Growth Trajectories of Digital Startups: Empirical Evidence and Directions for Digital Entrepreneurship Research

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More than machinery, we need humanity.

– Charles Chaplin, 1940

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I hope you find it enjoyable and insightful.

ABSTRACT

This thesis contributes to a more comprehensive understanding of the growth trajectories of digital startups. It sheds light on the increasing diffusion of digital technologies in various areas of entrepreneurial activity and highlights challenges that emerge during rapid growth. To balance depth and breadth in theorizing, empirical insights from a longitudinal, in-depth investigation of a rapidly growing startup were complemented by a qualitative interview study with founders and C-suite managers of 30 high-growth digital startups in nine countries. While employing the action design research method provided a cross-hierarchical view of the phenomenon based on a single case, a grounded theory analysis of the additional semi-structured interviews revealed a more nuanced perspective through a managerial lens. Both were accompanied by literature reviews, which provided a solid theoretical foundation and ensured that the findings could be positioned within ongoing debates at the intersection of entrepreneurship and digital technologies. The individual contributions to this cumulative dissertation provide multiple implications for theory and practice in the emerging field of digital entrepreneurship.

TABLE OF CONTENT

1 INTRODUCTION

Motivation. Scholarly interest in how digital technologies shape the growth trajectories of digital startups has intensified in recent years (Cavallo et al., 2019; Lin & Maruping, 2022; Nambisan, 2017; Sahut et al., 2021; Wimelius et al., 2023). Within this domain, high-growth startups constitute a particularly influential subset (Huang et al., 2017; Lange et al., 2023; Piaskowska et al., 2021). These ventures are central actors in regional entrepreneurial ecosystems and widely recognized as disproportionate contributors to net employment creation in the broader economy (Autio & Rannikko, 2016; Hamilton & Ng, 2025; Henrekson & Johansson, 2010). However, despite rich accounts of startups' growth challenges and mature theories of organizational change, our understanding of how digital startups grow and how founders and managers navigate the specific challenges of rapid growth remains limited. This thesis seeks to advance theorization of this highly relevant yet under-explored phenomenon in the dynamic field of digital entrepreneurship. In examining this phenomenon, two streams of research merit particular attention.

First, this concerns the increasing diffusion of digital technologies in all areas of entrepreneurial activity, which challenges current understanding of how new ventures evolve. Digital technologies carry the potential to fundamentally disrupt whole industries and entire entrepreneurial ecosystems (Autio et al., 2018; Kretschmer & Khashabi, 2020; Nambisan et al., 2018; Zuzul & Edmondson, 2017), shape internal and external collaboration and communication (Bailey et al., 2022; Lin & Maruping, 2022; Schreieck et al., 2021), and transform business models through innovative products and services (Lehmann et al., 2022; Oehmichen et al., 2023; Yoo et al., 2012). For startups, digital technologies are considered crucial in the venture creation process (Cavallo et al., 2019; von Briel et al., 2018).

In view of the transforming role of digital technologies, the body of knowledge on growth models provides a solid foundation to understand the growth trajectories of digital startups. Given their rich tradition in organization science and adjacent disciplines, growth models aim to capture the increasing complexity during organizational growth by depicting reality through stages of growth (Churchill &

Lewis, 1983; Greiner, 1998; Scott & Bruce, 1987). Each stage reflects manifold socio-technical challenges—such as establishing professional management or implementing formal systems—that must be anticipated and overcome (e.g., Ingley et al., 2017; Kindström et al., 2024). This deterministic view of organizational growth also led to the development of the concept of dynamic states as a contemporary alternative that emphasizes greater flexibility and openness (Levie & Lichtenstein, 2010; Sternad & Mödritscher, 2022). However, despite recent advances in this field, digital startups have been incorporated into growth model research—particularly in high-growth settings—only marginally. Hence, the first overarching research objective aims to better understand how digital technologies shape the growth trajectories of startups from a growth model perspective.

Second, this pertains to the enabling role of digital technologies in the specific context of high growth and scaling. This interest is based, among others, on the important contributions of fast-growing startups to the economy—such as job creation, innovation, or strengthening regional competitiveness (Acs et al., 2008; Birch, 1987; Gallagher & Miller, 1991; Hamilton & Ng, 2025; Piaskowska et al., 2021). Digital technologies have the potential to significantly accelerate business growth and strengthen the survival of new ventures by creating competitive advantages (Huang et al., 2017; Moedt et al., 2024; Piaskowska et al., 2021). For instance, the development of a business-aligned digital infrastructure that supports scalability and flexibility is considered a key factor for rapid growth (Coviello et al., 2024; Huang et al., 2017; Nambisan et al., 2018; Tilson et al., 2010; Wimelius et al., 2023). Hence, the second overarching research objective is to advance scholarly understanding of the role of digital technologies in the growth process by identifying specific challenges and tensions that digital startups encounter during phases of rapid growth.

Research approach. To balance depth and breadth in theorizing, in-depth insights from a three-year investigation of a rapidly growing startup were combined with semi-structured interviews with founders and C-suite managers of 30 additional startups from nine countries. The unique case, investigated employing the action design research method, provided the foundation for the qualitative interview study, in which the grounded theory method supported rigorous analysis of data and the generation of novel theory on the growth of digital startups. Multiple literature reviews accompanied this process and provided a solid theoretical foundation by contrasting extant theory with empirical insights.

Contribution. This thesis carries a wide range of implications for theory and practice. From a theoretical perspective, the individual contributions to this cumulative dissertation advance the emerging scholarly nexus of digital entrepreneurship by critically examining the role of digital technologies in shaping digital startups' growth trajectories. From a practical perspective, the findings help founders and managers anticipate the challenges and tensions that emerge when navigating the turbulences of rapid internal and external change.

2 THEORETICAL AND CONCEPTUAL FOUNDATIONS

2.1 Growth Trajectories of Digital Startups

2.1.1 The Value of Growth Models

Growth model research served as a solid starting point for theorizing the growth trajectories of digital startups. It has a long tradition in organization science and provides valuable insights into organizational change—from the dynamic venture creation process to complex incumbent firms (Churchill & Lewis, 1983; Galbraith, 1982; Greiner, 1972; Mount et al., 1993; Scott & Bruce, 1987). The conceptualization of organizational growth in stages has attracted much interest in theory and practice and informs the understanding of emerging challenges in the lifecycle of organizations. Literature has revealed that growth—and, thus, the accompanying increase in the number of employees—exacerbates coordination and communication problems, requires the introduction of new functions and hierarchical levels, and necessitates the introduction of formal systems, rules, and processes to cope with the increasing complexity of the maturing organization (Churchill & Lewis, 1983; Greiner, 1972; Hannan & Freeman, 1984; Mintzberg, 1979; Scott & Bruce, 1987). For instance, leadership challenges—such as establishing professional management or supervising employees—manifest in changes to organizational structure and managerial style. Following this, the organizational structure may evolve from an informal arrangement in phase I into a matrix of teams in phase V, while the managerial style shifts from an individualistic, entrepreneurial approach in phase I to a participative approach in phase V (Greiner, 1998).

However, while growth models support determining when and what challenges are likely to occur, they differ considerably in terms of their unit of analysis (e.g., the evolution of small or incumbent businesses), included attributes (e.g., organizational structure or managerial style), or number of stages (e.g., three as in Lippitt & Schmidt (1967), or ten as in Adizes (1979)). Despite this plethora of variation, the stage-based approach is well-established in related disciplines. For instance, it provides valuable insights for information systems—to manage crises in data processing (Nolan, 1979)—and entrepreneurship—focusing on dominant problems of new, technology-based ventures (Kazanjian, 1988). Given this long-standing tradition, recent studies have advanced the body of knowledge on growth models. For instance, Mamabolo and Myres (2020) linked entrepreneurs' skills to different stages, while An et al. (2020) investigated entrepreneurial decision-making logics (i.e., effectuation, causation, and bricolage) in new ventures.

Two aspects need to be considered when leveraging growth model research to understand the growth trajectories of digital startups. First, critiques of growth models stem from their deterministic viewpoint. This is illustrated by the lack of empirical validation of growth models, by debates regarding the number of stages and the attributes that should be included, and by the limited consideration of inherent dynamics of growth (e.g., Clarke et al., 2014; Davidsson & Gruenhagen, 2021; Es-Sajjade et al., 2021; Hanks et al., 1994; Kazanjian, 1988; Levie & Lichtenstein, 2010; Solli-Sæther & Gottschalk, 2010). Consequently, scholars have emphasized the need for further empirical research on the dynamics of entrepreneurial growth (see, e.g., Ingley et al., 2017; Levie & Lichtenstein, 2010; Sternad & Mödritscher, 2022). Second, new technologies potentially blur the distinction between stages (Mosca et al., 2021). As the intertwining of growth models and digital startups is still in its infancy, a fuller understanding of the role of digital technologies in the growth process carries valuable implications for theory and practice.

2.1.2 The Role of Digital Technologies

The diffusion of digital technologies—broadly defined as "combinations of information, computing, communication, and connectivity technologies" (Bharadwaj et al., 2013, p. 471)—impacts almost all areas of corporate activity (Baier et al., 2023; Bailey et al., 2022). For instance, digital technologies (e.g., cloud computing, artificial intelligence) have the potential to fundamentally reshape internal and external communication and collaboration (Bailey et al., 2022; Lin & Maruping, 2022) and transform all kinds of business processes and routines (Baiyere et al., 2025; Hess et al., 2016; Nambisan, 2017; Warner & Wäger, 2019; Zimmer et al., 2023). They have led to the emergence of new functions and placed novel demands on leadership (Eberl & Drews, 2021; Steininger et al., 2022) and can shape innovation activities (Chan et al., 2020; Kollmann et al., 2021; Lehmann et al., 2022; Nambisan et al., 2019; Oehmichen et al., 2023; Yoo et al., 2010, 2012).

Given their central role in growth, digital technologies have the potential to affect competitive advantage and, consequently, firm performance, for example by facilitating or inhibiting organizational agility (Kaganer et al., 2023; Khalil & Winkler, 2023; Lu & Ramamurthy, 2011; Sambamurthy et al., 2003; Zuzul & Tripsas, 2020). This duality becomes particularly evident when considering the implementation of a digital infrastructure. While it may enhance an organization's agility by facilitating cross-functional communication and supporting data-driven decision-making, it may also compromise an organization's agility if it fails to accommodate growth through scalability or flexibility (Crick & Chew, 2020; Khalil & Winkler, 2023; Lu & Ramamurthy, 2011; Sambamurthy et al., 2003; Tallon & Pinsonneault, 2011). Accordingly, the duality of digital technologies presents both opportunities and challenges in the growth process of startups, while simultaneously changing theoretical understanding of how organizations grow.

