.861*** (0.129)	1.861*** (0.122)	1.861*** (0.125)	1.861*** (0.132)
Reprogrammability	1.615*** (0.111)	1.615*** (0.110)	1.615*** (0.112)	1.615*** (0.115)
Cross-level interaction effects				
Personal background				
Digital technology exp. × recombinability	0.225 (0.239)	0.056* (0.029)	0.026* (0.014)	0.027* (0.015)
Digital technology exp. × reprogrammability	0.260 (0.216)	0.004 (0.027)	0.015 (0.012)	0.012 (0.013)
Entrepreneurial exp. × recombinability	1.394*** (0.185)	1.153*** (0.277)	0.101*** (0.034)	0.125*** (0.035)
Entrepreneurial exp. × reprogrammability	0.734** (0.303)	0.715*** (0.258)	0.074*** (0.024)	0.072** (0.032)
Organizational background				
CVC unit dep. × recombinability	0.252*** (0.088)	0.261*** (0.076)	0.736*** (0.214)	0.258*** (0.081)
CVC unit dep. × reprogrammability	0.029 (0.064)	0.027 (0.063)	0.420* (0.219)	0.028 (0.067)
Observations	864 (54)	864 (54)	864 (54)	864 (54)
CVC manager fixed-effects	No	No	No	Yes
CVC unit fixed-effects	Yes	Yes	Yes	No
Industry fixed-effects	Yes	Yes	Yes	No
Decision round dummy	Yes	Yes	Yes	Yes
Constant	3.797*** (0.118)	3.763*** (0.130)	3.741*** (0.125)	3.275*** (0.030)

Notes. All models are based on the pooled sample with 864 decisions. Cluster robust SEs in parentheses. Experience variables are winsorized at the 1% and 99% levels. Models 1 and 2 are based on two-level HLM with 864 decisions (level 1), nested in 54 CVC managers (level 2). Model 3 is based on three-level HLM with level 1 and 2 variables nested in 44 CVC units (level 3). Level 1 variables are group-mean centered, level 2 and 3 variables are grand-mean centered. Model 4 based on the original measures (Table 5). The analysis of average marginal effects using the alternative measures (Models 1–3) confirms the results. Results remain generally robust for the main test and retest sample. *$p < .1$; **$p < .05$; ***$p < .01$.

3.5. Discussion

In this study, we develop a theoretical model proposing that entrepreneurial agents consider affordances as decision cues in their future-oriented evaluations of opportunities. We test our theorization by analyzing CVC managers' evaluations of digital ventures as investment opportunities. The empirical results show that digital affordances—grounded in the recombinability and reprogrammability of digital technologies—determine the attractiveness of investment opportunities for CVC managers. We find that CVC managers individuate affordance-based investment opportunities differently based on their personal background (i.e., digital technology experience and entrepreneurial experience) and their organizational background (i.e., CVC unit dependence on business units).

3.5.1. Theoretical implications

Our study makes four important theoretical contributions. First, we develop a *theoretical model of affordance-based opportunity evaluation*. Although action orientation is central to the understanding of entrepreneurial activity (McMullen & Shepherd, 2006), thus far, extant opportunity evaluation research has limited its focus on more generic opportunity characteristics that do not explicitly imply potentials for action (Wood & McKelvie, 2015). Integrating opportunity evaluation reasoning with affordance theory, we theorize and show that entrepreneurial agents develop decision rules around affordances (i.e., relational action potentials) as structural components of opportunities. Complementing the resource-based view (Haynie et al., 2009), affordance theory advances the understanding of opportunity evaluation through an explicit consideration of relationality and action orientation, which allows theorizing on concrete action paths that entrepreneurial agents anticipate with opportunity exploitation. While resources reflect capacities that build the foundation for actions (Kraaijenbrink et al., 2010), affordances are concrete action potentials arising from the relation between an object (i.e., technological resource) and an actor (i.e., individual or organization) (Majchrzak &

Markus, 2013). In affordances terminology, resources provided by the opportunity under consideration represent the "object," and therefore the functional determinant of affordances (Volkoff & Strong, 2013). Yet, for an affordance to arise, it requires not only an object or technology with certain features, but also an individual or organizational actor with specific predispositions. In this regard, while we extend the notion of opportunity evaluation to corporate entrepreneurial actions (Shepherd et al., 2015), our theorizing can help generate important insights for other entrepreneurial decision-making contexts where affordances can represent opportunity characteristics (e.g., new venture creation or internationalization).

Second, we contribute to affordance theory by adding a *cognitive judgment perspective*. Despite insights into the emergence (e.g., Majchrzak & Markus, 2013; Malhotra et al., 2021) and actualization of affordances (e.g., Henningsson et al., 2021; Strong et al., 2014), we lack a theoretical understanding of the process through which actors evaluate the worthiness of affordances for pursuing their actualization. Recent literature suggests that before being able to actualize an affordance, actors need to observe and perceive the affordance in the first place (Henningsson et al., 2021). However, affordance perception relates to the mere cognitive awareness of an affordance's existence (Volkoff & Strong, 2018). Building upon opportunity individuation research (Wood et al., 2014), we advance affordance theory through a cognitive judgment perspective—that is, we theorize and show the importance of actors' interpretive assessments about the worthiness of affordances to pursue their actualization. Opportunity individuation research suggests that personal and organizational backgrounds influence how actors cognitively view opportunity characteristics (Shepherd et al., 2015). In this regard, we hypothesize and find that actors with different personal and organizational backgrounds differ in their evaluation of affordances as structural components of opportunity characteristics. Concretely, our theorization and findings suggest that personal job experiences and organizational settings determine what outcomes actors cognitively envision from prospective

affordance actualization in their future-oriented assessments. Their cognitive envisioning predisposes whether actors consider affordances as attractive for actualization. The cognitive judgment perspective is crucial for understanding the affordance-actualization process. The actual decision to pursue an affordance is an overlooked, yet critical condition of affordance actualization. Our theoretical insights into how affordances are evaluated help to understand why typically only a few affordances—out of bundles of affordances arising from actor-technology relations (Strong et al., 2014)—are pursued for actualization and produce concrete outcomes. Thus, we establish the evaluation process as an important step that precedes actualization and highlights the importance of interpretive judgments in affordance theory.

Third, we *theorize upon the recombinability and reprogrammability of digital technologies* (Kallinikos et al., 2013; Nambisan, 2017). Through our experimental operationalization, we were able to anchor affordances into these two observable digital technology characteristics and test their attractiveness for CVC managers. Our findings provide evidence that CVC managers value the powerful redeployment potential reflected by high recombinability and reprogrammability (Helfat & Eisenhardt, 2004). Although digital technologies can serve as "scale-free and fungible" resources (Giustiziero et al., 2022, p. 5), it is important to note there are theoretical differences between the concepts of resource fungibility on the one hand and recombinability and reprogrammability on the other hand. While resource fungibility reflects the general capacity of resources to get redeployed, recombinability and reprogrammability are relational constructs that suggest concrete action potentials. Resource fungibility literature distinguishes between externally fungible resources, which can be redeployed between firms due to their low specificity (e.g., cash) and internally fungible resources, which are created for specific purposes and exhibit high stickiness (e.g., brands), enabling their transfer within firms (Nason & Wiklund, 2018). Due to their unique ontology (Kallinikos et al., 2013), recombinable and reprogrammable digital technologies

outgo the limiting boundary conditions inherent to external and internal fungibility. On the one hand, recombinable and reprogrammable digital technologies can accomplish highly specific tasks while providing the capacity to be redeployed across firms (i.e., external fungibility). On the other hand, such digital technologies can be redeployed between business units of a firm (i.e., internal fungibility), as they are typically generative and "incomplete by design" (Garud et al., 2008). However, while technological resources serve as functional determinants of affordances, the capacity of actors (i.e., individuals or firms) for assimilation and recombination is equally important for the emergence of affordances. From a Penrosian perspective, the acquisition of novel resources by firms increases their capacity for future resource assimilation and recombination (Penrose, 1955). Accordingly, the actualization of affordances enforces the capability and resource basis of actors, which allows the emergence of powerful affordances from future actor-technology relations (Strong et al., 2014).

Fourth, by empirically examining the decision-making process of CVC managers as corporate entrepreneurial agents, we contribute to an *individual-level understanding of CVC investing*. Prior studies have analyzed firm- and industry-level drivers of CVC investment activity (Jeon & Maula, 2022), thus largely neglecting the role of CVC managers as important decision makers in the CVC investment process. Research on CVC managers is mostly limited to their general responsibilities (Weber, 2009), and differences to independent VCs (e.g., Dushnitsky & Shapira, 2010; Hill et al., 2009). Resultantly, researchers have increasingly called for an examination of CVC managers as corporate entrepreneurial agents in the investment decision-making context (Basu et al., 2016; Drover, Busenitz, et al., 2017). Employing the first experiment with CVC managers, we analyzed their real-time evaluation decisions of investment opportunities. We provide evidence for individual-level differences in the evaluation decisions based on prior digital technology experience and entrepreneurial experience, highlighting the importance of human capital in CVC investing (Marvel et al., 2016). Moreover, we show that

CVC unit dependence on business units also influences the evaluation of investment opportunities. Therewith, our results advance the understanding about implications of structural differences between CVC units, which is an underexplored theme to date. Additionally, next to recombinability and reprogrammability, we provide quantitative evidence for venture team experience and VC syndication—our control decision attributes—as two investment criteria identified by prior qualitative studies (Basu et al., 2016; Souitaris & Zerbinati, 2014).

3.5.2. Practical implications

Both CVC units and ventures can derive guidance from our results. Our findings can help CVC units in selecting CVC managers. Through a more detailed understanding of how CVC managers with specific personal backgrounds evaluate investment opportunities, CVC units can improve staffing decisions to hire CVC managers who fit with their investment strategy. Similarly, CVC managers can use our findings to explore their decision-making in greater detail and thereby develop tools that screen and filter investment opportunities more efficiently. Understanding how CVC managers evaluate investment opportunities is also critical for ventures that aim to attract CVC investments and thereby tap into unique resources and value-added services from CVC parents (Di Lorenzo & Van de Vrande, 2019; Uzuegbunam et al., 2019). The results suggest that ventures can increase their attractiveness for CVCs by designing digital technologies with strong redeployment potentials, hiring experienced team members, and convincing independent VCs to join as co-investors. Here, ventures have to ensure the clear communication of digital technology characteristics, particularly when negotiating with CVC managers who possess greater digital technology experience and entrepreneurial experience, or who are employed in CVC units that depend on business units of their corporate parent.

3.5.3. Limitations and future research

As with all research, our study is not without limitations. First, while our conjoint experiment serves as a powerful method to de-compose decision-making processes (Shepherd & Zacharakis, 1999), our investment profiles represent hypothetical, not real, venture profiles. Future research could employ field experiments or single case studies where CVC managers are accompanied throughout an evolving investment decision, or where archival data on prior investment decisions are made available. Importantly, although the conjoint experiment method is established in entrepreneurship research (Lohrke et al., 2010), we are the first to use it for studying CVC managers' investment decisions. Our study opens opportunities for future CVC research using conjoint experiments combined with post-experimental surveys to provide rich insights into CVC decision-making processes that are not yet fully understood. For example, future studies could employ conjoint experiments to study how CVCs make decisions on follow-on investments, exits of portfolio ventures, or entry into syndication networks (Keil et al., 2010). Second, while we find support for most moderating hypotheses, the effect sizes of the experience-based moderations are relatively small, and the overlap of the confidence intervals is considerable. The experience-based moderators are based on numbers of years, which reflect natural values not bounded to any scales. Therefore, the results show that a one unit (i.e., 1 year) increase in experience, as reflected by the HLM interaction coefficients, does not make an extensive difference in evaluation decisions. Rather, it is the accumulation of experience that leads to greater differences in this respect. In fact, the effect sizes from the robustness checks, where we used dichotomized experience measures, indicate support for this assumption. Future research could provide helpful insights by examining how opportunity evaluation decisions change with the accumulation of experience over time, for example, by employing longitudinal study designs that capture evaluations at multiple points of time (Williams & Wood, 2015). In addition, future studies could examine the influence of other

types of CVC managers' experience (e.g., VC or acquisition experience) on their decision-making. Third, in line with extant opportunity evaluation research, we limited our theoretical scope on first-person opportunity beliefs—that is, the evaluation of opportunities for "me or my firm." (Haynie et al., 2009; Wood & McKelvie, 2015; Wood & Williams, 2014). Future studies could examine the preceding opportunity recognition phase, specifically by theorizing upon how (corporate) entrepreneurial agents identify third-person opportunity beliefs (i.e., opportunities for others), which can emerge to first-person opportunity beliefs (McMullen & Shepherd, 2006). Fourth, we theorized upon affordances as opportunity decision cues. Future research could adopt an environmental-level perspective on affordance reasoning, for instance, by studying how entrepreneurial agents consider digital and spatial affordances at the ecosystem level in the evaluation of opportunities (Autio et al., 2018). Fifth, we analyzed CVC investment decisions without examining performance implications. Based on our findings, future studies can test outcomes of CVC investments in ventures characterized by our decision attributes at the dyad level (Smith & Shah, 2013) and portfolio level (Wadhwa et al., 2016).

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CHAPTER 4

Study 3 – Contextualizing Corporate Venture Capital: A Multi-Level Analysis of CEO Humility and the Urgency for Digital Transformation[1]

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Abstract

Combining upper echelons theory and the attention-based view of the firm within the tenets of contextual entrepreneurship, this study examines the relationship between CEO humility and corporate venture capital (CVC) investment activity in the contexts of external and internal urgency for digital transformation. Testing a sample of 373 CEOs from 198 firms and 35 industries from 2010 to 2019 with multi-level analysis, we provide evidence for the relationship between CEO humility and CVC investment activity. While we find support for the moderating role of emerging digital competition (i.e., external urgency), our results indicate that business model dependence on information and knowledge (i.e., internal urgency) moderates the CEO humility–CVC relationship only for investments in related ventures. Our findings contribute to extant CVC and humility literature by evidencing the importance of the CEO as a top decision-maker for CVC investment activity. Moreover, by demonstrating the moderating role of urgency for digital transformation for the CEO humility–CVC relationship, we introduce the contextual view of entrepreneurship to CVC investments as corporate entrepreneurial actions.

Keywords: attention-based view, CEO humility, contextual entrepreneurship, corporate venture capital, digital transformation, upper echelons theory

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4.1. Introduction

The ongoing digital transformation of business and society is imperiling the sustained success of traditional business models and operational processes of incumbent firms (Amit & Han, 2017; Lanzolla et al., 2021). To ensure long-term survival and competitiveness in the rapidly changing digital era (Hanelt et al., 2021; Sebastian et al., 2017), firms are increasingly enacting corporate entrepreneurial (CE) actions that enable them to renew resources, capabilities, and routines digitally (Corbett et al., 2013; Lyytinen et al., 2016). However, the productive facilitation of CE actions in the fast-paced digital world requires the CEO—as the head of the firm—to not only uphold the existing strengths of the firm, but also recognize weaknesses, and foster continual learning (Ling et al., 2008).

A largely overlooked but important characteristic of CEOs that provides a promising basis for such contemporary executive leadership is *humility*—"an individual's orientation toward obtaining accurate self-knowledge, appreciating others' strengths and contributions, and being open to self-improvement" (Ou et al., 2018, p. 1148). Humble leaders are well aware of the vulnerability of their firm and the resulting need for continuous innovation and renewal inherent to digital transformation endeavors (Nambisan et al., 2017; Nielsen & Marrone, 2018; Zhang et al., 2017). This awareness is essential for the expedient initiation of CE actions. To date, few studies have applied the concept of humility to the CEO context, demonstrating its relationship with, for example, market performance (Petrenko et al., 2019), firm performance (Ou et al., 2018), and organizational ethical culture (Cortes-Mejia et al., 2021). However, we miss an understanding of what *strategic actions* humble CEOs foster at the firm-level—an insight that is indispensable in today's times of rapidly progressing digital transformation requiring deliberate firm-level actions.

We propose corporate venture capital (CVC) investment activity, which refers to minority equity investments in entrepreneurial ventures (Dushnitsky & Lenox, 2005; Sharma &

Chrisman, 1999), as a prominent CE action that humble CEOs instigate in times of urgency for digital transformation. The establishment of CVC relations with entrepreneurial ventures, as the forerunners of digitalization, is a promising instrument for tapping into the newest digital innovations (Huang et al., 2017). CVC investments serve as a *window on new technologies* (Benson & Ziedonis, 2009), providing innovation benefits for both incumbent firms (e.g., Dushnitsky & Lenox, 2005; Smith & Shah, 2013; Wadhwa et al., 2016; Wadhwa & Kotha, 2006) and entrepreneurial ventures (e.g., Alvarez-Garrido & Dushnitsky, 2016; Park & Steensma, 2012; Uzuegbunam et al., 2019). Existing research has considerably advanced our understanding from a meta-perspective and unraveled the firm-level (e.g., Anokhin et al., 2016; Dushnitsky & Lavie, 2010) and industry-level drivers of CVC investment activity (Basu et al., 2011; Gaba & Meyer, 2008; Sahaym et al., 2010). However, we surprisingly lack knowledge on the influencing role of CEOs (Jeon & Maula, 2022). A recent report from The Global Corporate Venturing Institute (2020) shows that approximately 34% of all CVC units report directly to the CEO, while the majority of the remaining CVC units report to functions that are subordinated to the CEO. CVC investments are important financial commitments, which typically receive high attention from the media and are closely linked to the innovation strategy and reputation of an incumbent firm—factors that are certainly important to the CEO.

Therefore, our study aims to investigate *the relationship between CEO humility and CVC investment activity in the context of the urgency for digital transformation.* To address this research aim, we combine upper echelons theory (Hambrick & Mason, 1984) and the attention-based view of the firm (Ocasio, 1997) with the contextual view of entrepreneurship (e.g., Welter, 2011; Zahra & Covin, 1995; Zahra & Wright, 2011). Whereas upper echelons theory provides the theoretical foundations to explain the role of CEO humility for CVC investment activity as an important strategic action for the firm, the attention-based view of the firm argues that the strategic actions CEOs foster depend on the attention to their situational context. The

contextual view of entrepreneurship advances the principle of the situational context, explaining that entrepreneurial processes and activities spurred by individuals are contingent on the "meso-level" and "macro-level" context (e.g., Jack & Anderson, 2002; Kim et al., 2016; Zahra, 2007; Zahra et al., 2014). In this vein, we theorize upon the urgency for digital transformation to provide a contextual understanding of CVC investments as a form of CE actions in the digital era. Specifically, we build upon the study by Firk et al. (2021) and distinguish between two contextual facets of the urgency for digital transformation: the emerging digital competition as an alarming signal that jeopardizes market positions (i.e., external at the macro-industry-level), and the business model dependence on information and knowledge as an indicator for substitutability by the newest digital technologies (i.e., internal at the meso-firm-level). Concretely, we reason upon the situational mechanism emanated by the external and internal urgency for digital transformation for CVC investment activity as a CE action that humble CEOs at the micro-level foster (Sharma & Chrisman, 1999). We test our theoretical model with a sample of 373 CEOs from 198 CVC investing firms and 35 industries from 2010 to 2019 using multi-level analysis.

Overall, our study provides four main contributions. First, we identify a previously unconsidered individual-level driver, namely humility, as a significant CEO characteristic that conveys a theoretical causation for CVC investment activity. By evidencing the relationship between CEO humility and the number of CVC investments as small size commitments for the realization of uncertain digital transformation endeavors, we show the importance of executive leadership for CVC investment activity. Second, with our theoretical amalgamation, we introduce a contextualized perspective of CVC activity. By doing so, we demonstrate the theoretical usefulness of the notion of situated attention—as a context-related concept—in elaborating on the individual-centric upper echelons theory (Brielmaier & Friesl, 2022; Fisher & Aguinis, 2017). Concretely, we show that situational urgency mechanisms anchored in firm

and industry-level contexts play a contingent role for the CEO humility–CVC relationship in the context of digital transformation. Third, existing research treats various relationships between CEO characteristics, strategic actions, and performance outcomes of the firm as the same unit of analysis (Klein et al., 1999). Therewith, extant research theoretically and empirically neglects the various levels, and underlying level-specific mechanisms, in the analysis of CE. As we explicitly theorize across individual, firm, and industry levels—i.e., micro, meso, and macro (Kim et al., 2016), our study contributes toward a more holistic theorizing and nuanced understanding of CE phenomena. Fourth, we identify the urgency for digital transformation—which originates from the internal business model dependence on information and knowledge and external emerging digital competition (Firk et al., 2021)—as an unconsidered but important contextual factor that provides cross-level explanations for the enactment of CVC investments as CE actions.

4.2. Theoretical background

4.2.1. Upper echelons theory, CEO humility, and CVC investment activity

In their seminal article on the upper echelons theory of the firm, Hambrick and Mason (1984) propose that the psychological, demographic, and functional characteristics of top managers determine their pursuit of strategic actions and ultimately firm outcomes. The underlying rationale is that top manager characteristics determine their field of vision, leading them to selectively attend and interpret various issues in the context, which shapes their decisions about the pursuit of strategic choices (Hambrick, 2007; Hambrick & Mason, 1984). Throughout the last decades, the upper echelons theory has become a leading theory in management research (Neely et al., 2020; White & Borgholthaus, 2022), and it has inspired scholars to study the relationships between top managers, strategic actions, and firm outcomes (Carpenter et al., 2004; Wang et al., 2016). The largest body of research in this field has employed upper echelons

theory to examine the role of the CEO, presumably as "within any organization, the levers of power are uniquely concentrated in the hands of the CEO" (Nadler & Heilpern, 1998, p. 9).

Drawing upon upper echelons theory, we concentrate on *humility* as a cognitive characteristic of CEOs. Originating from psychology literature, the concept of humility is increasingly finding application in CEO studies (e.g., Ou et al., 2014; Ou et al., 2018; Zhang et al., 2017). Ou et al. (2018) highlight three orientations that humble CEOs exhibit in the organizational context: (1) willingness to obtain accurate self-knowledge, (2) tendency to keep an open mind and continuously learn and improve, and (3) appreciation of the strengths and contributions of others. Extant studies have mostly elaborated on these three orientations to explain how humble CEOs deal with top management teams (e.g., Cortes-Mejia et al., 2021; Ou et al., 2014). Specifically, researchers find that humble CEOs influence the decentralization of top management teams (Cortes-Mejia et al., 2021), thereby making it more likely that top management teams collaborate and share a common vision for the firm (Ou et al., 2018). Further, there is a growing consensus that CEO humility positively influences firm performance (Ou et al., 2018) and market performance (Petrenko et al., 2019). However, beyond these general insights, our understanding of *how* and *when* CEO humility influences *strategic actions* at the firm-level is still scarce. Investigating the role of CEO humility for strategic actions is important since it can help to uncover the mechanisms through which humble CEOs drive innovation and firm performance.

We examine *CVC investment activity* as an important *strategic action* that CEOs influence at the firm-level. CVC investments are strategic actions—or CE activities (Sharma & Chrisman, 1999)—that firms undertake to obtain financial (i.e., returns) and strategic value (i.e., access to the newest technological knowledge) through investment relations with entrepreneurial ventures (Dushnitsky & Lenox, 2005, 2006; Maula, 2007). Recent literature reviews highlight a range of industry-level and firm-level antecedent factors of CVC investment

activity (Jeon & Maula, 2022; Röhm, 2018). However, extant research has largely neglected the role of the CEO as the key decision-maker for CVC investments. CVC investments impact stock prices (Mohamed & Schwienbacher, 2016), innovation (e.g., Dushnitsky & Lenox, 2005; Wadhwa & Kotha, 2006), and firm value (Dushnitsky & Lenox, 2006)—outcomes that are of central interest to the CEO. Further, beyond the general influence of the CEO on the strategic actions of the firm, recent studies show that the CEOs are part of the investment committee in approximately 39% of CVC investing firms (Strebulaev & Wang, 2021). Insights from qualitative CVC studies provide further evidence for the involvement of the CEO in CVC investment activity (Basu et al., 2016; Souitaris & Zerbinati, 2014). Employing an upper echelons theory lens, our study aims to overcome this shortcoming and advance our understanding of the mechanisms through which CEOs influence the CVC investment activity of their firm.