2.1.3 The Case of High Growth

In an entrepreneurial context, several metaphors for rapidly growing firms have emerged, such as unicorns—(high-tech) ventures valued at over US$1 billion (Coviello et al., 2024; Cristofaro et al., 2023; Piaskowska et al., 2021). Another prominent example is gazelles: high-growth firms that face unique organizational challenges while they “move between small and large quickly—at various times in either direction” (Birch & Medoff, 1994, p. 163). Given that growth is a multifaceted phenomenon (Delmar et al., 2003; Lange et al., 2023), these metaphors are defined differently across studies (for gazelles, see, e.g., Henrekson & Johansson (2010)). For instance, definitions incorporate varying qualitative criteria, including high growth measured in terms of employees, sales, productivity, physical output, or market value (see, e.g., Birch et al., 1995; Coviello et al., 2024; Delmar et al., 2003; Hamilton & Ng, 2025; Henrekson & Johansson, 2010; Rasmussen et al., 2018).

However, within this jungle of metaphors, definitions, and criteria that reflect the heterogeneity of high-growth firms, retaining the advantages of small size (i.e., sustaining the ability to respond flexibly and at a fast pace to internal and external change) is generally considered a major competitive advantage (Churchill & Lewis, 1983). Against this backdrop, rapid growth entails a plethora of challenges for new ventures, highlighting the complex nature of early organizational development (DeSantola & Gulati, 2017; Hamilton & Ng, 2025; Lange et al., 2023; Moedt et al., 2024). For instance, the leadership requirements in managing high-growth firms differ from those associated with launching new ventures (Moedt et al., 2024). This is exemplified by the transition of a digital startup founder to CEO in view of potentially limited management skills and experience (Lange et al., 2023).

In addition, digital technologies have been identified as a key factor enabling rapid organizational growth (Bohan et al., 2024; Cavallo et al., 2019; Coviello et al., 2024; Giustiziero et al., 2023; Huang et al., 2017; Lange et al., 2023; Steininger et al., 2022). For instance (referring to the example from the previous sub-chapter), developing a digital infrastructure that meets business needs is essential for the growth and scaling of digital startups (Henfridsson & Bygstad, 2013, 2024; Huang et al., 2017; Koutsikouri et al., 2018). Hence, digital artifacts and technologies are pivotal to theorizing the growth trajectories of high-growth digital startups and enabling competitive advantage in practice.

2.2 Supplementary Theoretical Lenses

2.2.1 Socio-Technical Systems Theory

To understand the growth trajectories of digital startups, it is necessary to consider their strong interconnection with digital technologies. Socio-technical systems theory has a long research tradition and provides a revealing glimpse into the mutual influence of people and technologies in the context of organizational change (e.g., Leavitt, 1965; Orlikowski, 2000; Henfridsson & Bygstad, 2013). Here, the "technical system is concerned with the processes, tasks, and technology [...] [while] the social system is concerned with the attributes of people (e.g., attitudes, skills, values), the relationships among people, reward systems, and authority structures" (Bostrom & Heinen, 1977a, p. 17). The systems need to be optimized jointly, as people shape the technology structure that shapes their actions (Bostrom & Heinen, 1977b; Orlikowski, 2000). For instance, adopting a socio-technical perspective may guide organizations in developing digital infrastructure with regard to both social and technical requirements (Tilson et al., 2010). In this thesis, the perspective contributed to a better framing of change processes and revealing startup-specific challenges during the digital infrastructure evolution (see, e.g., paper IV or V). Thus, as digital technologies occupy a prominent position in the growth trajectories of digital startups, adopting a socio-technical lens led to a more holistic consideration of social and technical aspects and their synergistic relationship. This proved valuable for both theory and practice (e.g., when theorizing the evolution of the digital infrastructure of digital startups and deriving recommendations for action).

2.2.2 Tensions and Contradictions

In the context of growth-related challenges, the rich body of knowledge on tensions and contradictions provided further insights that contributed to a solid theoretical foundation for understanding the growth trajectories of digital startups (see, e.g., paper VII). While research on tensions in the digital realm is increasing (e.g., with regard to ambidexterity in the evolution of digital infrastructure (Montealegre et al., 2019), information technology (IT) consulting firms' activities (Werner et al., 2024), digital platform business models (Mini & Widjaja, 2019), or digital and IT transformation (Gregory et al., 2015; Kratochvil, 2025)), their consideration in the context of rapidly growing digital startups is still in its infancy. In light of the pervasive role of time in organizational phenomena (Mathias et al., 2018), rapid growth potentially accelerates the rendering of latent tensions salient. This pressures founders and managers to respond to their manifestations in conflicts in a shorter period. In the process, competing identities may create "conflict and ambiguity regarding strategic action" (Smith & Lewis, 2011, p. 383), potentially leading to organizational inertia. Furthermore, this might also create high-growth-specific tensions, which present a promising avenue for future research in the field of digital entrepreneurship.

However, there is a lack of conceptual clarity regarding tensions (e.g., as paradox, contradiction, duality, dualism, dialectic, or dilemma) in the literature (Farjoun & Fiss, 2022; Putnam et al., 2016; Smith & Lewis, 2011). One way to understand the emergence and mechanisms of tensions in digital startups experiencing rapid growth is through a paradox lens reflecting "contradictory yet interrelated elements (dualities) that exist simultaneously and persist over time" (Smith & Lewis, 2011, p. 387). For instance, Smith and Lewis (2011) cataloged organizational tensions in paradoxes of belonging (identity/interpersonal relationships), learning (knowledge), organizing (processes), and performing (goals). These four categories build on prior work on this topic and represent interrelated core activities and elements in organizations (Lewis, 2000; Lüscher & Lewis, 2008; Quinn, 1988), and they provided valuable guidance to approaching the challenges that high-growth digital startups face.

Another lens is dialectics, which has a long research tradition rooted in different historical perspectives (Benson, 1977; Bhaskar, 2008; Schneider, 1971). Frequently, organizational studies build on Hegelian or Marxian philosophy when contrasting dialectics with paradoxes in organizational change (Berti & e Cunha, 2022; Hargrave & van de Ven, 2017; Langley & Sloan, 2012; Las Heras et al., 2024; Lewis & Smith, 2022). This is often related to the "notions of thesis, antithesis, and synthesis as the unity of opposites" (Putnam et al., 2016, p. 11). Like paradox, dialectics is "rooted in the premise that human understanding of reality is composed of logically and socially constructed contradictions—opposed yet interdependent elements which presuppose each other for their existence and meanings," but it follows a different approach to contradictory elements (Hargrave & van de Ven, 2017, p. 325).

While paradox theory deals with the question of how "organizations and managers can effectively engage in A and B simultaneously" (Smith & Lewis, 2011), dialectics rather focuses on the dynamic interplay of oppositions in a processual manner (Baxter & Montgomery, 1996). Similarities are reflected by the notion of contradictions "that form the roots of dialectics and paradox" (Putnam et al., 2016, p. 10). In light of this, contradictions potentially become productive or dysfunctional (Farjoun & Fiss, 2022), which can be related to vicious and virtuous cycles from paradox theory. However, a dialectical connection can exist without contradiction (Bhaskar, 2008) and does not necessarily lead to change (Farjoun & Fiss, 2022). Hence, tensions in general—and employing a paradoxical and dialectical approach to these in particular—seem fruitful for advancing understanding of entrepreneurial change, sources of contradictions, and the resolution of conflicts in rapidly growing digital startups.

2.2.3 Enterprise Architecture

The field of enterprise architecture research provides another perspective on transformative processes in entrepreneurial settings. Enterprise architecture, with its holistic view of the organization and its environment, aims to improve business–IT alignment by documenting the current state and providing a roadmap to a target state (Kurnia et al., 2021; Tamm et al., 2011). For this purpose, research and practice have developed numerous models and best practices (see, e.g., Bui, 2017; Simon et al., 2013; Winter & Fischer, 2006). These models relate relevant artifacts of a company to each other, covering strategic aspects and business processes as well as the technical infrastructure, including software and hardware (Winter & Fischer, 2006).

While enterprise architecture research has focused on large companies with significant financial resources and IT expertise, practical implications and guidance for small and medium-sized enterprises are scarce. For instance, these might lack the resources and expertise to fill out complex architecture models. In addition, more mature architectures do not necessarily add business value (Ross & Quaadgras, 2012). Hence, enterprise architecture scholars have postulated the creation of an value-oriented architecture support (see, e.g., Horlach et al., 2020). This approach emphasizes the development of lightweight, pragmatic models and visualizations, rather than heavyweight, complex ones, while highlighting their specific benefits for individual departments and employees (Winter, 2016). To bridge the gap between theoretical modeling and practical application, the advantages of enterprise architecture were applied to the context of digital entrepreneurship. Doing so supported both a holistic view of the startup in the action design research project and the subsequent theorizing of startups' digitality.

2.2.4 Digitality

As this thesis aims to elucidate the growth trajectories of digital startups, a brief reflection on their nature is required. The ontological foundations of "digital" were recently discussed in the digital x discourse (Baiyere et al., 2023; Rodriguez & Piccoli, 2018). It was aimed at providing conceptual clarity in distinguishing between the terms "digital" and "IT" (e.g., in the context of digital—or IT—transformation, strategy, or infrastructure), which is critical for both empirics and theory (Baiyere et al., 2023, 2024, 2025; Wessel et al., 2025). With regard to the thesis, it proved particularly useful in clarifying what makes a startup digital and, thus, in reducing conceptual ambiguity between digital and non-digital startups, which was necessary for selecting interviewees.

However, other approaches—such as distinguishing between IT-facilitated startups, IT-mediated startups, IT-bearing startups, and digital startups (Steininger, 2019)—were considered. Following his work, digital startups represent "new ventures that use IT in the role of a ubiquity, meaning that they leverage completely IT-driven and digital business models for their value creation and capture" (Steininger, 2019, p. 382). However, this was only partially compatible with the understanding that digital startups can be both hardware- and software-centric. This is more closely related to the concept of born versus grown digital organizations, in which grown digital organizations acquire digital capabilities over time rather than at founding, and highlights the central role of digital technologies and digital infrastructure in the growth process (Tumbas et al., 2015, 2018). Huang et al. (2017, p. 301) consider digital ventures as "startups growing by drawing on and adding to digital infrastructures" (see also paper VIII with regard to the definition of a digital infrastructure). This later led to the widespread adoption of Lin and Maruping's definition of digital startups as "startups that have digital artifacts at the core of their business model for value creation and capture" (Lin & Maruping, 2022, p. 212).

In sum, these approaches reflect the need for a "careful consideration of digital technologies and their unique characteristics in shaping entrepreneurial pursuits" (Nambisan, 2017, p. 1029), as they result in new startup processes and outcomes due to digital artifacts, platforms, and infrastructures that may differ from those of traditional startups (Baier et al., 2023; Kallinikos et al., 2013; Zaheer et al., 2019). An overview of digital technologies can be found in the comprehensive research article by Baier et al. (2023). Hence, digital technologies can be considered decisive factors in differentiating between digital and non-digital startups, which was relevant for selecting interviewees and later led to the development of degrees of digitality (see paper V) that aim to better represent the digital shades of digital startups.