4.2.2. The attention-based view and CVC investment activity as a CE response

The attention-based view of the firm regards firm behavior as a function of the attention that decision-makers allocate to activities of the firm (Ocasio, 1997). Concretely, the attention-based view defines the strategy of a firm as a "pattern of organizational attention, the distinct focus of time and effort by the firm on a particular set of issues, problems, and opportunities, and threats, on a particular set of skills, routines, programs, projects, and procedures" (Ocasio, 1997, p. 188). In other words, the attention-based view adopts an information-processing perspective that is contingent upon the allocation of attention (Brielmaier & Friesl, 2022; Ocasio et al., 2018). Numerous studies have employed this theoretical lens to explain the role of CEO attention—particularly in interaction with the environmental context—for firm-level behavior and outcomes (e.g., Gamache et al., 2015; Gupta, 1984; Nadkarni & Chen, 2014).

Specifically, according to the principle of *situated attention* that the attention-based view of the firm proposes, "individual decision-makers will vary their focus of attention depending

on the situation" they find themselves in (Ocasio, 1997, p. 190). Employing this logic to our study context, the influences on the proclivity of CEOs toward CVC investment activity (i.e., CE actions) can be divided into an external context and internal context (Zahra & Covin, 1995). The external context is defined by the industry in which the firm of the CEO operates. The examination of industrial factors in the context of the strategic actions of the firm is long-standing (Dess et al., 1990). CEOs observe industry-level changes to analyze competitors, assess the relative stance of their firm (Nadkarni & Chen, 2014), and make decisions about CVC investment activity as an instrument for strategic change. Additionally, CEOs are influenced by the internal firm-level context in their consideration of CVC investment activity. As the head of the firm, the CEO has a full overview of the business model of the firm (Nadler & Heilpern, 1998). Thus, CEOs can assess the strength of the business model of their firm in the face of recent technological developments and make decisions on leveraging CVC investment activity to renew or modify firm capabilities.

4.2.3. The urgency for digital transformation from the perspective of the contextual view of entrepreneurship

The contextual view of entrepreneurship proposes that the realization of entrepreneurial pursuits depend on the "meso-level" and "macro-level" context in which individuals are active (Welter, 2011; Zahra, 2007). Context describes any situation, including circumstances in the cultural, economic, political, social, and technological spheres, which can foster or inhibit the pursuit of (corporate) entrepreneurship (Jack & Anderson, 2002; Schade & Schuhmacher, 2022; Spigel, 2017; Welter, 2011). Based on the contextual view of entrepreneurship, we combine the upper echelons theory with the attention-based view to theorize upon the situational mechanism of *urgency for digital transformation* emanating from the macro- and meso-level context.

Digital transformation refers to the "organizational change that is triggered and shaped by the widespread diffusion of digital technologies" (Hanelt et al., 2021, p. 1160). Thus, digital

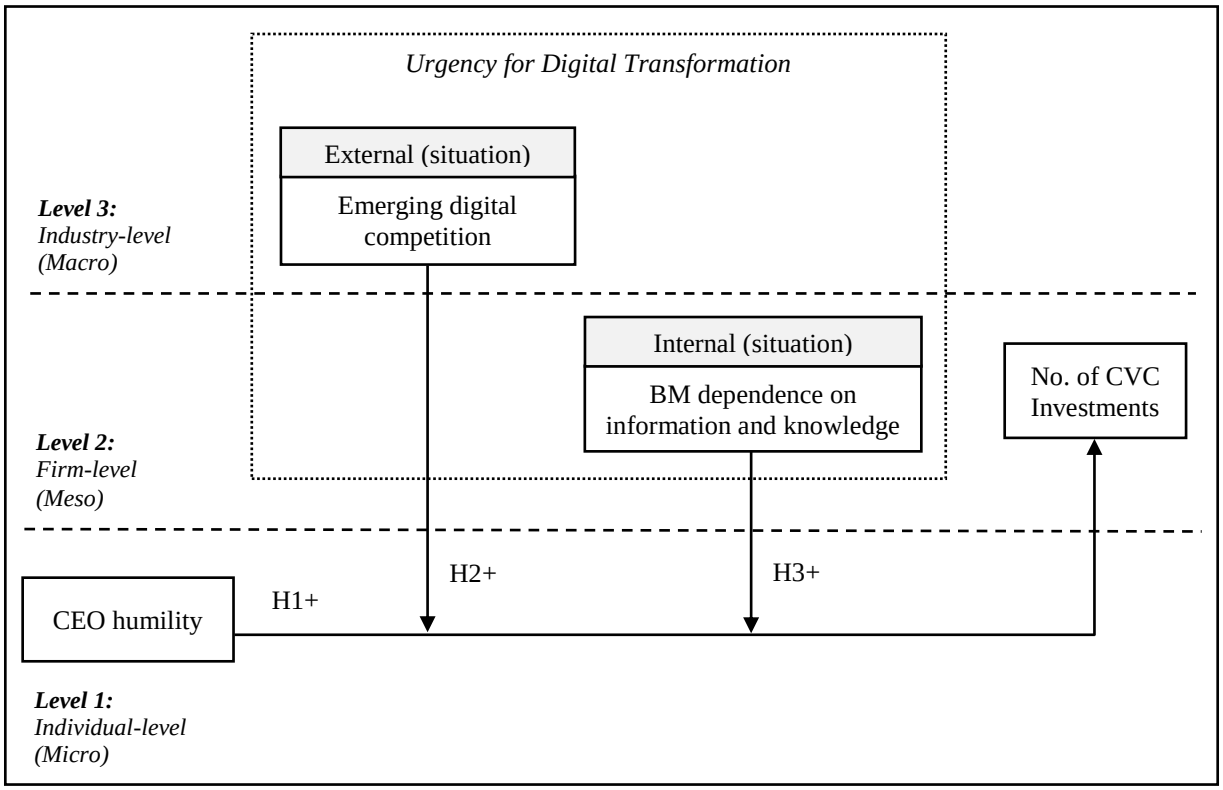
transformation is a contemporary challenge that incumbent firms face to ensure their long-term competitiveness (Amit & Han, 2017; Sebastian et al., 2017). Firk et al. (2021) define the urgency for digital transformation along two dimensions: (1) emerging digital competition (i.e., external situation) and (2) business model dependence on information and knowledge (i.e., internal situation). Emerging digital competition refers to the entrance of digital technology ventures—that is, ventures that have a digital technology at their core (Von Briel et al., 2018)—into the industry of a focal incumbent firm. As incumbent firms have built their competitive advantage on traditional product innovations (Lyytinen et al., 2016), we assume that the entrance of ventures with novel digital technologies into the industry of a focal firm results in an *external form of urgency for transformation* at the macro-industry-level. That is, the pressure for embracing digital technologies that originates from *outside the boundaries of the firm* (i.e., competition).

The dependence of a business model on information and knowledge describes the intensity of a firm's reliance on intangible assets, including patents, copyrights, and trademarks (Firk et al., 2021). Case examples show that firms relying heavily on information and knowledge are greatly affected by ongoing digital transformation processes. For example, with the translation of analog information into digital forms and the proliferation of the Internet (Tilson et al., 2010), individuals have shifted to mobile and online media consumption. Similarly, knowledge-based business models are increasingly threatened by the newest digital technologies, as for instance artificial intelligence solutions that can substitute traditional knowledge-creation processes (Tschang & Almirall, 2021). Thus, the vulnerability of a firm toward digital transformation is particularly strong when its business model is easily replaced by digital substitutes. Consequently, in line with Firk et al. (2021), we argue that the dependence of a firm's business model on information and knowledge exhibits an *internal form of urgency*

for digital transformation at the meso firm-level, that is, the necessity for adopting digital technologies that originates from *within the boundaries of the firm* (i.e., business model).

In sum, we reason that the urgency for digital transformation is a contextual situation (Firk et al., 2021; Welter, 2011; Zahra, 2007) that shapes the influence of mirco-level CEO humility on CVC investment activity. In this regard, we examine the CVC investment activity as a CE response to the contextual situations of external and internal urgency for digital transformation, which allows investment firms to collaborate with entrepreneurial ventures, access the newest technologies, and add value to mainstream business units. Figure 6 depicts the conceptual model that is hypothesized.

Figure 6. Conceptual model



4.3. Hypotheses development

4.3.1. CEO humility and CVC investment activity

Drawing upon tenets of the upper echelons theory, we propose that CEO humility is positively associated with the number of CVC investments of a firm. Extant research finds that incumbent

firms prefer CVC investment activity over acquisitions when payoffs are difficult to evaluate in advance (Tong & Li, 2011). Therefore, CVC investment activity has been conceptualized as an option-creating instrument (Basu & Wadhwa, 2013; Van de Vrande & Vanhaverbeke, 2013), which serves as a proven vehicle for absorbing external technological knowledge (Dushnitsky & Lenox, 2005). Therewith, researchers agree that CVC investments represent relatively low-risk investments in terms of size and commitment in comparison to other firm-level strategic actions, such as acquisitions (Tong & Li, 2011). There is ample evidence that overconfident CEOs spur the engagement of a firm in acquisitions (Malmendier & Tate, 2005) and even pay acquisition premiums (Hayward & Hambrick, 1997). Against this backdrop, we argue that a CEO exhibiting high levels of humility will increase the number of CVC investments in their firm.

This is because, first, with their willingness to obtain accurate self-knowledge (Ou et al., 2018), we expect that humble CEOs can recognize and acknowledge the limitations of the capabilities and resources of the firm. Resultantly, they proactively look for means to overcome these limitations. In this context, humble CEOs recognize the importance of investing in new ventures that can fill existing gaps in capabilities and resources (Chesbrough, 2002). Second, the open-mindedness and willingness to continuously learn and improve make humble CEOs more open to external digital innovations and their integration with existing products or services within the firm. In other words, we assume that humble CEOs do not suffer from the *not invented here syndrome* (Katz & Allen, 1982). Notably, prior research has found that CVC investment relations often result in strategic alliances to facilitate inter-organizational knowledge transfer (Van de Vrande & Vanhaverbeke, 2013). Humble CEOs will acknowledge the opportunity of intensifying technological collaborations with investee ventures to drive innovation, and thus, they have a more positive mindset about the formation of CVC investment relations. Third, because they appreciate the strengths and contributions of others (Ou et al.,

2018), humble CEOs will not underestimate the innovativeness and potential of entrepreneurial ventures to add value to well-established lines of business within their firm. Therefore, humble CEOs increase the usage of CVC as an existing innovation vehicle of the firm by initiating a higher number of CVC investments. We hypothesize that:

> **Hypothesis 1:** *In incumbent firms with existing CVC units, CEO humility is positively associated with the number of CVC investments.*

4.3.2. CEO humility, emerging digital competition, and CVC investment activity

Building upon the attention-based view of the firm, we propose that CEO humility will be more strongly associated with higher numbers of CVC investments in contexts with emerging digital competition. Such contexts are characterized by new ventures that are able to scale up digital technologies in a short period of time (Huang et al., 2017). These new and agile ventures increasingly enter existing competitive market structures (Skog et al., 2018), thereby competing with incumbent firms in their focus industries, which results in high uncertainty and potential disruption for incumbents. These shifts in competitive structures provide a situational mechanism of urgency for digital transformation, which reduces the stability of the competitive advantage of a company (Firk et al., 2021; Von Briel et al., 2018).

Contexts characterized by a high level of emerging digital competition threaten the long-term survival of incumbents, urging them to take measures for overcoming organizational inertia. Here, humble CEOs focus their attention on the pressure and threats imposed by emerging digital competition as an externally grounded urgency for digital transformation situated in the industry. The urgency to act, exerted by digital entrants in the industry, strengthens the open-mindedness of humble CEOs about obtaining external digital innovations. To access external digital innovations and create conditions that facilitate inter-organizational learning, humble CEOs identify the existing CVC vehicle as a promising instrument that can be quickly leveraged through the equipment with necessary resources to increase investment

activity. Paying attention to the changing structure of the industry reinforces the appreciation of humble CEO for the digital capabilities and resources of emerging ventures, which increases their awareness that it is not purposeful to rely solely on the traditional sources of competitive advantage of the firm. As a result, humble CEOs channel their attention toward renewing organizational routines by leveraging CVC investment activity as important CE actions (Corbett et al., 2013; Ou et al., 2018; Simsek & Heavey, 2011). Therefore, among CEOs possessing a similar level of humility, the ones facing higher industry-level urgency for digital transformation through emerging digital competition engage in the increase of CVC investment activity to form technological collaborations with entrepreneurial ventures.

In industries with a low level of emerging digital competition, competitive structures change less rapidly, which indicates less urgency for digital transformation. Therefore, paying timely attention to the digital capabilities and resources of emerging ventures in the focal industry becomes less important. This leads humble CEOs to refrain from the continuous re-evaluation of the competitive advantage of their firm (McGrath, 2013). Rather, humble CEOs focus their attention on the self-improvement measures of their firm in response to well-established competitors, which often builds their competitive advantage using traditional capabilities and resources. Therefore, we argue that—among CEOs possessing a similar level of humility—those who have to cope with less industry-level urgency for digital transformation put less emphasis on acknowledging the limitations of the capabilities of the firm. By doing so, they are less likely to proactively spur CVC investments to overcome limitations (Chesbrough, 2002). On this basis, we conjecture that:

> **Hypothesis 2:** *In incumbent firms with existing CVC units, emerging digital competition positively moderates the relationship between CEO humility and the number of CVC investments, such that this relationship is more positive in contexts with higher emerging digital competition.*

4.3.3. CEO humility, business model dependence on information and knowledge, and CVC investment activity

In line with arguments from the attention-based view, we propose that humility will be strongly associated with high numbers of CVC investments when CEOs find themselves in firms with information and knowledge-based business models. Business models with high dependence on information and knowledge are easily replaced by digital substitutes, putting firms under pressure for renewal (Firk et al., 2021). This pressure reflects an internally grounded situational mechanism of urgency for the digital transformation, which likely enforces humble CEOs to increase CVC investment activity as a response.

Humble CEOs have an increased awareness of the vulnerability of their firm to digital substitutes in firm contexts where the business model dependence on information and knowledge is high. Humble CEOs engage more thoroughly with business unit managers (Ou et al., 2014), which helps them identify the specific pain points in existing business models that require a digital overhaul. The awareness of the vulnerabilities of the business model enforces the attention of humble CEOs on activities that spur self-improvement and continuous learning. In this context, leveraging the existing CVC unit by increasing its investment activity is promising to obtain access to the newest digital technologies that can spur the digital transformation of the business model of the firm. Entrepreneurial ventures are at the forefront of the development of the newest digital technologies (Huang et al., 2017), which is a strength that humble CEOs acknowledge.

In firm contexts where the dependence of a business model on information and knowledge is low, that is, in firms that rely heavily on tangible assets, such as large-scale production facilities or machinery, the urgency for digital transformation is not as pronounced as in firms with information and knowledge-based business models (Firk et al., 2021). In this case, the organizational self-knowledge of humble CEOs increases their awareness of the low urgency

for digital transformation. Contrarily, humble CEOs are well aware that—while they need to be vigilant for the newest developments in the digital technology sphere—their business model cannot be easily replaced by emerging digital technologies. Therefore, in these contexts, humble CEOs concentrate their continuous learning orientation on facilitating efficiency and incremental improvements to their existing business model. As they perceive no necessity to radically innovate their business model, humble CEOs are less likely to focus their attention on equipping the existing CVC vehicle with a strong investing mandate. Accordingly, when CEOs exhibit similar levels of humility, the ones directing firms with high business model dependence on information and knowledge will direct their attention and action-formation strongly toward leveraging the investment activity of their CVC units to pursue digital business model innovations. Thus, we hypothesize that:

> **Hypothesis 3:** *In incumbent firms with existing CVC units, business model dependence on information and knowledge positively moderates the relationship between CEO humility and the number of CVC investments, such that this relationship is more positive in contexts with higher business model dependence on information and knowledge.*

4.4. Method

4.4.1. Data and measures

To test our hypotheses, we collected data for the time period from 2010 to 2019. All investment data were obtained from the "Private Equity Screener" of the Refinitiv Eikon database, and all other firm and industry variables were retrieved from S&P Capital IQ. To ensure the accuracy of our CVC investment data, we followed data cleaning suggestions by Röhm et al. (2020). Specifically, we dropped all undisclosed investors classified as CVCs. Additionally, we triangulated our data with information available in the S&P Capital IQ database and excluded all investors for which we could not identify a profile that matched with Refinitiv Eikon (i.e., unknown investors). Using the "corporate tree" function and business descriptions in S&P Capital IQ, we determined if the investor is truly a CVC. We removed all investors that were

not considered "wholly-owned subsidiaries" or were falsely declared as CVCs, such as accelerators, business angels, incubators, independent VCs, and private equity (PE) investors. By applying this thorough data-cleaning procedure, our dataset follows a generic definition for a CVC unit and promotes coherence in CVC research (Röhm et al., 2020).

Relevant CEO-level variables and firm-level controls were collected through the S&P Capital IQ database. To measure the humility of CEOs, we collected annual reports from the corporate website of the respective company and extracted the letter to shareholders (LTS). For annual reports not found on the company websites, we used search engines to supplement our data. Overall, the sample of this study consists of 373 CEOs from 198 CVC investing firms and 35 industries. In total, the sample contains 1,597 firm-year observations and 6,907 CVC investments over the period considered. We present all variable descriptions in Appendix E.

4.4.2. Dependent variable

Number of CVC investments. We relied on the data provided by the 'Private Equity Screener' of the Refinitiv Eikon database and collected information on all completed CVC investments over the period from 2011 to 2019. In unison with research on CVC activity, we measured the number of CVC investments by counting all minority equity investments of the incumbent firm in ventures in the given year t (e.g., Keil, Maula, et al., 2008). To enhance causal inference, we lagged the dependent variable by one year ($t + 1$) (Wooldridge, 2010). In line with our theorizing, we considered only the variance of investment activity between and within firms with established CVC units. Since we theorize upon increasing investment activity through an existent CVC unit and not the launch of a new CVC unit (Cabral et al., 2021), the consideration of firms that do not have any CVC unit at all would distort our theoretical and empirical model.

4.4.3. Independent variable

CEO humility. We capture CEO humility by conducting a dictionary-based and computer-aided text analysis (CATA) of annual LTS from 2010 to 2018. This approach corresponds with existing research showing that the cognitive traits and orientations of CEOs determine the strategic actions of a corporation (Gamache & McNamara, 2019; Nadkarni & Chen, 2014; Shipp & Jansen, 2011).

To linguistically inquire about CEO humility, we measured the reversed "clout score," a summary variable from the well-known Linguistic Inquiry Word Count (LIWC) Software (Pennebaker et al., 2015). High values of "clout" suggest "that the author is speaking from the perspective of high expertise and is confident," whereas low values suggest "a more tentative, humble, even anxious style" (Pennebaker et al., 2015, p. 22). In other words, CEOs with a high level of humility exhibit low "clout" in their language. The clout score was derived from the project on the use of pronouns by Kacewicz et al. (2014) and is increasingly finding application in management research (e.g., Zyung & Shi, 2021).

4.4.4. Moderator variables

To operationalize urgency for digital transformation, we adapted the measure provided by Firk et al. (2021), consisting of emerging digital competition (i.e., external urgency) and business model dependence on information and knowledge (i.e., internal urgency).

External urgency for digital transformation. The first moderator is *emerging digital competition* and captures the external industry-level situation. To measure emerging industry-level digital competition, we counted the number of digital ventures that received a VC investment in the same industry as the focal CVC investing firm (i.e., 2-digit-SIC overlap) and year t, divided by the number of non-digital ventures that received a VC investment in the same year and industry. To classify ventures as digital or not, we relied on the Refinitiv Eikon's classification of the "company primary technology application (CTA)," which categorizes the

technology of a venture specifically. We considered ventures as "digital" if their primary technology is classified within one of the following categories in the Refinitiv Eikon database: "Internet/Online Related," "Content or Services via the Internet/Online," "E-commerce via the Internet/Online," "Communications/Infrastructure," "Internet/Online Hardware Technology," "Software or Tools for the Internet/Online," or "Services for the Internet." With this measure, we can distinguish the technological classification of the venture (i.e., digital or not) from the primary industry it operates in. For example, the venture "AutoTrader" runs an online marketplace that brings together car dealers, manufacturers, and individuals to facilitate sales processes. The CTA filter in Refinitiv Eikon considers the primary technology of AutoTrader as "E-commerce via the Internet/Online," while the standard industrial classification (SIC) of the venture is 5012 (Automobiles and other vehicles). Thus, while the venture is considered digital, it will likely compete with firms operating in the Automobile industry. Additionally, we considered only VC-backed ventures to control for quality and ensure visibility in the industry.

Internal urgency for digital transformation. The second moderator is *business model dependence on information and knowledge.* Similar to Firk et al. (2021), to capture firm-level urgency for digital transformation, we calculated the total intangible assets of a firm subtracted by the amount of goodwill, divided by the total assets of a firm (Antia et al., 2010). A high value suggests that the business model of the firm exhibits high dependence on information- and knowledge-based assets (e.g., patents, copyrights, and trademarks). A low value indicates that the business model of the firm relies more heavily on tangible assets, such as machinery or production equipment.

4.4.5. Control variables

We include several potential control variables to empirically test the deduced hypotheses and preclude alternative explanations that could influence the proclivity of a CEO to increase CVC investment activity. At the individual CEO-level, we controlled for *age, change, digital*

orientation, education, gender, and *tenure.* Extant research has spawned empirical evidence that young CEOs are highly incentivized to engage in acquisition activities (Yim, 2013). Further, we controlled for CEO age because young CEOs may be considerably eager to engage in CVC activities. We control for *CEO change* since a replacement of the CEO likely leads to the heterogeneity of humility. In addition, we also controlled for *CEO tenure* (Nadkarni & Chen, 2014). To ensure that the number of CVC investments is not solely driven by a *CEO's digital orientation*, but by humility, we controlled for the verbiage-based digital orientation of a CEO by applying the construct of Kindermann et al. (2021). The construct is manifested in four dimensions, i.e., (i) digital technology scope, (ii) digital capabilities, (iii) digital ecosystem coordination, and (iv) digital architecture configuration, which we obtained through CATA. Further, we controlled for the educational attainment of the CEO by adapting the classification proposed by Datta and Rajagopalan (1998). We assessed the level of *CEO education* by differentiating between undergraduate degree, master's degree, and doctorate. Further, we included *CEO gender* as a socio-demographic covariate.

In addition to the CEO-level controls, we account for general firm-level contingencies to diminish the possibility of drawing misleading conclusions about the hypothesized effect of CEO humility. To control for the strong reliance on advertising expenditures as the strategy of a firm to achieve market penetration (Covin et al., 1994), we controlled for log-transformed *advertising expenditures* in millions of USD. We controlled for a *firm's age* by counting the years since its founding. This is because young firms may face a higher likelihood to exploit new domains of competencies than old firms, which exhibit high inertia to innovate (Basu et al., 2011; Sørensen & Stuart, 2000). We controlled for a *firm's available slack*, captured as total current assets to total liabilities, as it has been shown to affect general investment proclivity, e.g., in the form of acquisitions (Nohria & Gulati, 1996). Additionally and consistent with previous research, we controlled for log-transformed *R&D expenditures* to proxy a firm's

technological capabilities and reflect the overall strategy of a company (Dushnitsky & Lenox, 2006; Seo et al., 2015). In case R&D expenditures data were not reported, we used mean-replacement. This procedure has been carried out in previous analyses on various variables for calculating diversification, the value of acquisitions, and firm investment horizon (Gamache et al., 2015; Gamache & McNamara, 2019). Lastly, considering the findings of Singh (1986) that large firms possess greater resources to make uncertain and discretionary investments in new ventures, we controlled for *firm size* using the log-transformed number of total employees.