3 RESEARCH DESIGN

3.1 Philosophical Underpinning

To understand the growth trajectories of digital startups, reason and experience ought not to be considered in isolation; rather—in light of ratio-empiricism as their synthesis—theories as "products of reason […] must be checked by empirical operations, and these in turn must be designed in the light of theories" (Bunge, 1996, p. 322). Research on growth models provided initial insights into theorizing the growth of digital startups. However, existing theoretical assumptions are challenged by the diffusion of digital technologies. In view of limited empirical validation and constrained sample sizes, growth models might also not accurately depict the reality of every venture (Levie & Lichtenstein, 2010; Mount et al., 1993). Bunge (1996, p.

337) described the possibility of incomplete observations with the following anecdote: “A scientific research team is radically different from a primitive tribe—not in its operations being mysterious, but in their having an extremely specialized function, that of producing scientific knowledge through processes that, unlike gathering, hunting, or fishing, are not in full view.” With regard to growth model research, the empirical investigation of digital startups revealed both similarities and inconsistencies with established models and frameworks, which led to new theory development—the combination of stage-based models with dynamic states (see paper VI).

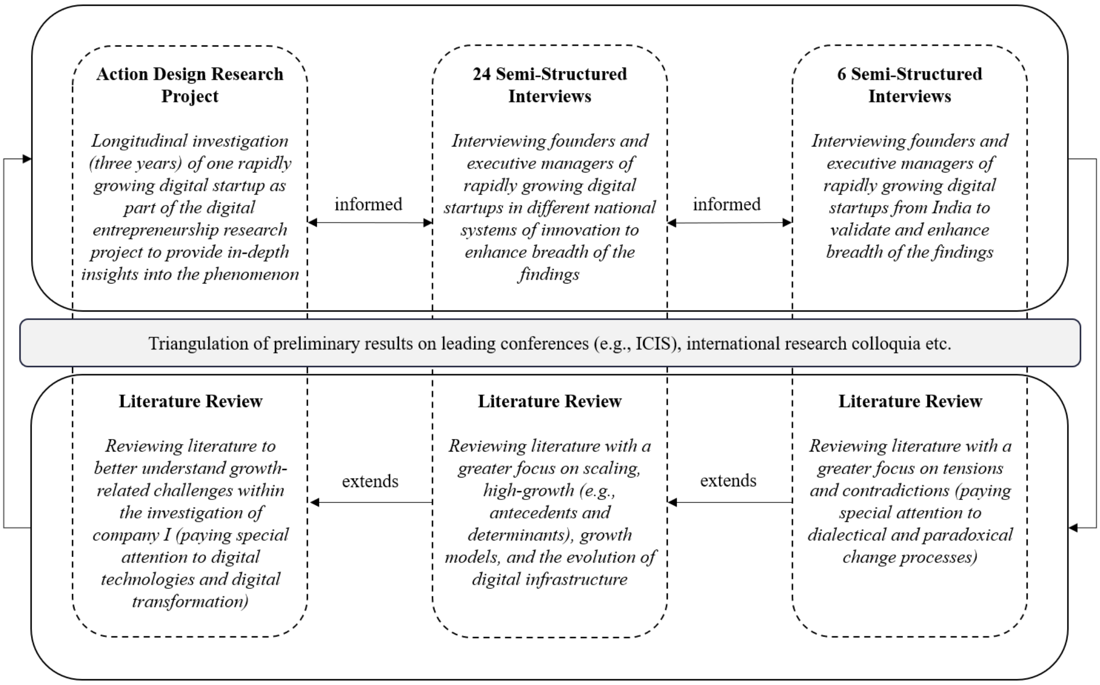
Realism centers around the idea that theories aim to reliably depict reality even though knowledge of it may not be perfect (Mingers & Willcocks, 2004; Smith, 2006). In contrast to naïve realism, “where truth is simply the direct product of experiences” (Smith, 2006, p. 200), this thesis takes the stance of critical realism rather than an interpretivist or positivist paradigm (see, e.g., Alvesson & Sköldberg, 2009; Bhaskar, 1978). As a philosophical underpinning, critical realism allowed critical reflection on the generative mechanisms and limitations of existing approaches (e.g., with regard to growth models or the digital infrastructure evolution) without restriction to specific research methods (Henfridsson & Bygstad, 2013; Maxwell, 2012; Mingers & Willcocks, 2004; Wynn & Williams, 2012).

3.2 Setting

3.2.1 Chronological Sequence

The origin of this thesis lies in a three-year research project on digital entrepreneurship. It was aimed at strengthening the small and medium-sized economy of a transition region in northern Germany against the backdrop of the increasing intertwining of entrepreneurial activities and digital technologies. In the collaboration between two universities (involving six professors from various disciplines, such as information systems and strategic management) and several multipliers (e.g., the Chamber of Industry and Commerce), more than 20 participating companies were examined from various perspectives and accompanied throughout their transformations. Two of the companies demonstrated an increased demand for digital transformation measures due to growth-related operational inefficiencies and were further investigated using the action design research method (see papers I and II). Due to its rapid growth and technology-related challenges, one (company I) later became the cornerstone of further research into the growth trajectories of digital startups (Figure 1).

Figure 1. Overview of the Research Endeavour



The in-depth insights gained in the action design research project with company I allowed for a better understanding of the growth trajectories of digital startups and provided the foundation for the following interview study on rapidly growing digital startups ("digital gazelles"), which forms the core of this thesis. The additional semi-structured interviews with founders and C-suite managers of 30 predominantly fast-growing digital startups were conducted in several phases. Most of these were collected during the action design research project through personal and professional networks, LinkedIn and email outreach, and a research stay of several weeks at the Victoria University of Wellington in New Zealand. The interviews also informed the collaboration with company I by providing empirical insights on similar challenges (e.g., with regard to developing the digital infrastructure) during growth. Additional interviews were conducted after the action design research project and ultimately supplemented during a half-year research stay at the Indian Institute of Technology in Delhi (on-site and remotely) in 2025.

The empirical investigation was accompanied by several (semi-systematic) literature reviews (i.e., the search and synthesis of phenomenon-related literature and the derivation of avenues for future research through identified knowledge gaps), which significantly influenced collaboration efforts within and theorizing beyond the action design research project. The reviews crossed disciplinary boundaries and synthesized findings from different streams of research to generate a better theoretical understanding of digital startups and their growth trajectories, validated, adapted, or falsified by the empirical data.

Geared toward the research objective and target group, different guidelines and frameworks for the literature reviews were applied (e.g., Paré et al., 2015; Schryen et al., 2017; Snyder, 2019; Webster & Watson, 2002), which supported rigor in the documentation of the search process (vom Brocke et al., 2009, 2015). In the process—depending on the degree of interdisciplinarity—various databases were searched for peer-reviewed articles in high-ranking journals and selected conference proceedings. For instance, it included the fields of information systems (e.g., the AIS senior scholars' list of premier journals and the *International Conference on Information Systems*), entrepreneurship (e.g., *Entrepreneurship Theory and Practice*, *Journal of Business Venturing*, *Strategic Entrepreneurship Journal*), and organizational studies (e.g., *Academy of Management Journal*, *Organization Science*, *Strategic Management Journal*) (see paper V for a more detailed description of the process). This was usually followed by a forward and backward search of pertinent articles (e.g., to create a more comprehensive overview of existing (and relevant) definitions, concepts, dimensions, and characteristics). The findings flowed reciprocally into the research project, the design of the interview guidelines, and the selection of interviewees. As the focal point of research changed over time (i.e., from growth-related challenges to a more general understanding of digital startups' growth trajectories), search terms were constantly adapted and expanded (e.g., with regard to the digital x discourse that emerged in the later process).

Empirical data from the semi-structured interviews and the action design research project and extant theory from the literature reviews were—to a certain extent—therefore considered together. This is reflected, for example, by bridging theory on stage-based growth models with dynamic states, paying attention to the role of digital technologies in digital startups' growth processes (see, e.g., paper VI). Hence, in light of questioning existing theory, empirically observing the phenomenon, and generating new theory, shifting between inductive and deductive reasoning supported a continuous revision and sharpening of the research design (Alvesson & Kärreman, 2011; Charmaz, 2006).

3.2.2 Action Design Research Project

To enhance depth in theorizing, this thesis draws on extensive insights obtained in the action design research project (see papers I and II). While this project included the investigation of another, more mature company, it was particularly company I—an entrepreneurial online marketing agency that achieved continuous rapid growth in terms of employees and sales—that provided an initial understanding of the multitude of socio-technical challenges that arise during rapid growth.

Action design research (Sein et al., 2011) lies at the intersection of design science research (Baskerville et al., 2018; Hevner et al., 2004) and action research (Baskerville & Wood-Harper, 1998; Susman & Evered, 1978). The building, intervention, and evaluation of an artifact aim both to generate knowledge and to provide practical solutions (Sein et al., 2011). While designing artifacts occupies a prominent position in the information systems discipline (Orlikowski & Iacono, 2001; Sein et al., 2011), it has also been applied to adjacent fields, including entrepreneurship research (e.g., Seckler et al., 2022). Artifacts manifest, for example, as software, models, or methods (Baskerville et al., 2018; Hevner et al., 2004; March & Smith, 1995; Peffers et al., 2007; vom Brocke et al., 2020). Examples of such artifacts include decision support systems, process models, and methods for information systems evaluation (Gregor & Hevner, 2013; Hevner et al., 2004; Peffers et al., 2007). In general, a design science approach is considered appropriate for generating prescriptive knowledge and solving real-world challenges posed by digitalization in the economy and in society (vom Brocke et al., 2020).

The application of the action design research method provided firsthand insights and facilitated the generation of both design knowledge and a practice-oriented solution, with an emphasis on digitalization strategies. The action design research process encompasses four stages, each grounded in a set of principles that guide the development of an artifact. At the problem formulation stage, discussions with the two founders revealed that the company faced significant challenges due to inefficient processes, redundant data, and nonintegrated software solutions, highlighting the need for a holistic approach to digital transformation. This motivated the development of a digitalization strategy informed by enterprise architecture principles. At the building, intervention, and evaluation stage, companies' enterprise architecture—particularly the integration of processes and software solutions—was analyzed collaboratively with founders, managers, and other employees. In this process, eight cross-hierarchical semi-structured interviews from CEO(s) to trainee were conducted (Table 1). The investigation was later extended by an additional interview with the COO, who gradually transitioned into the role of CEO.