At the industry-level, we included log-transformed covariates for *industry R&D expenditures* (in millions of USD) and *industry size* measured in the total revenue of the 2-digit SIC. Further, since the number of CVC investments may vary over time, we controlled for systematic period effects using year-dummy variables for the sample period and included industry dummies to account for unobserved industry effects.

4.5. Analysis and results

4.5.1. Analysis

Our sample consisted of 373 CEO observations over time (level 1; micro), nested within 198 CVC investing firms (level 2; meso), and 35 industries (level 3; macro). To statistically reflect the hierarchical nature of the data, we used a three-level hierarchical modeling technique (Rabe-Hesketh & Skrondal, 2012). Since the dependent variable—the number of CVC investments—is a count-based variable, which can only take values that are integer and non-negative (Wooldridge, 2018), we applied a nonlinear regression approach (Hausman et al., 1984). More specifically, we employed multi-level negative binomial regression to model our data. To test our cross-level moderation hypotheses, we followed best practices and mean-centered the predictors (Aguinis et al., 2013). Additionally, by excluding all explanatory covariates in our multi-level model (Hox et al., 2018), we calculated the variance partitioning coefficients (VPCs), which is analogous to the intra-class correlation coefficients (ICCs) for continuous

responses (Leckie et al., 2020). As we aim to understand how the relationship between CEO humility and the number of CVC investments varies in interaction with urgency for digital transformation situated at the firm-level and industry-level, we allowed the intercept and slope to vary (Aguinis et al., 2013; Preacher et al., 2006). Consistent with previous research and to enhance causal inference, we lagged our dependent variable by one year (t_{+1}) for all analyses performed (e.g., Gamache & McNamara, 2019; Nadkarni & Chen, 2014).

We calculated the estimates in three steps (see Table 10). First, we estimated the "fully unconditional model" to calculate the VPCs for our multi-level negative binomial regression model. Second, we added individual-, firm-, and industry-level controls (Model 1). Third, we integrated the individual-level main effect of CEO humility (Model 2). Fourth, we added the cross-level interactions (Model 3).[2]

4.5.2. Results

Table 9 displays the descriptive statistics and correlation matrix for all industry-level and firm-level variables, as well as individual CEO-level predictors, and covariates for the final sample. Results from the performed variance inflation factors (VIFs) test show that we can exclude multicollinearity in our data (VIFs < 5).

To decompose the proportion of the variance in the number of CVC investments, as explained by the specific nesting levels (i.e., individuals, firms, industries), we calculated the VPCs. Overall, 41.27% of the variance was explained by individual CEO-level, 54.28% by the firm-level, and the remaining 4.45% by the industry-level. Since VPC calculation is a new methodological approach for decomposing variance structures in count-based multi-level models, there are no existing "thresholds" that would indicate the appropriateness of multi-level modeling. However, extant research recommends multi-level modeling for cases where the ICC takes a value greater than 5% (Mathieu & Chen, 2011). Given the VPC results, we conclude

[2]Following Anderson et al. (2019), we report the exact *p*-values for increased clarity.

that multi-level modeling is advantageous over the conventional (non-hierarchical) negative binomial regression (Aguinis et al., 2013; Hox et al., 2018). In Table 10, we report the results of the multi-level negative binomial regression.

Consistent with Hypothesis 1, the results presented in the comprehensive Model 3 showed that CEO humility was significantly and positively associated with the number of CVC investments ($\beta = .012$, $p < .05$). Further, in line with Hypothesis 2, we observed that the urgency for digital transformation, which is manifested via emerging digital competition situated at the external industry-level context, positively moderates the effect of CEO humility on the number of CVC investments ($\beta = .001$, $p < .05$) (see Model 3). Lastly, the cross-level interaction between CEO humility and business model dependence on information and knowledge, as the internal manifestation of the urgency of a firm for digital transformation, was not statistically significant. Thus, we found no support for Hypothesis 3 (see Model 3).

Table 9. Descriptive statistics and correlation matrix

Variables	Mean	SD	Min.	Max.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	VIF
(1) CEO humility	12.01	7.71	1	45.93	1.00																	1.06
(2) CEO age	55.04	6.46	32	80	0.10	1.00																1.28
(3) CEO change	0.13	0.34	0	1	-0.02	-0.14	1.00															1.18
(4) CEO digital orientation	0.88	1.06	0	5.76	-0.03	-0.20	-0.04	1.00														1.46
(5) CEO education	2.75	0.71	1	4.00	-0.01	-0.04	-0.01	-0.08	1.00													1.05
(6) CEO gender	0.04	0.19	0	1	0.04	-0.06	0.00	0.08	0.06	1.00												1.04
(7) CEO tenure	6.53	5.61	0	35	0.05	0.20	-0.37	0.15	-0.02	-0.01	1.00											1.37
(8) Number of CVC investments	3.81	9.27	0	101	-0.00	-0.07	0.06	0.20	-0.00	-0.03	-0.01	1.00										1.18
(9) Firm advertising exp. (log)	1.81	2.93	-1.35	9.38	-0.06	0.05	0.00	0.16	-0.06	-0.00	-0.06	0.14	1.00									1.17
(10) Firm age (log)	4.07	0.90	0	6.48	-0.02	0.19	0.02	-0.32	0.04	-0.01	-0.16	-0.05	-0.03	1.00								1.41
(11) Firm available slack	1.60	1.05	0.22	11.18	-0.01	-0.10	0.02	0.05	0.02	-0.00	-0.01	0.14	0.04	-0.20	1.00							1.33
(12) Firm R&D exp. (log)	2.99	3.66	0	10.27	-0.09	0.04	0.02	0.00	0.11	-0.03	-0.05	0.24	0.18	0.00	0.30	1.00						1.74
(13) Firm size (log)	10.40	1.37	5.04	13.38	-0.11	0.20	0.02	-0.03	0.04	-0.10	-0.16	0.18	0.26	0.38	-0.20	0.16	1.00					1.55
(14) BM dependence on I. & K	0.10	0.11	0	0.58	-0.14	-0.00	-0.04	0.02	0.01	0.04	0.01	0.06	0.09	-0.06	-0.16	0.08	-0.07	1.00				1.10
(15) Emerging digital competition	4.15	6.52	0	48	0.01	-0.28	0.01	0.46	-0.14	0.01	0.12	0.07	0.06	-0.30	0.01	-0.19	-0.15	0.04	1.00			1.52
(16) Industry R&D exp. (log)	8.74	3.73	-6.91	12.27	0.01	0.01	0.02	0.09	0.02	0.08	0.01	0.13	0.15	-0.15	0.27	0.52	-0.07	0.09	0.07	1.00		1.59
(17) Industry size (log)	14.88	0.74	11.30	15.76	-0.00	0.03	0.04	0.00	-0.06	0.04	-0.15	0.08	-0.01	0.05	-0.06	0.04	-0.04	-0.00	0.06	0.17	1.00	1.12

Notes. *N* = 1,597 years by 373 CEOs (level 1) from 198 firms (level 2) and 35 industries (level 3). Distribution of industry groups by SIC: Manufacturing (46.40%), Transport & Public Utilities (17.91%), Services (17.41%), Finance, Insurance, & Real Estate (8.39%), Wholesale Trade (4.32%), Retail Trade (2.88%), Mining (1.88%), and Construction (0.81%). Correlations greater than 0.05 or less than -0.06 are significant at $p < .05$.

Table 10. Multi-level negative binomial regression

	Model 1			Model 2			Model 3		
DV: No. of CVC investments (t+1)	Coef.	*p*-value	Sig.	Coef.	*p*-value	Sig.	Coef.	*p*-value	Sig.
CEO variables (level 1)									
CEO age	-0.038 (0.023)	0.100		-0.039 (0.023)	0.096	*	-0.038 (0.023)	0.096	*
CEO change	0.168 (0.113)	0.137		0.162 (0.113)	0.151		0.166 (0.113)	0.140	
CEO digital orientation	0.143 (0.056)	0.011	**	0.141 (0.059)	0.017	**	0.144 (0.060)	0.018	**
CEO education	-0.023 (0.089)	0.790		-0.027 (0.088)	0.755		-0.030 (0.087)	0.732	
CEO gender (female = 1, male = 0)	-0.193 (0.251)	0.440		-0.231 (0.253)	0.361		-0.203 (0.249)	0.415	
CEO tenure	0.026 (0.014)	0.062	*	0.025 (0.014)	0.078	*	0.026 (0.014)	0.077	*
Firm variables (level 2)									
Firm advertising exp. (log)	0.027 (0.012)	0.027	**	0.029 (0.011)	0.014	**	0.028 (0.012)	0.019	**
Firm age (log)	0.083 (0.122)	0.083		0.079 (0.126)	0.528		0.079 (0.129)	0.540	
Firm available slack	0.010 (0.039)	0.800		0.012 (0.039)	0.762		0.010 (0.039)	0.800	
Firm R&D exp. (log)	0.098 (0.021)	0.000	***	0.099 (0.022)	0.000	***	0.098 (0.022)	0.000	***
Firm size (log)	0.268 (0.049)	0.000	***	0.272 (0.052)	0.000	***	0.270 (0.054)	0.000	***
BM dependence on I. & K	0.153 (0.712)	0.830		0.196 (0.691)	0.777		0.333 (0.673)	0.621	
Industry variables (level 3)									
Emerging digital competition	0.012 (0.013)	0.343		0.013 (0.013)	0.309		0.014 (0.013)	0.287	
Industry R&D exp. (log)	-0.073 (0.114)	0.522		-0.073 (0.114)	0.523		-0.071 (0.112)	0.524	
Industry size (log)	0.306 (0.215)	0.156		0.313 (0.214)	0.144		0.308 (0.213)	0.147	
Main effect									
CEO humility				0.014 (0.006)	0.020	**	0.012 (0.005)	0.010	**
Cross-level interaction effects									
CEO humility × Emerging digital competition							0.001 (0.001)	0.019	**
CEO humility × BM dependence on I. & K.							0.054 (0.050)	0.275	
Additional information									
Degrees of freedom	31			32			34		
Wald $\chi 2$ (sig.)	10500.68***			53703.03***			1.26e+06***		
Log-pseudolikelihood	-3172.64			-3168.77			-3166.96		
AIC	6413.28			6405.54			6401.93		

Notes. N = 1,597 years by 373 CEOs (level 1) from 198 firms (level 2) and 35 industries (level 3). AIC refers to Akaike's information criterion. Cluster robust SEs in parentheses. Year-fixed and industry-fixed effects included. Two-tailed tests with *$p < .1$; **$p < .05$; ***$p < .01$.

4.5.3. Additional analyses and robustness checks

Drawing upon organizational learning theory (Cohen & Levinthal, 1990), prior studies highlighted the importance of relatedness between the investing firm and the investee venture for both the formation (Colombo & Shafi, 2016; Dushnitsky & Shaver, 2009), and the outcomes of CVC investment relations (Keil, Maula, et al., 2008; Van de Vrande & Vanhaverbeke, 2013; Wadhwa & Kotha, 2006). Thus, we conducted an additional analysis by splitting our dependent variable (i.e., number of CVC investments) into related and unrelated CVC investments. To capture the venture relatedness, we conducted SIC code matching between the venture and focal investing firm (e.g., Haleblian & Finkelstein, 1999; Villalonga & McGahan, 2005). Specifically, we classified the CVC investment as "related" if the first two digits of the SIC codes between the investing firm and the investee venture were identical; otherwise, the CVC investments were designated as "unrelated" (Bryce & Winter, 2009). The results reported in Table 11 (Models 1 and 2) confirm that our main findings depicted in Table 10 are robust for both types of investments. However, Model 2 reveals that the cross-level interaction effect between business model dependence on information and knowledge and CEO humility becomes significant for related investments ($\beta = .081$, $p < .1$). This significant finding indicates that humble CEOs foster related investments to enforce the business model when it is vulnerable to digitalization.