Table 1. Data – Action Design Research Project (Company I)

Interviewee	**Years*1**	**Length*2**	**Secondary Data**
Founder/CEO (1x)	>10	92	Rich business process and enterprise architecture descriptions and visualizations (e.g., software and hardware, vision and mission, organizational chart, products and services, stakeholder, partnerships), workshops on digital transformation, challenges, and success factors during rapid growth (on-site and virtual), logged phone calls, press reports, website, financial and funding statements, social media posts etc.
Founder/CEO (1x)	>10	73	
COO/CEO*3 (2x)	>6	60/63	
Head of Consulting	>4	29	
Head of Software Development	>2	23	
Head of Social Media	>7	20	
Head of Paid Media	>5	22	
Trainee	<1	34	

*1 = years of experience in the company; *2 = interview duration (in minutes); *3 = first interview as COO, second interview as CEO

The interview questions focused on the digital transformation of the maturing startup and, thus, informed our understanding of the emergence of socio-technical challenges from multiple perspectives. Without delving too deeply into the literature on tensions (e.g., with regard to a paradoxical or dialectical perspective) at this point, this approach was particular advantageous for understanding the emergence of contradictory elements at multiple organizational levels. For instance, tensions surfaced during the implementation of a new enterprise resource planning system (e.g., related to user resistance when weighing up personal software preferences with overarching goals such as data-driven decision-making requiring integration). More generally, tensions also became evident in the rapidly expanding organizational structure, particularly when identity shifts occurred as sub-cultures emerged. Simultaneously, a substantial amount of secondary data was collected from workshops, video conferences, and archival data (e.g., software and process descriptions), providing a comprehensive basis for the development of the digitalization strategy.

Parallel to the first two stages, the learning and evaluation stage supported the conceptional transfer of insights from the development of the digitalization strategy to a broader class of problems—a solution for other small and medium-sized enterprises (for a detailed description, see papers I and II). The process of developing and evaluating the artifact was informed by existing knowledge, in particular that drawn from literature reviews at the intersection of information systems—especially enterprise architecture—and entrepreneurship. The action design research project, which culminated in a comprehensive redesign of the company's digital infrastructure, led to the development of a lightweight method for developing digitalization strategies based on enterprise architecture principles. Grounded in four design principles which were formalized in stage four, the artifact facilitates sustainable business–IT alignment in small and medium-sized businesses. At the same time, the action design research project sparked a growing research interest in the growth trajectories of digital startups—particularly in the challenges and tensions that emerge during phases of rapid growth—which were further investigated in the qualitative interview study.

3.2.3 Qualitative Interview Study

To enhance breadth in theorizing, a qualitative interview study was conducted (DeMarrais, 2004). It involved semi-structured interviews with founders and C-suite managers of 30 fast-growing digital startups of different sizes and ages (Table 2). As Bansal and Corley noted, "quantitative researchers typically look at a handful of "trees" and try to draw the implications for the forest […] [whereas qualitative researchers] are trying to see the forest through the trees" (Bansal & Corley, 2012, p. 511). Adopting a qualitative research approach was essential for theorizing the growth trajectories of digital startups and understanding the managerial challenges caused by rapid growth (DeMarrais, 2004; Gioia et al., 2013). Data analysis was therefore "closely tied to the writing process" and the theory narrative (e.g., the archetypes of digital infrastructure evolution) emerged—to some extent—later in this process (Bansal & Corley, 2012, p. 512).

Data selection. With purposeful case selection (Morse, 2007), startups in the critical growth phase between 10 to 100 employees were targeted. Substantial changes were expected across various departments and hierarchies. Two criteria were applied: high-growth and a high degree of digitality. With regard to the high-growth classification, the Organization for Economic Co-operation and Development (OECD, 2008, p. 61) provided guidance:

"All enterprises with average annualized growth greater than 20% per annum, over a three-year period should be considered as high-growth enterprises. Growth can be measured by the number of employees or by turnover."

A threshold of 10 employees was set to avoid classifying small enterprises that grow from one to two employees as high-growth enterprises (OECD, 2008) while revealing complex organizational change processes beyond the venture creation process. However, to provide a more comprehensive picture of their growth trajectories, digital startups were included that had only recently been founded (e.g., company XX), were on the edge of being considered startups due to their size (e.g., company XXVII), or had experienced significant organizational decline after previous phases of rapid growth (e.g., companies VII, IX, XXII, and XXIV). In terms of digitality, these were characterized by the intensive use of digital technologies in business models, such as a cloud-based digital infrastructure to support communication and collaboration, blockchain for payment processes, or virtual reality embedded in products (see, e.g., paper V).

TABLE 2. Sample of Startups

#	F*1	E*2	Country	Interviewee	I*3	Industry
I	2009	150	GER (-)	CEO	63	Marketing
II	2015	42	USA (ZAF)	COO	62	Renewable energies
III	2015	37	GER (-)	CEO	73	eCommerce
IV	2014	59	GER (-)	Co-founder	41	Advertising
V	2015	16	GER (-)	CTO	60	Tech
VI	2018	40	FRA (MGA)	CEO	55	Education
VII	2015	85/35*4	GER (-)	CFO	70	Electronics
VIII	2015	98	GER (NLD)	Co-founder	61	Fashion
IX	2013	33/18*4	GER (-)	COO	55	Medicine
X	2014	58/55*4	NZL (CAN, USA*5)	CEO	54	Marketing
XI	2018	22	NZL (AUS, ITA)	CEO	53	Software
XII	2007	87	NZL (USA, IRL)	CEO	54	Market research
XIII	2017	65	NZL (AUS)	CEO	53	Accounting
XIV	2014	52	NZL (-)	Co-founder	62	Automotive
XV	2008	25/22*4	NZL (-)	CEO	55	Payroll
XVI	2019	40	EST (-)	Co-founder	60	Last mile delivery
XVII	2015	198/160*4	GER (USA, GBR)	COO	51	Marketing
XVIII	2021	30	GER (-)	Co-founder	52	Automotive
XIX	2019	13	FIN (-)	CEO	62	Automotive
XX	2023	6	NIG (-)	CEO	51	Electrical engineering
XXI	2011	30	EST (-)	Co-founder	78	Education
XXII	2016	30/1*4	EST (-)	CEO	59	Robotics
XXIII	2015	201	FIN (USA +7)	CMO	61	Process automation
XXIV	2018	35/7*4	POL (USA*5)	CEO	49	IT recruiting
XXV	2012	25	DNK (USA)	Co-founder	68	Social
XXVI	2021	23	IND	CTO	56	Lifestyle
XXVII	2012	950	IND	CTO	67	Education
XXVIII	2022	60	IND (USA)	CEO	63	Fintech
XXIX	2019	43	IND	Co-founder	51	Education
XXX	2015	380	IND (USA, ARE)	CEO	54	Fintech
XXXI	2019	11	IND	CEO	57	Logistics

*1 = founding year; *2 = total number of employees; *3 = interview duration (in minutes);
*4 = highest number of employees vs. date of the interview; *5 = eventually closed

Data analysis. For rigorous analysis of the data obtained from the semi-structured interviews, the grounded theory methodology served as an appropriate tool, as it provided guidance for investigating the phenomenon and, thus, developing theory where extant theory from growth model research did not apply (Gioia et al., 2013; Strauss & Corbin, 1998). It grounds theory in data, with data collection, analysis, and theory development being closely intertwined (Strauss & Corbin, 1998). Without delving too deeply into the nuances of the Glaserian and Straussian schools (e.g., in terms of differences in the coding process), following grounded theory according to the Straussian school allowed a more active role in the research process (Jones & Noble, 2007; Locke, 2003). It also supported generating knowledge beyond theory (e.g., through high-level descriptions or conceptual ordering) (Jones & Noble, 2007; Strauss & Corbin, 1998).

The steps of open, axial, and selective coding provided valuable guidance for analyzing the phenomenon (Strauss & Corbin, 1998). In this context, Gioia et al. (2013) propose illustrating the process of theorizing by building a data structure (for a simplified example, see paper IV). This was particular useful "because it shows the progression from raw data to first-order codes to second-order theoretical themes and dimensions, which is an important part of demonstrating rigor in qualitative research" (Gehman et al., 2018, p. 286). Although these steps do not necessarily have to be performed in sequence, breaking down the data ("open coding") is usually the first step (Strauss & Corbin, 1998). By using the qualitative data analysis software MAXQDA, initial concepts were identified through a line-by-line analysis of the transcribed interviews. Then, axial coding was used. Axial coding is the "process of relating categories to their subcategory, termed "axial" because coding occurs around the axis of a category" (Strauss & Corbin, 1998, p. 123). This supported the contextualization of the phenomenon under investigation and, thus, to create patterns (see, e.g., paper VIII). Building on this, selective coding was applied, which reflects the "process of integrating and refining categories" (Strauss & Corbin, 1998, p. 143). Depending on the paper, categories were then organized around a central concept or idea in the process of theory development. For instance, this was particularly relevant for bridging stages and states theory (paper VI). However, new data gathered through additional semi-structured interviews often led to revising concepts, categories, and their relationships. Hence, developing theory, typically unfolding alongside the writing process, entailed comprehensive integration efforts that inevitably involved some degree of selectivity and interpretation (Strauss & Corbin, 1998). In some cases, within the broader aim of investigating rapidly growing digital startups, data analysis and theory generation in an earlier paper formed the basis for another paper. This is reflected in the early process of analyzing growth-related challenges, which was later built upon to bridge stages and states theory (see papers IV and VI). The development of digital infrastructure evolution archetypes, extended with pre-conditions, provides another example of the mutual influence of different analysis steps and the incorporation of new findings (see papers VI and VIII).

4 PUBLICATIONS AND THEIR CONTRIBUTIONS

The research objective has shifted over the course of writing the thesis, as is reflected in the research questions (Table 3).

Table 3. Paper – Overview of Research Questions

#	Research Question
Paper I	*How can SMEs develop and implement digitalization strategies using a lightweight architecture-based method?*
Paper II	*How can a lightweight, architecture-based method support SMEs in developing and implementing digitalization strategies?*
Paper III	*How to design a digital infrastructure that supports digital gazelles in staying agile?* [*]
Paper IV	*What are the challenges digital gazelles face during phases of high growth?*
Paper V	*How can we leverage the EA perspective for disentangling the digitality of startups?*
Paper VI	*How can growth models be adapted to better reflect the dynamics of entrepreneurial growth trajectories and increasing DT pervasion in digital startups?*
Paper VII	*Which tensions emerge during phases of rapid growth and how do startups navigate these?*
Paper VIII	*How does the evolution of the DI influence digital startups' early growth phases?*

[*] teaching case (not explicitly formulated research question)

This change was primarily driven by the action design research project with company I, which would later be coined a "digital gazelle" due to its high growth rate and technology use. While the initial focus was on the development of a digitalization strategy and growth-related challenges in general, the in-depth investigation motivated stronger theorizing of the growth trajectories of digital startups, with a particular emphasis on phases of rapid growth. Moreover, this also prompted a methodological change (Table 4), which led to employing the grounded theory method to analyze data collected in the qualitative interview study. In addition to multiple literature reviews spanning both the action design research project and the qualitative interview study, paper V was methodologically based on the taxonomy development process proposed by Nickerson et al. (2013) and Kundisch et al. (2022). This supplementary research approach facilitated a clear presentation of the results in view of startups' digitality through a taxonomy.

Table 4. Paper – Methodology

#	**Action Design Research**	**Grounded Theory**	**Literature Review**	**Taxonomy Development**
Paper I	x		x	
Paper II	x		x	
Paper III	(x)		(x)	
Paper IV		x	x	
Paper V	(x)	(x)	x	x
Paper VI		x	x	
Paper VII		x	x	
Paper VIII		x	x	

The empirical findings were considered in light of different strands of research, and their contributions to digital entrepreneurship research cover various areas (Table 5). For instance, while highlighting the unique challenges of rapidly growing digital startups, the findings also encourage theorizing their digital nature and advancing growth model research in general. In the following, the contribution of each manuscript is delineated.