Table 11. Related vs. unrelated CVC investments

	Model 1 Unrelated CVC Investments			**Model 2** Related CVC Investments		
DV: No. of CVC investments (t+1)	Coef.	*p*-value	Sig.	Coef.	*p*-value	Sig.
CEO variables (level 1)						
CEO age	-0.036 (0.018)	0.053	*	-0.047 (0.029)	0.115	
CEO change	0.149 (0.120)	0.213		0.229 (0.100)	0.022	**
CEO digital orientation	0.128 (0.073)	0.079	*	0.104 (0.040)	0.009	***
CEO education	-0.001 (0.089)	0.991		-0.238 (0.080)	0.003	***
CEO gender (female = 1, male = 0)	-0.104 (0.234)	0.656		-0.208 (0.389)	0.593	
CEO tenure	0.031 (0.018)	0.090	*	0.019 (0.014)	0.177	
Firm variables (level 2)						
Firm advertising exp. (log)	0.035 (0.013)	0.011	**	0.012 (0.015)	0.435	
Firm age (log)	0.094 (0.135)	0.485		-0.088 (0.184)	0.630	
Firm available slack	0.008 (0.059)	0.892		0.017 (0.021)	0.402	
Firm R&D exp. (log)	0.103 (0.025)	0.000	***	0.071 (0.038)	0.064	*
Firm size (log)	0.260 (0.057)	0.000	***	0.436 (0.099)	0.000	***
BM dependence on I. & K	0.616 (0.730)	0.399		-0.524 (0.531)	0.324	
Industry variables (level 3)						
Emerging digital competition	0.007 (0.015)	0.617		0.006 (0.014)	0.680	
Industry R&D exp. (log)	-0.124 (0.106)	0.242		0.223 (0.149)	0.135	
Industry size (log)	0.337 (0.262)	0.198		0.619 (0.448)	0.167	
Main effect						
CEO humility	0.012 (0.004)	0.013	**	0.015 (0.006)	0.031	**
Cross-level interaction effects						
CEO humility × Emerging digital competition	0.001 (0.001)	0.037	**	0.001 (0.001)	0.008	***
CEO humility × BM dependence on I. & K.	0.047 (0.058)	0.413		0.081 (0.049)	0.096	*
Additional information						
Degrees of freedom	34			34		
Wald $\chi 2$ (sig.)	61905.34***			8.96e+11***		
Log-pseudolikelihood	-2742.87			-1310.86		
AIC	5553.74			2687.72		

Notes. *N* = 1,597 years by 373 CEOs (level 1) from 198 firms (level 2) and 35 industries (level 3). Relatedness is measured by SIC code matching between CVC investing firm and investee venture (1 if the first two SIC-digits are identical, 0 if not). In total, 1,808 CVC investments (26%) were related, and 5,099 CVC investments were unrelated (74%). Year-fixed and industry-fixed effects included. AIC refers to Akaike's information criterion. Cluster robust SEs in parentheses. Two-tailed tests with *p < .1; **p < .05; ***p < .01.

Further, to investigate the potential value-creating effect of CVC investments, we performed a lagged fixed-effects panel regression with the number of CVC investments (t_0) as the independent variable and Tobin's q as the dependent variable ($t_{+1} - t_{+4}$). Tobin's q captures firm value (Chung & Pruitt, 1994), and has been used by prior CVC studies (e.g., Dushnitsky & Lenox, 2006; Titus & Anderson, 2018). Our sample comprises 1,544 firm-years from 196 firms for the time frame of 2010–2019. Table 12 provides evidence for the relationship between

the number of CVC investments and Tobin's q for the periods t_{+1}, t_{+2}, and t_{+3} after the investment. In year t_{+4} after the CVC investment, the significant effect vanished.

Table 12. Firm value effect of CVC investments

DV: Tobin's q (t_n)	Tobin's q (t_{+1})	Tobin's q (t_{+2})	Tobin's q (t_{+3})	Tobin's q (t_{+4})
Control variables				
Advertising exp. (log)	-0.003 (0.002)	-0.003 (0.002)	-0.004* (0.002)	-0.003 (0.266)
Available slack	0.049*** (0.005)	0.017 (0.005)	0.006 (0.006)	-0.010 (0.151)
Capital exp. (log)	-0.018** (0.008)	-0.022** (0.009)	-0.001 (0.010)	0.004 (0.011)
Firm age (log)	0.065** (0.030)	0.040 (0.035)	0.025 (0.042)	0.053 (0.051)
Firm size (log)	0.046*** (0.016)	0.051 (0.018)	0.033 (0.022)	0.042* (0.024)
R&D exp. (log)	-0.009** (0.004)	-0.001 (0.004)	0.006 (0.005)	0.004 (0.005)
Return on assets	0.004*** (0.001)	0.003*** (0.001)	0.001 (0.001)	0.001 (0.001)
Total revenue (log)	-0.071*** (0.016)	-0.065*** (0.018)	-0.050** (0.021)	-0.047* (0.024)
Industry revenue (log)	-0.016 (0.026)	0.013 (0.288)	0.035 (0.031)	0.001 (0.034)
Industry R&D exp. (log)	-0.004 (0.003)	0.002 (0.004)	-0.002 (0.005)	-0.008 (0.008)
Main effect				
No. of CVC investments (t_0)	0.0015*** (0.0005)	0.0017*** (0.0006)	0.0014** (0.0007)	0.0004 (0.0008)
Additional information				
Year-fixed effects	*Yes*	*Yes*	*Yes*	*Yes*
Firm-fixed effects	*Yes*	*Yes*	*Yes*	*Yes*
Observations (firm-years)	1,554	1,393	1,228	1,058
Groups	196	191	189	182
R^2	0.163	0.076	0.058	0.061
F-Test (sig.)	12.45***	5.15***	3.52***	3.31***

Notes. Two-tailed tests with *p < .1; **p < .05; ***p < .01.

Lastly, clustered data can arise in two different ways. First, when there is a hierarchy of data, where CEOs are nested in firms, which, in turn, are nested in industries. In such a case, multi-level modeling is used to account for the nesting structure of the data. Conversely, clustered data can also originate from repeated observations of the same units (i.e., panel data) (Rabe-Hesketh & Skrondal, 2012). Further, as our data can also be considered as a panel structure with 1,597 firm-year observations, and to check for the robustness of our results, we conducted negative binomial regressions with both firm fixed-effects and firm random-effects (Greene, 1997). Overall, the results reported in Appendix F and G are robust and almost identical to the reported baseline findings (Model 3, Table 10).

4.6. Discussion

Our study aimed to investigate the role of CEO humility for CVC investment activity in the context of the external and internal urgency for digital transformation. We find empirical support for the direct CEO humility–CVC investment activity relationship, and our findings show that emerging digital competition (i.e., external situational context) positively moderates this relationship. While we do not find support for the moderating role of business model dependence on innovation and knowledge (i.e., internal situational context) for general CVC investment activity, our findings suggest that the situational mechanism arising from the firm-level context moderates the relationship between CEO humility and CVC investment activity for investments in ventures that are related to the CVC investing firm.

4.6.1. Theoretical contributions

Our theorization and findings point to four important theoretical contributions to the understanding of CE in the digital era. First, as our analysis sheds initial light on CEO humility as a significant antecedent cognition for CVC investment activity, we make a contribution to theory by introducing CEO humility as a previously unrecognized but relevant driver for CE. Based on the upper echelons theory, the cognitive mechanism of humility is the lever that generates observable CE activities (Bhaskar, 1997). Therewith, we contribute to CVC literature and CEO humility research. Although CVC research has examined a range of firm and industry-level drivers of CVC investment activity (Jeon & Maula, 2022; Röhm, 2018), it has largely overlooked the role of the CEO as the top decision-maker. By evidencing the relationship between CEO humility and CVC investment activity, we overcome this research gap and contribute toward the individual-based view on CVC. Resultantly, our study adds knowledge to CEO humility research. Thus far, studies have advanced our understanding of the direct effects of CEO humility on firm performance (Nielsen & Marrone, 2018; Ou et al., 2018; Petrenko et al., 2019). However, we miss an understanding of what strategic actions humble

CEOs foster at the firm-level. Our findings suggest that humble CEOs spur CVC investments as small-size commitments for realizing digital transformation endeavors.

Second, we draw upon the contextual view of entrepreneurship to theorize that CVC investment activity is contingent on both the ”meso-level” and “macro-level” context of the CEO as the firm’s key individual decision-maker (Jack & Anderson, 2002; Zahra & Covin, 1995). In this vein, we complement upper echelons theory (Hambrick, 2007; Hambrick & Mason, 1984) with the attention-based view (Ocasio, 1997) to explain the externally and internally situated role of urgency for digital transformation in the unfolding of CE actions. However, although the upper echelons theory is very helpful in theorizing individual-level effects, the original theoretical framework does not provide a fine-grained understanding of the contingent role of contextual factors in influencing the relationship between CEO characteristics and the strategic actions of a firm. To address this shortcoming, we supplemented our theorizing with the attention-based view of the firm (Ocasio, 1997). In particular, we applied the principle of *situated attention*, which echoes the tenets of contingency leadership by stating that CEOs vary their allocation of attention contingent upon the contextual situation (Brielmaier & Friesl, 2022; Ocasio, 1997). By combining both theories with the contextual view of entrepreneurship, we show that contextual considerations are important for theorizing individual entrepreneurial pursuits (Jack & Anderson, 2002; Welter, 2011; Zahra, 2007; Zahra et al., 2014). Further, if elaborated with appropriate theories, the contextual view of entrepreneurship is a fruitful basis to explain and predict CVC investments as a form of CE in the digital era (Fisher & Aguinis, 2017).

Third, given the complexity of factors potentially affecting CE in the digital era, we proposed a conceptual framework along three distinct levels of analysis that assumes that CVC investment activity—as a form of CE—is determined by the individual-level, firm-level, and industry-level that interact to shape CVC investment activity. In comparison to our approach,

extant research treats the relationship between CEO characteristics and strategic actions as well as performance outcomes of the firm as the same level of analysis (Klein et al., 1999). CE has predominantly been studied from a purely single level or pseudo-multi-level angle by not considering nesting structures (e.g., CEOs in firms, nested in industries). By explicitly theorizing across multiple levels, which has been lacking in CE research so far—but which is enabled by upper echelons theory as an inherently multi-level theory—our work promotes a more comprehensive and cross-level theorizing of CE phenomena. In this way, our multi-level model is an improvement over alternative single-layer approaches as it includes cross-level explanations that are important for understanding CE but would otherwise have been omitted.

Fourth, in the contextual view of entrepreneurship, the rapid technological progress and its pace of change is a crucial situation for top decision-makers (Welter, 2011). By employing the contextual view of entrepreneurship to the CVC context, we introduce a hitherto omitted factor, namely urgency for digital transformation, that emanates from internally (i.e., business model dependence on information and knowledge) and externally (i.e., emerging digital competition) grounded situations CEOs face. Thus, we provide a cross-level explanation of the CEO–CVC investment activity relationship in the digital age.

4.6.2. Practical implications

Our findings provide important practical implications. Supervisory boards that are interested in opening up the organizational boundaries of the incumbent firm for driving innovation through CVC investment activity may use our findings to select CEOs. Specifically, our findings suggest that supervisory boards should select humble CEOs to foster CE in times of urgency for digital transformation. The willingness of humble CEOs to obtain accurate self-knowledge, their openness for continuous learning and improvement, and their appreciation of the strengths and contributions of others (Ou et al., 2018) lead them toward positively assessing the potential value that entrepreneurial ventures can yield in the realm of CVC investment relationships.

Given the ample evidence for the innovation and firm performance benefits of CVC investment activity (Huang & Madhavan, 2021), hiring humble CEOs should increase innovation and performance. In fact, our post-hoc analysis reveals a positive effect of CVC investment activity on firm value over time. Drawing upon these findings, we encourage incumbent firms to further pursue CVC investment activity as an important vehicle for innovation and firm performance in the digital age. Further, our results highlight the importance of the urgency for digital transformation as a contextual moderating factor of the CEO–CVC investment activity relationship. Additionally, our results suggest that humble CEOs are sensitive to the context of urgency for digital transformation, which provides support for the importance of the humility trait to cope with new challenges arising from the digital transformation process.