Table 5. Paper – Areas of Contribution

#	Digital Startups and Technologies	High Growth	Growth Models	Digital Infrastructure	Enterprise Architecture	Challenges, Strategies, and Tensions
Paper I	(x)	(x)		x	x	x
Paper II	(x)	(x)		x	x	x
Paper III	x	x		x		x
Paper IV	x	x	(x)			x
Paper V	x			(x)	x	
Paper VI	x	x	x	x		x
Paper VII	x	x	(x)	(x)		x
Paper VIII	x	(x)	(x)	x		(x)

Papers I and II stem from the action design research project. The short and the full paper are dedicated to the development of a lightweight, architecture-based method for the development of digitalization strategies in small and medium-sized enterprises. The method and the associated lightweight enterprise architecture model support the creation of coordinated, comprehensive visualizations of companies, including their internal processes and external influences. A structured collection of data and the uncovering of dependencies between IT and business from an enterprise architecture perspective support setting digital transformation priorities and at the same time creating transparency. In contrast to complex, resource-intensive, and abstract frameworks, the pragmatic, visualization-oriented solution is tailored to the requirements of startups and other small and medium-sized enterprises. The steps outlined for developing a digitalization strategy also serve as a guideline for practitioners that helps them rethink their strategy, organizational structure, and use of technology in digital transformation while shedding light on socio-technical challenges in the growth process.

Paper III underscores the relevance of aligning the digital infrastructure with business needs. To transfer theory to practice, the teaching case, which is based on one of the companies from the digital entrepreneurship research project, illustrates socio-technical challenges during growth through an infrastructural lens. It highlights the tension between initial agility and the threat of inertia due to the maturing organizational structure and increasing complexity. In sum, the teaching case helps practitioners and students to understand the socio-technical challenges that fast-growing digital startups face and to develop a digital roadmap paying close attention to digital infrastructure development.

Paper IV provides additional insights on the organizational and technological challenges digital gazelles face during high growth. These were condensed into nine key challenges in their early stages of growth and supported later theorizing the revision of established growth models. In addition, this paper makes a terminological contribution by introducing and defining the concept of the digital gazelle.

Paper V sheds light on the ontological foundations of "digital" by disentangling the "digitality" of digital startups, understanding digital in this context as a spectrum rather than binary opposites. It highlights the increasing diffusion—or pervasion—of digital technologies, which supports juxtaposing traditional startups with digital startups in light of the digital x discourse (Baiyere et al., 2023; Rodriguez & Piccoli, 2018). Following the taxonomy development process of Nickerson et al. (2013) and its extension by Kundisch et al. (2022) resulted in a taxonomy of startups' digitality that integrates findings from both the action design research project and the qualitative interview study.

Paper VI builds on the insights from the previous papers and advances digital entrepreneurship research by making three main contributions toward adapting growth models, summarized as directions for future research. First, it proposes revising extant growth models by capturing the increasing digital technology diffusion in digital startups, illustrated by two growth model attributes: organizational structure and managerial style (direction I). This supports a better understanding of new forms of organizing driven by digital technologies, opportunities of global collaboration, and leadership in the digital realm. Second, it calls for extending established growth models with new attributes that better represent the increasing digital technology diffusion in digital startups. This is illustrated by digital startups' digital infrastructure evolution, which emphasizes the importance of a structure–technology fit when digital startups scale (direction II). Third, seminal research on dynamic states that contradict the dominant view of deterministic stages in growth model research is explored. Here, the need to intertwine stage-based and dynamic approaches when designing new growth models is demonstrated by four archetypes of digital infrastructure evolution (direction III). Thus, while the paper advances the understanding of the growth trajectories of digital startups, it also serves as a starting point for theory development that questions the timeliness of growth models in the digital age.

Paper VII contributes to theorizing entrepreneurial growth by addressing two key issues: the under-theorization of tensions in an entrepreneurial high-growth setting and the empirical under-investigation of managerial responses to these. Hence, it bridges a gap between the rich body of knowledge on tensions and growth-related challenges, and applies this knowledge to high-growth startups in the digital age. Novel insights into the categorization, underlying mechanisms, environmental factors, and managerial responses to tensions were revealed. Thus, it advances the insights gained related to digital startups' challenges found in papers I, II, and IV through a tension lens. At the same time, it contributes to the findings in paper VI and may serve as a starting point for theorizing stage-bound and stage-less tensions during rapid growth.

Paper VIII deepens this understanding by elaborating on the archetypes of digital infrastructure evolution of digital startups presented in paper VI. It provides additional insights into underlying mechanisms and preconditions (i.e., the social, human, and financial capital that affect the development of digital infrastructure). In addition, the paper highlights several opportunities for future research. From a theoretical perspective, the investigation of inflection points of growth (i.e., when and which orchestration efforts and tensions might emerge due to increasing complexity) seems fruitful with regard to the "late bloomer" archetype. In terms of the "architect" archetype, constructing opportunities for contributions might be grounded in the design principles of lightweight enterprise architectures or in tools supporting technological decision-making during early stages of growth. Concerning the "model pupil" archetype, it seems appealing to investigate the role of embeddedness during the growth of digital startups. For example, this could be related to the role of professional networks in the evolution of digital infrastructure and how a diversification of mentors in terms of technological and business expertise can lead to superior performance. Furthermore, from a practical perspective, skill sets relevant to different stages of growth and platforms for seeking advice from experts in selected industries might be developed. Lastly, with regard to the “orchid bee” archetype, the role of extensive financial capital could provide fertile ground for exploring how the digital infrastructure evolves in early stages. Developing state-of-the-art digital infrastructure evolution blueprints for digital and non-digital startups that tackle increasing bureaucracy and socio-technical tensions while supporting agility and scalability seems to be valuable for founders and managers and might guide policy-makers.

In sum, the individual contributions of this thesis advance the understanding of the growth trajectories of digital startups through varying lenses (Table 6). While the core of the thesis is located in the discipline of digital entrepreneurship—whether it is understood as an independent discipline at the intersection of information systems and entrepreneurship (e.g., Kollmann et al., 2022; Nambisan, 2017; Zaheer et al., 2019) or as a subdiscipline (e.g., Hull et al., 2007)—it builds on and expands adjacent disciplines. For instance, from a narrow perspective, it provides valuable implications for the field of strategic entrepreneurship in anticipating growth-related challenges, or, with a special focus on rapid internal and external change, high-growth entrepreneurship. At the same time, there is a strong link to organization science—paying particular attention to research on tensions and growth models—and, due to the exposed role of digital technologies and digital infrastructure, information systems. The overlap of different research streams was essential both for investigating the phenomenon and for revealing avenues for future research that will advance theory and practice within and beyond the field of digital entrepreneurship.

Table 6. Publications

#	Authors	Title	Outlet	Status
I	Nils J. Tschoppe Paul Drews	Supporting the Development and Implementation of a Digitalization Strategy in SMEs Through a Lightweight Architecture-Based Method	Proceedings of the 16th International Conference on Wirtschaftsinformatik (WI)	Published
II	Nils J. Tschoppe Paul Drews	Developing Digitalization Strategies for SMEs: A Lightweight Architecture-Based Method	Proceedings of the 55th Hawaii International Conference on System Sciences (HICSS)	Published
III	Nils J. Tschoppe Jan K. Tänzler Paul Drews	How to Stay Agile While Growing – (Re-) Designing the IT Landscape of a Digital Gazelle in the Online Marketing Industry	Edward Elgar Publishing (Book Chapter)	Published
IV	Nils J. Tschoppe Andreas Drechsler Paul Drews	Challenges of Digital Startups During Phases of High Growth	Proceedings of the 34th Australasian Conference on Information Systems (ACIS)	Published
V	Nils J. Tschoppe Paul Drews	Disentangling the Digitality of Startups From an Enterprise Architecture Perspective	Proceedings of the 34th Australasian Conference on Information Systems (ACIS)	Published
VI	Nils J. Tschoppe Paul Drews	Adapting Growth Models for Digital Startups: Empirical Evidence and Directions for Digital Entrepreneurship Research	Proceedings of the 45th International Conference on Information Systems (ICIS)	Published
VII	Nils J. Tschoppe Markus Reihlen Paul Drews Jan K. Tänzler	Pulling It Off Like a Crab? Navigating Tensions in High-Growth Startups	Journal	Submitted (Under Review)
VIII	Nils J. Tschoppe Paul Drews	Linking Digital Entrepreneurship and Digital Infrastructure Research: Four Archetypes of the Early Digital Infrastructure Evolution	Journal	Submitted (Under Review)

5 LIMITATIONS AND FUTURE RESEARCH

While this thesis makes significant contributions to the field of digital entrepreneurship, attention should also be drawn to limitations that could be addressed in future research.

Boundary conditions. Concerning the data collection, particular attention needs to be paid to the boundary conditions and, thus, the selection of interviewees. With regard to the application of boundary conditions, critique might be rooted in selecting startups that were on the edge to being considered digital. Although the selection was meticulously built on related criteria and definitions, their classification remains somewhat fuzzy in light of multi-faceted streams of literature and underlying assumptions. For instance, by building on the definition of Lin and Maruping (2022, p. 212), digital startups are defined as “startups that have digital artifacts at the core of their business model for value creation and capture.” Although this complicates clear classification in terms of the type of digital artifact and a definition of the core of the startup, it paints a vivid picture of the diversity found in digital startups. Both startups that placed a strong focus on software and those that digitally enhanced traditional products or used digital technologies to support design, sales, and/or collaboration were deliberately included. This may be addressed by a future discourse on the nature of startups that digitally enhance traditional products or by contrasting software startups with hardware startups in terms of their technology use. Furthermore, as digital technologies are becoming increasingly relevant, the growth trajectories and nature of artificial intelligence or purely virtual startups particularly merit further investigation.

In addition, critique can be related to applying criteria of high growth with its diverse definitions in the literature. Delmar et al. (2003) described seven growth patterns highlighting the heterogeneity of high-growth firms, which includes high absolute growth in sales and employment, a strong but erratic growth of sales and employment, or negative size development on average except for one exceptional growth year. This description was useful, as it supported a better understanding of growth patterns when choosing startups for the sample (e.g., continuous, episodic, or late rapid growth). Despite criticism, the Organization for Economic Co-operation and Development's (2008) classification of high growth is widely applied and informed the selection of interviewees (see, e.g., Coviello et al., 2024). However, the sample includes startups that did not grow for a long time but later achieved high growth rates, for example. In addition, corresponding to "hypergrowth" (Moedt et al., 2024), some startups significantly exceeded this definition. Although this raises questions as to whether they can still be characterized as startups due to their size, the retrospective management perspective offered valuable insights into earlier phases of growth. This also gives rise to various challenges depending on the type—or speed—of growth that future research could address. Furthermore, taking into account the definition of digital gazelle in paper IV, a threshold of at least US$ 100,000 in revenue was set, based on the definition proposed by Birch et al. (1995). Although the value of this boundary condition has changed over time and might be criticized and addressed in future research, it was nevertheless suitable for excluding high percentage increases in sales with low total sales in the early stages of growth.