4.6.3. Limitations and future research

As other empirical studies, our research also has limitations. First, we limit our theoretical scope to the examination of CEO humility as an important characteristic that is gaining increasing academic attention (Ou et al., 2018). However, other CEO characteristics could also play an important role in spurring or inhibiting CVC investment activity, and in fact, CVC literature has largely overlooked the upper echelons view. Future studies should dive further into this theoretical lens and examine CEO characteristics that have been found to influence strategic actions, such as temporal focus (Nadkarni & Chen, 2014), regulatory focus (Gamache et al., 2015), or digital orientation (Kindermann et al., 2021). In this regard, while we control for digital orientation and find a significant relationship with CVC investment activity, future studies can theorize upon this construct to examine the CVC investment process in more detail (e.g., regarding the composition of CVC investment portfolios). Second, although the examination of CEO humility through CATA allows the avoidance of retrospective reporting biases inherent to common survey-based measures (e.g., Ou et al., 2014), we are well aware of the common limitations of using LTS. However, we weighed these limitations against the

benefits of obtaining a longitudinally comparable data basis for length, scope, and audience across the different firm, industry, and geographical contexts (Gamache & McNamara, 2019). Importantly, prior studies showed that CEOs—as the head of firms and the ones bearing responsibility for shareholder value—are intensively involved in the formulation of annual LTS, which they ultimately sign personally (Duriau et al., 2007). In addition, there has been recent evidence for the significant correlation between cognitive constructs retrieved through the content analysis of LTS and those obtained through the analysis of transcribed texts from video interviews of CEOs, which further confirms validity (Back et al., 2020). This is in line with earlier studies, which found that CEOs are consistent in their use of language across different public formats (Nadkarni & Chen, 2014). Third, while we took great care to construct a hand-collected and unique dataset, we do acknowledge the common limitations of secondary data. Future research could employ scenario-based experiments with CEOs to provide detailed insights into their cognitive processes and decision-making, albeit obtaining access to such data is a great challenge.

4.7. Conclusion

CVC investment activity is increasingly establishing itself as an instrument to spur digital innovation. Our findings unravel the role of CEO humility for CVC investment activity and shed light on the urgency for digital transformation as an important contextual factor that emanates a situational mechanism to strengthen the CEO humility–CVC investment activity relationship. In this vein, our study introduced a contextual view of CVC investment activity as an important CE action in the digital age. We hope that future research will build upon our work to examine the role of the CEO and other top decision-makers to shed light on CE pursuits for addressing challenges imposed by the context of digital transformation.

CHAPTER 5

Concluding Remarks

The aim of this doctoral thesis was to advance our understanding of the phenomenon of CVC investing in the digital age. Through three empirical studies, this work provides in-depth insights into the instigation (study 3), evaluation (study 2), and post-investment integration (study 1) activities of CVC investors in the context of aspirations for digital transformation. Beyond the contributions to CVC literature, this doctoral thesis draws upon the CVC setting as an intriguing study context to advance the theoretical understanding of the role of affordances for inter-organizational partnerships (Majchrzak & Markus, 2013), corporate entrepreneurial decision-making (Shepherd et al., 2015), and the role of the peculiarities of digital technologies for entrepreneurial activities (Kallinikos et al., 2013; Nambisan, 2017). Future research can build upon the contributions of this work to further advance theory and practice in these fields.

First, while this work provides important insights into decision-making processes of CVC investors along essential phases of CVC relations, recent research also highlights the importance of the venture perspective in the unfolding of CVC relations (e.g., Paik & Woo, 2017; Uzuegbunam et al., 2019). Future research could examine the decision-making of ventures in the CVC context, such as how ventures interact with the corporate parent of CVCs, how they deal with multiple co-investors and, ultimately, how they approach exits in their role as CVC portfolio ventures. Furthermore, as CVC relations may be considered as failed, it would be interesting to analyze conditions under which ventures actually redeem CVC investments. Here, theorizing upon psychological characteristics of venture founders could provide an interesting basis for future research (Shepherd et al., 2015). Second, while the digital focus of CVC investments has become prevalent in investing firms across different industries, there are indications for new trends in the CVC investing field, which offer promising opportunities for new theorizing. For example, future research could theorize upon specific characteristics of

CVC investing for sustainability purposes (Hegeman & Sørheim, 2021), structural differences of CVC investing among different regions (Dushnitsky & Yu, 2022), or the potentially changing role of CVC in the context of token-based entrepreneurial financing (Momtaz, 2021). Third, a main contribution of this doctoral thesis grounds on the nature of the data and methods. In two of the three studies, we collect and analyze primary empirical data, which is quite rare in the CVC context due to the challenge of obtaining such data from this relatively small and hard-to-get population (Drover, Busenitz, et al., 2017). Specifically the conjoint experiment method, which we use in the second study of this thesis, offers unique opportunities to study CVC decision-making in real-time. Beyond the CVC investor perspective, future research could employ this methodology to study how key stakeholders—such as shareholders, R&D managers, business unit managers, or other investors—evaluate CVC units. Such insights can help to understand how CVC units can increase legitimacy in both their corporate parent and the VC market (Souitaris et al., 2012), which is key to their survival and success. Fourth, the theoretical advancements of this doctoral thesis with regard to affordance theory, corporate entrepreneurial decision-making, and the digital technology perspective, provide implications beyond the CVC setting. Future work can build upon our theoretical development to study related individual and corporate-level entrepreneurial activities. For example, researchers can draw upon our theorization of affordance-based decision-making, the peculiarities of digital technologies, and the cognition of key decision-makers to examine new venture creation processes, internal corporate venturing activities, acquisitions, or strategic alliances.

Overall, this doctoral thesis contributes towards a comprehensive and fine-grained understanding of the phenomenon of CVC in the digital age, which opens up promising avenues for future research. The interdisciplinary and multi-method nature of this doctoral thesis offers important theoretical and methodological advancements, which I hope provides a helpful foundation for researchers interested in further advancing this intriguing line of research.

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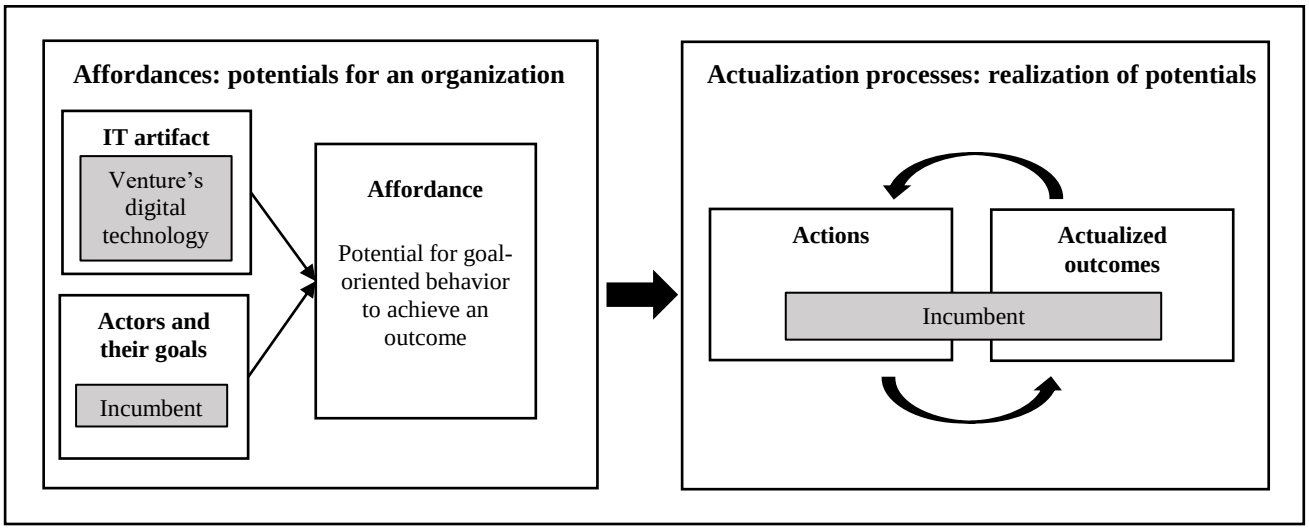
Appendices

Appendix A. The affordance-actualization framework in our study context



Source: Adapted from Strong et al. (2014, p. 70)

Appendix B. Hypothetical profile of CVC investment opportunity

You are evaluating an early stage venture with a novel digital technology that arouses your interest for an initial investment. The venture's digital technology has paying pilot customers and fits with:

- the strategic search fields,
- a growing market, and
- the geography in which your firm invests.

Contingent upon a favorable due diligence outcome, you are expected to indicate your willingness to invest in the digital venture. Please bear in mind that the digital ventures under consideration do not differ in any other characteristics besides the ones explicitly mentioned in the following:

Profile Details

The venture's digital technology offers little potential for modifying and thereby repurposing it to other use cases for business units of your parent firm and other ventures of your portfolio *(low reprogrammability relative to other digital technologies)*. At the same time, the venture's digital technology offers immense potential for coupling it with complementary technologies from business units of your parent firm and other ventures of your portfolio to create synergies *(high recombinability relative to other digital technologies)*. The venture team has little experience in successfully developing and commercializing new technologies *(low venture team experience relative to other ventures)*. Moreover, in the midst of the interest of other potential investors, it is very likely that an independent venture capital (VC) investor would join as a syndication partner for co-investing in this venture *(high possibility of syndication with independent VC investor relative to other venture investment opportunities).*

Profile Summary

Reprogrammability of digital technology	Low
Recombinability of digital technology	High
Venture team experience	Low
Possibility of syndication with an independent VC investor	High

Notes. This is an illustrative example of a detailed practice profile, including both the profile details and the profile summary. Respondents indicated their willingness to invest on a 7-point scale (1 – "low willingness" to 7 – "high willingness"). For further information on the dependent variable of interest for this study, see "Method" section in the main document. Detailed practice profiles were excluded from the main analysis. In the summary profiles, we omitted detailed descriptions of decision attributes. Under each summary profile, we included a web link that provided access to the detailed descriptions of the decision attributes under consideration.

Appendix C. Latent constructs

Construct	Loading
CVC unit dependence on business units (Hill et al., 2009), α = 0.71	
If a venture is in the domain of an existing business unit, to what extent do you do the following?	
1. Seek their cooperation in working with us on the business venture	0.67
2. Require their approval/sign-off before we make an investment	0.73
3. Try to encourage them to retain ownership of the venture, even if we provide funding	0.67
1 = not at all; 7 = to a great extent	
Exploitation objectives (Hill & Birkinshaw, 2014), α = 0.67	
When investing in ventures how important are the following objectives to your corporation?	
1. Retention and motivation of our employees	0.87
2. Better use of existing corporate assets	0.54
3. Creation of spin-out companies	0.44*
4. Source of funding for internal entrepreneurs	0.53
1 = not at all important; 2 = minor importance; 3 = major importance	
Exploration objectives (Hill & Birkinshaw, 2014), α = 0.81	
When investing in ventures how important are the following objectives to your corporation?	
1. Creation of breakthrough technology for the corporation	0.49*
2. Investment in disruptive technologies that can potentially cannibalize existing technologies	0.80
3. Window on emerging technologies	0.85
1 = not at all important; 2 = minor importance; 3 = major importance	
Digital strategy objectives (Eller et al., 2020), α = 0.69	
To what extent do you agree that the following are objectives of your firm's digital strategy?	
1. Fundamentally transform business processes and/or business model (e.g., grow new lines of business)	0.89
2. Improve customer experience and engagement	0.55
3. Improve innovation	0.60
4. Improve business decision-making	0.26*
5. Increase efficiency (e.g., automation, timely access to expertise and communities)	0.25*
1 = strongly disagree; 5 = strongly agree	

Notes. The results indicate very good fit: $\chi 2$ [37] = 46.532 (n = 54, p = 0.135); comparative fit index (CFI) = 0.925; root mean square error of approximation (RMSEA) = 0.070; standardized root mean square residual (SRMR) = 0.087. All indices are within acceptable ranges. Our measure of "CVC unit dependence on business units" (reversed horizontal autonomy scale by Hill et al., 2009) indicates convergent validity since all factor loadings are positive and significant ($p < 0.001$). With 0.71, the alpha coefficient is favorably higher than in the study of Hill and colleagues (α = 0.66). The measures of the latent constructs we use as control variables also show convergent validity and acceptable reliabilities. The resultant alpha values are similar to the values reported in the original studies (exploration objectives: 0.81, Hill et al.: 0.70; exploitation objectives: 0.67, Hill et al.: 0.68; digital strategy objectives: 0.69, Eller et al.: 0.87). * = item dropped due to low factor loading.