Another point of criticism is expressed in the different founding years and ages of the startups, which complicated their comparison. Although the initial focus was on startups with 10 to 100 employees, companies that had just been founded and those that had grown so rapidly that they could be classified as medium-sized or large companies were also included. This contrast painted a more accurate overall picture, which was particularly beneficial for the investigation of growth paths of startups from a growth model research perspective. Accordingly, there are several opportunities for future research that could provide more insight into individual phases, sizes, and their similarities—or differences. In addition, reality was depicted based on a sample of 31 digital startups from nine countries, which points to research opportunities to investigate the phenomenon in different national systems of innovation (Lundvall, 2007). Moreover, by interviewing founders and executive managers, light was shed on digital infrastructure evolution only from a managerial perspective. Although the three-year action design research project provided insights into the growth path of a startup, further in-depth case studies could shed additional light on this phenomenon from different perspectives (e.g., a stronger focus on the role of employees).

Methodology. With regard to the research methodology, different approaches might support a better understanding of the phenomenon. For instance, with reference to advancing theory on growth models, the findings offer valuable insights into how they can be adapted in light of the increasing diffusion of digital technologies. One way to validate the findings is to conduct quantitative studies with digital startups of different sizes, ages, and growth rates. Doing so could provide a broader understanding of size- and phase-related challenges.

In addition, the enterprise architecture lens supported drawing a holistic picture of the company, the use of technology, and the actors involved. The lens could also be applied to other areas of research, as the paper on disentangling the digitality of startups demonstrates. Furthermore, action design research projects might deepen the findings with regard to the development of enterprise architecture-based digitalization strategies. The insights could be also enriched by a multi-case theory-building approach according to the Eisenhardt method (Eisenhardt, 1989, 2021) or by theorizing from process data according to Langley (Langley, 1999; Langley et al., 2013). Studies could additionally aim to better explain how and why challenges emerge in an enterprise architecture context and beyond. An overview of the similarities and differences between these two methods and the Gioia method (Gioia et al., 2013; Gioia & Chittipeddi, 1991), which was later used in some of the papers, can be found in the paper by Gehman et al. (2018). However, grounded theory, which "puts a high emphasis on theory as process; that is, theory as an ever-developing entity, not as a perfected product" (Glaser & Strauss, 1967, p. 32), is a particularly appropriate methodological lens for analyzing novel, adjacent phenomena within the context of digital startups.

The interdisciplinary nature of the phenomenon posed notable complexities for both the literature reviews and the conceptual positioning of the papers, which must be taken into account in future research through greater integration—or, depending on the research objective, delimitation. For instance, while challenges were approached from a general perspective in earlier contributions, a deeper understanding of them and, thus, grounding in different research fields, grew later. This offers a variety of research opportunities to investigate digital startups' challenges during phases of rapid growth through different lenses such as paradox or dialectics.

Finally, the philosophical and theoretical underpinnings carry further implications for future research. While critical realism was carefully discussed as a philosophical underpinning, there were limited opportunities to position it in the papers. Although it is positioned more prominently in the papers, this also applies to socio-technical systems theory, which was particularly helpful in understanding interwoven elements from organizations' technical and social systems in the action design research project.

6 CONCLUSION AND OUTLOOK

This thesis contributes to digital entrepreneurship theory and practice by investigating the growth trajectories of digital startups. With special consideration given to growth model research, a wide range of emerging tensions and challenges during phases of rapid growth was revealed. In addition, special emphasis was placed on the exposed role of a business-aligned digital infrastructure and a careful selection of digital technologies during the growth of startups. Four supplementary theoretical lenses—socio-technical systems theory, tensions and contradictions, enterprise architecture, and digitality—supported a better understanding of the growth trajectories of digital startups and their characteristics. New terms, such as "digital gazelles" and "digitality" were coined, which facilitate more precise differentiation between digital and non-digital ventures. Consequently, the findings contribute to addressing current theoretical limitations in digital entrepreneurship and adjacent disciplines through empirical evidence and, at the same time, demonstrate practical implications for anticipating challenges during rapid organizational growth.

The findings draw on semi-structured interviews with founders and C-suite managers of 30 startups across nine countries, enriched by a longitudinal, in-depth investigation of a rapidly growing digital startup. By providing rich empirical evidence on the underlying mechanisms and emergence of challenges and tensions in an entrepreneurial context, this thesis supports theorizing the rapid organizational change of digital startups from a growth model perspective. In light of its interdisciplinary nature at the intersection of entrepreneurship and digital technologies, the thesis provides guidance for investigating, understanding, and addressing the manifold challenges that digital startups face during phases of rapid growth. Concomitantly, it reveals a plethora of opportunities for practice. In particular, it may support founders and executive managers in anticipating and addressing future challenges in a fast-paced, dynamic, globalized, and digitalized environment.

Three avenues for future research stand out as particularly promising. First, the thesis (and paper VI in particular) illuminates the dynamics of entrepreneurial growth. Although deterministic growth models deserve—to a certain extent—criticism, they remain a practical tool for anticipating digital startups' growth-related challenges. Examining the interplay of dynamic and deterministic aspects, with a focus on digital technologies, presents a fruitful research opportunity. Second, further investigating the tensions that digital startups encounter during phases of rapid growth, as addressed in paper VII, seems compelling. Investigating tensions in early growth phases through a paradoxical or dialectical lens constitutes a particularly promising line of inquiry. Third, building on these avenues, investigating the factors and underlying mechanisms that cause rapidly growing startups to lose momentum—or organizational agility—holds considerable potential. It may be examined how socio-technical tensions emerge—and materialize in conflicts—during the growth phase between 10 to 100 employees across different contexts and hierarchical layers, including purely virtual organizations, varying business models, situations of financial abundance and scarcity, and the influence of founders' human or social capital. By providing empirical evidence and outlining avenues for future research, the individual contributions to this cumulative dissertation pave the way for scholars to further investigate the growth trajectories of rapidly growing digital startups. They offer meaningful implications for both theory and practice in the dynamic field of digital entrepreneurship.

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APPENDIX

– FIRST PUBLICATION –

Supporting the Development and Implementation of a Digitalization Strategy in SMEs Through a Lightweight Architecture-Based Method

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Proceedings of the 16th International Conference on Wirtschaftsinformatik

ABSTRACT

Like larger companies, small and medium-sized enterprises (SMEs) need to develop and implement a digitalization strategy. However, they face specific challenges such as a lack of IT know-how, relevant market information, and appropriate methods for developing a strategy. Following the action design research method and in cooperation with two medium sized companies, we started to develop a lightweight, architecture-based method for the development and implementation of digitalization strategies in SMEs.

1 INTRODUCTION

The digital transformation as a technology-based change process is not limited to large and established companies. In times of a digital economy, enterprises of all sizes and ages need to rethink their strategy, organization, and technology use. This has been referred to as digital entrepreneurship in the literature and it results in manifold change and innovation activities (Böhmann et al., 2015; Hinings et al., 2018; Nambisan, 2017; Nambisan et al., 2019). However, most research in this field is based on the assumption that a professional and sufficiently large IT organization with differentiated roles is established in the organization (Horlach et al., 2016; Passerini et al., 2012). SMEs, especially away from the conurbations, often face special challenges such as high exploration costs, perceived unbalance of risks and chances for the adoption of innovations and technologies, a lack of relevant market information as well as insufficient digital skills of employees (Abel-Koch et al., 2019; Huck-Fries et al., 2016, 2018; Passerini et al., 2012; Zimmermann & Thomä, 2016).

With increasing relevance in practice and research (Simon et al., 2013), the management of enterprise architecture (EA) is considered to be an "essential enabler of the digital transformation" (Hanschke, 2018, p. 280). With an enterprise-wide view on organizational and technological artifacts, it supports the alignment of business and IT (Aier & Winter, 2008; Simon et al., 2013). It helps to document and analyze the current state and serves as the basis for planning future target states and transformation steps (Aier et al., 2009; Aier & Winter, 2008; Buckl, 2011; Keuntje et al., 2010; Petrikina et al., 2014; Schmidt & Drews, 2015; Winter & Fischer, 2006). Digital transformation processes may lead to tensions on multiple organizational levels (Nambisan et al., 2019). To anticipate and address these tensions, experts from different departments and levels should be involved in the development process while considering the "big picture" consisting of strategic objectives, business processes, and IT landscape (Horlach et al., 2020). In contrast to existing complex frameworks such as TOGAF (The Open Group, 2018) and FEAF v2 (Chief Information Officers Council, 2013), we seek to develop a more lightweight, visualization-oriented and pragmatic approach for SMEs and realize Winter's idea of architectural thinking for this field (Winter, 2014). Hence, our research question is:

How can SMEs develop and implement digitalization strategies using a lightweight, architecture-based method?

2 RESEARCH APPROACH

While this work in progress seeks to contribute to the information systems research discipline by advancing methods of enterprise architecture modelling and management, it also draws upon and contributes to the literature on digital entrepreneurship. In order to develop and evaluate a solution that is both theory-ingrained and practice-oriented, we employed the action design research (ADR) method according to Sein et al. (2011), which focuses on building, intervening and evaluating (BIE) artifacts and allows to co-develop an approach in practice while also supporting the generalization and theorizing.

During the preparation phase, two companies—an online-agency (A) with approximately 100 employees which can be classified as a digital "gazelle" (Birch, 1987) as well as the headquarter of a more senior company (B) selling luxury outdoor furniture with approximately 200 employees—were identified as particularly suitable for the development of a digitalization strategy. The extraordinary growth despite regional restrictions of company A and the advanced maturity, expansion efforts and corporate integration of company B serve as an interesting contrast.

In the problem formulation stage, we diagnosed the lack of an explicit digitalization strategy in both companies. As digitalization describes "the manifold sociotechnical phenomena and processes of adopting and using technologies in broader individual, organizational, and societal contexts" (Legner et al., 2017, p. 302), a digitalization strategy follows the overall corporate strategy and goes far beyond the mere technology trend; "it constitutes a holistic intention of a company to streamline all activities regarding the digital transformation process to generate competitive advantages through new technologies and methods" (Pfenning & Eigner, 2020, p. 670).