Appendix D. Predicted values including moderators

Variables	Level	Predicted WTI	S.E.	*p*-value	95% C.I.	
					Lower	Upper
Recombinability and digital technology exp.	Low-high	2.798	0.157	0.000	2.490	3.106
	Low-mean	2.905	0.101	0.000	2.705	3.104
	Low-low	3.011	0.145	0.000	2.762	3.297
	High-low	4.711	0.145	0.000	4.425	4.996
	High-mean	4.766	0.072	0.000	4.624	4.907
	High-high	4.821	0.139	0.000	4.547	5.095
Recombinability and entrepreneurial exp.	Low-high	2.708	0.172	0.000	2.369	3.046
	Low-mean	2.905	0.101	0.000	2.705	3.104
	Low-low	3.102	0.169	0.000	2.770	3.433
	High-low	4.695	0.126	0.000	4.447	4.942
	High-mean	4.766	0.072	0.000	4.624	4.907
	High-high	4.837	0.145	0.000	4.552	5.121
Reprogrammability and entrepreneurial exp.	Low-high	2.887	0.176	0.000	2.540	3.233
	Low-mean	3.027	0.088	0.000	2.853	3.201
	Low-low	3.168	0.158	0.000	2.858	3.478
	High-low	4.628	0.134	0.000	4.365	4.892
	High-mean	4.643	0.076	0.000	4.493	4.793
	High-high	4.658	0.128	0.000	4.406	4.910
Recombinability and CVC unit dependence	Low-high	2.800	0.212	0.000	2.383	3.217
	Low-mean	2.905	0.101	0.000	2.705	3.104
	Low-low	3.009	0.160	0.000	2.695	3.323
	High-low	4.477	0.145	0.000	4.193	4.761
	High-mean	4.766	0.072	0.000	4.624	4.907
	High-high	5.054	0.139	0.000	4.782	5.327

Notes. For the decision attributes (recombinability and reprogrammability), the "low" value represents -0.5 and "high" represents 0.5 (group-mean centered). For the moderating variables (digital technology experience, entrepreneurial experience, and CVC unit dependence), "low" represents the respective value at 1 S.D. below the mean, and "high" represents the respective value at 1 S.D. above the mean (grand-mean centered). WTI = willingness to invest.

Appendix E. Data description and sources

Variable	Description	Type	Level	Source
Dependent				
Number of CVC investments	Number of CVC investments per year	Continuous	Firm	Refinitiv Eikon
Independent				
CEO humility	CATA with annual LTS: Reversed LIWC 'clout' score, calculated through CATA with annual LTS (clout score = 1 – 100)	Continuous	Individual	LTS
BM dependence on I. & K	Business model dependence on knowledge and information, calculated as: (intangible assets – goodwill) / total assets	Continuous	Firm	S&P Capital IQ
Emerging digital competition	Ratio of digital VC-backed ventures / non-digital VC-backed ventures in the same industry (two-digit SIC code). Classification as 'digital' by selection of pre-defined filters by the Private Equity Module of the Eikon database	Continuous	Industry	Refinitiv Eikon
Control Variables				
CEO age	Number of years	Continuous	Individual	S&P Capital IQ
CEO change	Coded 0 if CEO already in position before year t; coded 1 if new CEO in year t	Binary	Individual	S&P Capital IQ
CEO digital orientation	CATA with annual LTS: Percentage of words belonging to "digital orientation" dictionary by Kindermann et al. (2021)	Continuous	Individual	LTS
CEO education	1 = no degree, 2 = undergraduate, 3 = graduate, 4 = doctorate	Categorical	Individual	S&P Capital IQ
CEO gender	Coded 1 if an individual is female and otherwise, 0	Binary	Individual	S&P Capital IQ
CEO tenure	Number of years in the position	Continuous	Individual	S&P Capital IQ
Firm advertising exp.	In million USD	Continuous	Firm	S&P Capital IQ
Firm age	Years since foundation	Continuous	Firm	S&P Capital IQ
Firm available slack	Total current assets / total liabilities	Continuous	Firm	S&P Capital IQ
Firm R&D exp.	In million USD	Continuous	Firm	S&P Capital IQ
Firm size	Number of total employees	Continuous	Firm	S&P Capital IQ
Industry R&D exp.	In million USD	Continuous	Industry	S&P Capital IQ
Industry size	Denoted in total revenue	Continuous	Industry	S&P Capital IQ

Notes. When demographic information on the CEO was missing in S&P Capital IQ (e.g., age and education), we conducted comprehensive web search to supplement this data.

Appendix F. Fixed-effects negative binomial panel regression

	Model 1			Model 2			Model 3		
DV: No. of CVC investments (t+1)	Coef.	*p*-value	Sig.	Coef.	*p*-value	Sig.	Coef.	*p*-value	Sig.
CEO variables									
CEO age	0.007 (0.008)	0.359		0.004 (0.008)	0.593		0.004 (0.008)	0.555	
CEO change	0.108 (0.080)	0.175		0.108 (0.079)	0.172		0.116 (0.079)	0.145	
CEO digital orientation	0.111 (0.036)	0.002	***	0.107 (0.036)	0.003	***	0.112 (0.036)	0.002	***
CEO education	0.004 (0.059)	0.946		0.008 (0.059)	0.886		0.011 (0.059)	0.846	
CEO gender (female = 1, male = 0)	-0.458 (0.229)	0.046	**	-0.530 (0.231)	0.022	**	-0.501 (0.231)	0.030	**
CEO tenure	-0.007 (0.009)	0.446		-0.009 (0.009)	0.321		-0.008 (0.009)	0.368	
Firm variables									
Firm advertising exp. (log)	0.042 (0.016)	0.009	***	0.043 (0.016)	0.008	***	0.043 (0.016)	0.007	***
Firm age (log)	0.260 (0.120)	0.031	**	0.273 (0.120)	0.023	**	0.285 (0.121)	0.019	**
Firm available slack	0.083 (0.039)	0.035	**	0.079 (0.039)	0.044	**	0.075 (0.039)	0.053	*
Firm R&D exp. (log)	0.026 (0.029)	0.364		0.024 (0.029)	0.407		0.023 (0.290)	0.411	
Firm size (log)	0.078 (0.078)	0.320		0.087 (0.078)	0.267		0.078 (0.791)	0.321	
BM dependence on I. & K	0.829 (0.577)	0.151		0.791 (0.580)	0.173		0.909 (0.589)	0.123	
Industry variables									
Emerging digital competition	0.005 (0.009)	0.517		0.006 (0.008)	0.448		0.006 (0.008)	0.474	
Industry R&D exp. (log)	0.008 (0.049)	0.863		0.013 (0.048)	0.778		0.011 (0.048)	0.814	
Industry size (log)	0.049 (0.141)	0.728		0.028 (0.142)	0.839		0.036 (0.142)	0.797	
Main effect									
CEO humility				0.017 (0.004)	0.000	***	0.016 (0.004)	0.000	***
Cross-level interaction effects									
CEO humility × Emerging digital competition							0.001 (0.001)	0.044	**
CEO humility × BM dependence on I. & K.							0.015 (0.445)	0.724	
Additional information									
Degrees of freedom	31			32			34		
Wald $\chi 2$ (sig.)	287.19***			305.13***			308.94***		
Log-likelihood	-2412.39			-2405.66			-2403.67		
AIC	4888.79			4877.32			4877.34		

Notes. N = 1,564 years from 183 firms. Year-fixed and industry-fixed effects included. SEs in parentheses. Two-tailed tests with *p < .1; **p < .05; ***p < .01.

Appendix G. Random-effects negative binomial panel regression

	Model 1			Model 2			Model 3		
DV: No. of CVC investments (t+1)	Coef.	*p*-value	Sig.	Coef.	*p*-value	Sig.	Coef.	*p*-value	Sig.
CEO variables									
CEO age	-0.006 (0.007)	0.417		-0.008 (0.007)	0.265		-0.007 (0.007)	0.288	
CEO change	0.088 (0.079)	0.266		0.090 (0.078)	0.252		0.094 (0.078)	0.233	
CEO digital orientation	0.107 (0.034)	0.002	***	0.102 (0.033)	0.002	***	0.107 (0.033)	0.002	***
CEO education	0.008 (0.053)	0.870		0.009 (0.053)	0.865		0.011 (0.053)	0.826	
CEO gender (female = 1, male = 0)	-0.372 (0.204)	0.069	*	-0.421 (0.205)	0.040	**	-0.381 (0.20)	0.064	*
CEO tenure	0.003 (0.008)	0.702		0.001 (0.008)	0.866		0.001 (0.008)	0.841	
Firm variables									
Firm advertising exp. (log)	0.040 (0.014)	0.005	***	0.040 (0.014)	0.004	***	0.040 (0.014)	0.005	***
Firm age (log)	0.189 (0.079)	0.017	**	0.187 (0.079)	0.019	**	0.188 (0.079)	0.018	**
Firm available slack	0.090 (0.035)	0.011	**	0.087 (0.034)	0.013	**	0.085 (0.034)	0.015	**
Firm R&D exp. (log)	0.047 (0.020)	0.021	**	0.047 (0.020)	0.022	**	0.046 (0.020)	0.025	**
Firm size (log)	0.168 (0.050)	0.001	***	0.178 (0.050)	0.000	***	0.176 (0.050)	0.000	***
BM dependence on I. & K	0.903 (0.463)	0.051	**	0.960 (0.039)	0.039	**	1.104 (0.471)	0.019	**
Industry variables									
Emerging digital competition	0.009 (0.008)	0.238		0.010 (0.008)	0.201		0.010 (0.008)	0.189	
Industry R&D exp. (log)	0.029 (0.032)	0.366		0.028 (0.032)	0.385		0.027 (0.032)	0.402	
Industry size (log)	0.113 (0.097)	0.244		0.108 (0.098)	0.268		0.114 (0.097)	0.242	
Main effect									
CEO humility				0.015 (0.004)	0.000	***	0.014 (0.004)	0.001	***
Cross-level interaction effects									
CEO humility × Emerging digital competition							0.001 (0.001)	0.031	**
CEO humility × BM dependence on I. & K.							0.045 (0.043)	0.288	
Additional information									
Degrees of freedom	31			32			34		
Wald $\chi 2$ (sig.)	329.91***			346.67***			353.38***		
Log-likelihood	-3225.95			-3219.62			-3216.99		
AIC	6519.90			6509.24			6507.98		

Notes. N = 1,564 years from 183 firms. Year-fixed and industry-fixed effects included. SEs in parentheses. Two-tailed tests with $*p < .1$; $**p < .05$; $***p < .01$.

Affidavit

I hereby declare that I completed the papers submitted and listed hereafter independently and with only those forms of support mentioned in the relevant paper or in the following supplementary list. When working with the authors listed, I contributed no less than a proportionate share of the work. In the analyses that I have conducted and to which I refer in the papers, I have followed the principles of good academic practice, as stated in the Statute of Justus Liebig University Giessen for Ensuring Good Scientific Practice.

List of Papers

- **Ademi, P.**, Schuhmacher, M.C., and Bausch, A. (2022). The Transfer of Digital Technologies from Entrepreneurial Ventures to Incumbent Firms: An Affordance Perspective. *Working Paper*.

- **Ademi, P.**, Schuhmacher, M.C., and Zacharakis, A.L. (2022). Evaluating Affordance-Based Opportunities: A Conjoint Experiment of Corporate Venture Capital Managers' Decision-Making. Published online in *Entrepreneurship Theory and Practice*. https://doi.org/10.1177/10422587221134788

- **Ademi, P.**, Schade, P., and Schuhmacher, M.C. (2022). Contextualizing Corporate Venture Capital: A Multi-Level Analysis of CEO Humility and the Urgency for Digital Transformation. *Working Paper*.

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