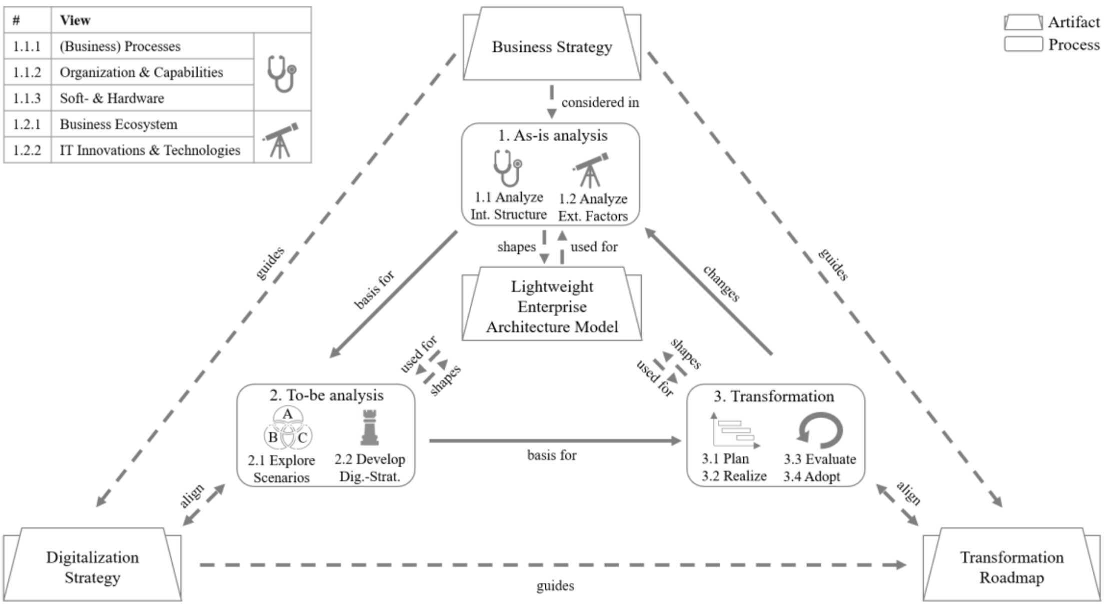
With special emphasis on the redesign of the software landscape (A) and the use of new technologies such as virtual and augmented reality (B), the selected BIE form was organization-dominant in both cases as we seek to create a method for developing a digitalization strategy. In the alpha cycle, we iterated and evaluated early designs of the digitalization strategy in workshops with the CEO and the COO (A) and the head of IT (B). As part of a first as-is analysis, the application of Porter's five competitive forces that "determine industry profitability" (Porter, 1985, p. 5), amongst others, helped us to develop an understanding of the business ecosystem (Moore, 2006), enterprise systems used therein as well as to reveal potential dependencies. It was accompanied by an analysis of archival material such as industry reports, process descriptions, the organizational chart, and a transcript of vision and values as part of the business strategy, and supplemented by instruments such as the Gartner Hype Cycle of Emerging Technologies to identify relevant technologies (Gartner, 2020). For identifying inefficiencies and outdated, incompatible software, we mapped existing software to an organization-specific model of Porter's generic value chain (Porter, 1985). This helped us to review the core processes and served as the starting point for discussing which software will be necessary in the future (to-be landscape). In the beta cycle, we took our preliminary findings into a wider organizational setting as our know-how was limited in terms of strategy (B) and software selection (A). By inviting the CEO, the sales manager and other experts from the business departments, we were able to enrich our findings in a workshop (B). As company B's business was more affected by COVID-19, the data collection had to be stopped in March 2020. Nevertheless, we complemented our data by conducting semi-structured interviews (one offline and seven online) on the different levels at company A including the two CEOs and founders, the COO, four department managers as well as a trainee. These interviews lasted between 20 and 90 minutes depending on experience and responsibility of the interviewee and covered questions ranging from the individual software usage and acceptance to personnel and strategic issues such as digital literacy and the market environment.

By analyzing and coding these with MAXQDA (VERBI Software GmbH, 2019), we were able to further refine our lightweight, architecture-based method as well as our understanding of the internal structure and external factors. In addition, we conducted a subsequent online workshop across the departments which were likely to be most affected by the transformation to identify internal capabilities and prepare the development of the digitalization strategy and roadmap. To validate and enrich our findings theoretically and practically, intermediate findings regarding the development of the digitalization strategy were mirrored several times with the COO (A) and the head of IT (B) while reviewing the lightweight, architecture-based method through interdisciplinary discussions in a circle of researchers from different fields such as information systems, strategic management, psychology, and organizational science.

3 RESULTS

Based on the findings of the two companies investigated so far, we propose our method for the development of a digitalization strategy in SMEs and its transformation with special attention to a lightweight visualization of the enterprise architecture (Figure 1).

Figure 1. Lightweight, Architecture-Based Digitalization Strategy Development Method



First of all, an as-is analysis of the internal structure and external factors is beneficial to gain a deeper understanding of the need for necessary changes. Taking into account the business strategy helps to prevent shortsightedness in the development process as it can have a decisive influence on the later design of the digitalization strategy and may additionally provide useful business information. The analysis of the organization and its capabilities as well as the (business) processes linked to the existing software and hardware landscape (1.1) enables a better understanding of potential dependencies in order to reduce medium to long-term costs caused by inefficiencies and wrong IT investments. By doing so, it may be also important to point out interrelations with supplier portals and their interfaces when it comes to selecting, developing, or implementing new software. Documents such as organization and capability charts, hardware and software constellations and process descriptions, which may be supplemented by a business model canvas (Osterwalder & Pigneur, 2010) or a value proposition canvas (Osterwalder et al., 2014), can help to gain a comprehensive picture of the internal structure. As an illustration, it can be advantageous to map the company's software solutions and their dependencies to primary and secondary activities in Porter's generic value chain (Porter, 1985) tailored to the enterprise. The significance of required changes can be pictured, for example, as simple traffic lights (e.g., urgent need for change, needs to be checked, meets requirements). In the case of a multi-divisional organization with several departments, it can also be helpful to represent these as swim lanes and to map existing software to their activities, e.g. ranging from sales generation to invoicing and maintenance.

The external view (1.2) comprises the identification of relevant technologies and IT innovations as well as factors of the business ecosystem, which can have a direct (e.g., interlocked supplier processes) or indirect (e.g., competition, customer, partner) impact on the company. One effective tool for this is Porter's five competitive forces that "determine industry profitability" (Porter, 1985, p. 5), which allows a comprehensive visualization of the market environment and may be supplemented by industry reports and instruments such as the Gartner Hype Cycle of Emerging Technologies (Gartner, 2020). This perspective can also provide interesting information about which technologies and software the competitors use. After an initial draft of the internal structure and external factors has been prepared by the person or team responsible for the digitalization strategy, further employees from the departments to be transformed should be involved to enrich these findings.

This may also help to sensitize employees to technical and organizational changes within the transformation (3).

Secondly, it has proven promising to explore several to-be scenarios of the internal structure under consideration of external factors (2.1) based on the findings of the as-is analysis. This supports prioritization and again sensitizes for the transformation process. After creating a comprehensive overview of the current state and developing a potentially promising scenario, the next step is to develop the business aligned digitalization strategy (2.2). Here, an illustrative presentation of the data compiled in phase 1 and 2.1 should form the basis, coordinated with other stakeholders within the company.

To operationalize the digitalization strategy, a transformation roadmap tailored to the company and its capabilities has to be developed closely coordinated with existing and planned company-wide projects (3.1). For this, it is necessary to allocate resources as well as to determine who is responsible for the realization of the (sub-)projects underlying the transformation (3.2). In some cases, especially when dealing with new technologies or complex software, it can be necessary to draw on external know-how. If this is the case, a selection of possible partners must be made and their advantages and disadvantages in terms of costs, expertise and capacities weighed up. In any case, the transformation process has to be evaluated (3.3) and adjusted (3.4) regularly as changes in 1.1 and 1.2 may occur.

However, we also observed some frictions in this model between theoretical modeling and practical applicability. Despite the lack of an elaborated business strategy (A and B) and without an existing IT department (A), it was nevertheless possible to build on the knowledge of the IT responsible person(s). In smaller companies, such a person with knowledge about the technical properties of IT systems might not be available. While the business strategy is usually anchored in the heads of the management, it is rarely written down and communicated, which may hinder the development of the digitalization strategy and the transformation as it may reveal important insights (e.g., of the business ecosystem, internal processes, and technology trends).

4 CONCLUSION AND OUTLOOK

In this paper, we present our research approach and intermediate findings towards the development of a lightweight, architecture-based method for developing and implementing digitalization strategies in SMEs. The method proposes to create coordinated, comprehensive visualizations of relevant views including internal processes and external influences. A structured collection of data and the uncovering of dependencies between IT and business through the enterprise architecture lens helps to set priorities when developing a digitalization strategy while supporting transparency and documentation (Aier & Winter, 2008). The underlying transformation process, however, does not necessarily imply the use of new technologies such as virtual or augmented reality (B), but often also requires basic work like redesigning the software and hardware landscape (A).

Besides this, there are manifold reasons why digital transformation projects fail. One of the main reasons is the disconnection between the pure formulation of a strategy and its implementation (Correani et al., 2020) which has to be addressed through a constant questioning of the status quo. In order to validate and generalize our results, it is necessary to investigate further companies from different industries. We will take a closer look at the phases and evaluate the results at A and B after some time. So far, the consideration of digital technologies has played a subordinate role in entrepreneurial research and its intersection with information systems related research (Nambisan, 2017; Nambisan et al., 2018; Recker & von Briel, 2019). The investigation of the specific conditions as well as success factors including the selection, evaluation and appropriation of IT innovations in the context of developing a digitalization strategy is still in its infancy and therefore offers a promising field of research.

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– SECOND PUBLICATION –

Developing Digitalization Strategies for SMEs: A Lightweight Architecture-Based Method

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ABSTRACT

Like larger companies, small and medium-sized enterprises (SMEs) need to develop and implement digitalization strategies. These help to address necessary organizational- and technology-related changes in order to create competitive advantages. However, SMEs often face specific challenges, including a lack of IT know-how, relevant market information, and appropriate methods for developing a strategy. In this paper, we present a lightweight, architecture-based method including its underlying model for the development and implementation of digitalization strategies in SMEs. It was developed by following the action design research (ADR) method and in cooperation with two medium-sized companies. Rather than adopting highly abstract and complex enterprise architecture (EA) frameworks, we suggest creating easy-to-use visualizations of the EA, the business ecosystem, and related cross-layer dependencies. While transferring the discipline of EA into the context of digital entrepreneurship, we derived four design principles which help to enrich the theoretical body of knowledge in this research area.

1 INTRODUCTION

As a technology-based change process, the digital transformation (DT) is not limited to large and established companies. In times of a digital economy, enterprises of all sizes and ages need to rethink their strategy, organization, and technology use. This has been referred to as digital entrepreneurship in the literature and it results in a variety of change and innovation activities (Nambisan, 2017; Nambisan et al., 2019; von Briel et al., 2021). However, most research in this field is based on the assumption that a professional and sufficiently large IT organization with differentiated roles supports the innovation activities (Passerini et al., 2012). SMEs, especially away from conurbations, often face special challenges, such as high exploration costs, a perceived imbalance of risks and chances to adopt innovations and technologies, a lack of relevant market information as well as insufficient digital skills among the employees (Huck-Fries et al., 2016; Passerini et al., 2012). To anticipate and address potential tensions on multiple organizational levels in the DT process (Nambisan et al., 2019), experts from different departments and hierarchies should be involved in the development and implementation process to also include their organization-, process-, and technology-related knowledge.

EA (management) finds high acceptance in science and in practice (Simon et al., 2013). By supporting the alignment of business and IT with an enterprise-wide view on organizational and technological artifacts (Sandkuhl et al., 2018; Simon et al., 2013; Winter & Fischer, 2006), the benefits of enterprise modeling are largely undisputed (Sandkuhl et al., 2018). EA helps to document and analyze the current state as well as to plan future target states of the enterprise (Petrikina et al., 2014; Winter & Fischer, 2006), and can serve as the basis for developing strategies in the context of DT (Zimmermann et al., 2021). However, frameworks such as the Zachman Framework (Zachman, 1987) and TOGAF (The Open Group, 2018) are predominantly complex, highly abstract (Hanschke, 2010) and criticized with respect to their practical applicability (Hanschke, 2010; Kim & Everest, 1994; Ylimäki & Halttunen, 2005). In the sense of grass-roots modeling (Sandkuhl et al., 2018) and by realizing Winter's idea of architectural thinking for this field (Winter, 2014), we seek to develop a more lightweight solution for SMEs, which is visualization-oriented and pragmatic. Hence, our research question is:

How can a lightweight, architecture-based method support SMEs in developing and implementing digitalization strategies?

The paper is organized as follows: First, we summarize related research and outline our understanding of a digitalization strategy and existing concepts for its development. We highlight the importance of an architecture-based view of the enterprise and its business ecosystem based on results from EA research. Next, we present our research approach, which is based on the ADR method by Sein et al. (2011) and expound the methods applied in the development process of the two investigated companies. As a result, we present our lightweight, architecture-based method for developing digitalization strategies in SMEs and the underlying lightweight enterprise architecture (LEA) model. In addition, we derive design principles to enrich the theoretical body of knowledge in this research area. We conclude with a discussion of our results and implications for further research in this field.

2 THEORETICAL BACKGROUND

In the literature, the terms IT strategy, DT strategy, digital business strategy, digital strategy, and digitalization strategy in particular are often used synonymously, and their distinction remains unclear (D'Cruz et al., 2015; Dang & Vartiainen, 2019). Digitalization describes "the manifold sociotechnical phenomena and processes of adopting and using technologies in broader individual, organizational, and societal contexts" (Legner et al., 2017, p. 302), and thus goes far beyond a purely technical view (Vial, 2019; Zimmermann et al., 2021). Accordingly, a digitalization strategy "constitutes a holistic intention of a company to streamline all activities regarding the DT process to generate competitive advantages through new technologies and methods" (Pfenning & Eigner, 2020, p. 670). Building on this understanding, in the context of transforming (small and medium-sized) enterprises, for us, a digitalization strategy is transformation- and capability-oriented and goes hand in hand with the business needs and, thus, the corporate strategy. It takes into account the existing enterprise architecture with all its organizational, process-related, and technical dependencies, and incorporates significant influences from the business ecosystem as well as from available and emerging digital technologies.

Digital technologies such as big data and analytics, digital twins and platforms, (advanced) robotics, cloud computing, or artificial intelligence are known for being a major driver of DT (Bordeleau et al., 2021; Vial, 2019; von Briel et al., 2021) and for (re-)defining the value proposition (Wessel et al., 2021). However, taking such steps also requires a redesign of the software and hardware landscape as well as (digital) process optimization. Nevertheless, the question arises how a digitalization strategy can be developed and operationalized, and which input and influences need to be considered in the development process. The literature on business and information systems already provides important insights in this regard (e.g., Bharadwaj et al., 2013; Hanschke, 2010; Hess et al., 2016; Pfenning & Eigner, 2020) and serves as a starting point for our work. However, most of this work focuses on large companies with significant financial resources and IT expertise, lacks practical implications and guidelines, and only partially considers the requirements of a comprehensive view of internal and external factors as well as of their dependencies.

To that end, the discipline of EA (management) provides important implications for this work, as it offers a solid base for developing a digitalization strategy and planning the company's transformation. EA practice and research have produced a large number of best practices and models (Urbaczewski & Mrdalj, 2006; Winter & Fischer, 2006), which help to map and manage corporate structures. In this field, architecture represents "the fundamental organization of a system, embodied in its components, their relationships to each other and the environment" (Institute of Electrical and Electronics Engineers Computer Society, 2000, p. 3). EA typically comprises five layers: business, process, integration, software, and technology (or infrastructure) architecture, whose spectrum ranges from strategic and organizational aspects to (business) processes, data, software, and hardware (Winter & Fischer, 2006). Building on this, EA pursues the goal of creating a model based on the most important artifacts of an enterprise and their relationships, which is sufficient for the documentation of the actual state and its analysis, as well as for the representation and planning of a target state (Winter & Fischer, 2006). In this context, Hanschke (2010) provides helpful implications from EA planning to transformation including best practice visualizations. Moreover, EA tools such as Dragon1 (Dragon1 Inc., 2021) and LUY (Iteratec GmbH, 2021) are geared toward a complex representation of the existing EA.

However, they only partially fulfill the requirement of a lightweight, intuitive representation of the internal structure and external dependencies as a basis for developing a digitalization strategy, as SMEs may lack knowledge and resources to infill complex architecture models. “As more mature architectures do not necessarily lead to business value” (Ross & Quaadgras, 2012), Horlach et al. (2020) emphatically suggest creating a value-oriented architecture support. This perspective draws on the concept of Winter’s architectural thinking, which proposes avoiding heavy and complex models and visualizations of architectural layers (Winter, 2014). Instead, he argues for developing lightweight and pragmatic models and visualizations by pointing out the respective local benefits for individual departments and employees (Winter, 2014, 2016). Thus, to close the gap between theoretical modeling and practical use, we pick up the advantages of EA management and transfer them to the context of digital entrepreneurship by offering a lightweight, and architecture-based method for the development of a digitalization strategy in SMEs.

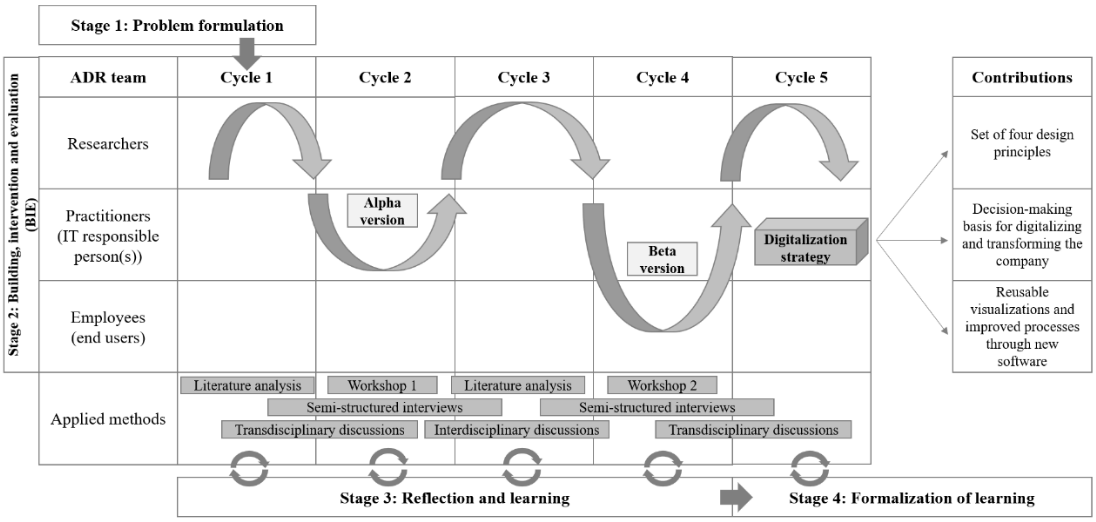
3 RESEARCH APPROACH

While this work seeks to contribute to the information systems research discipline by advancing enterprise architecture modelling and management methods, it also draws upon and contributes to the literature on digital entrepreneurship. In order to address the research question, we developed and evaluated a solution that is both theory-ingrained and practice-oriented by employing the ADR method (Sein et al., 2011). ADR focuses on building, intervening and evaluating (BIE) artifacts (Sein et al., 2011). These also include methods (Hevner et al., 2004; March & Smith, 1995), defined as a “set of steps used to perform a task” (March & Smith, 1995, p. 257), which “provide guidance on how to solve problems” (Hevner et al., 2004, p. 79).

Thus, ADR allows to co-develop an approach in practice while also supporting the generalization and theorizing.

During the preparation phase, two companies—an online-agency (case A) with approximately 100 employees, and the headquarter of a more senior company (case B) selling luxury outdoor furniture with approximately 200 employees—were identified as particularly suitable for the development of a digitalization strategy. We illustrate our ADR approach at company A in Figure 1, which resulted in the implementation of a new cloud-based enterprise resource planning (ERP) system. The extraordinary growth of company A despite regional restrictions required, among other things, a re-evaluation of currently used software solutions. Meanwhile, the advanced maturity, expansion efforts and corporate integration of company B, allowed it to focus on new technologies, such as augmented and virtual reality, which served as an interesting contrast.

Figure 1. ADR (Adapted From Sein et al., 2011 and Lebek et al., 2013)



In the problem formulation stage, we diagnosed the lack of an explicit digitalization strategy in both companies in search of orchestrated DT measures. With special emphasis on the redesign of the software landscape (case A) and the use of new technologies to enter the business-to-consumer market (case B), the selected BIE form was organization-dominant in both cases as we sought to develop a digitalization strategy. Based on the insights gained from strategic management (e.g., Aguilar, 1967; Fahey & Narayanan, 1986; Mintzberg, 1987; Porter, 1985) and EA research (e.g., Drews & Schirmer, 2014; Winter & Fischer, 2006), we drafted and continuously refined an initial outline of relevant factors influencing the digitalization strategy development.

In the alpha cycle, we iterated and formatively evaluated early designs of the digitalization strategy in workshops with the CEO and the COO (case A) and the head of IT (case B). For example, the business ecosystem-view (Drews & Schirmer, 2014; Moore, 1996) served as a first orientation for developing an understanding of the business and its environment. Enterprise systems used therein as well as dependencies were revealed and macroenvironmental influences uncovered. This enabled us to address legal challenges in website design (case A) and environmental challenges in the furniture production (case B), among other issues. Complementing this, the application of Porter's five competitive forces that determine industry profitability helped us to identify relevant market participants as part of the as-is analysis (Porter, 1985). This was accompanied by an analysis of archival materials, such as industry reports, process descriptions, organizational charts, and a transcript of the vision and values as part of the business strategy. Instruments such as the Gartner Hype Cycle of Emerging Technologies (Gartner Inc., 2020) supported the identification of potentially relevant technologies. To illustrate inefficiencies and outdated, incompatible software, we mapped existing software to an organization-specific model of Porter's generic value chain (Porter, 1985). This helped us to review the core processes and served as the starting point for discussing which software will be necessary in the future (to-be landscape).

In the beta cycle, we took our preliminary findings into a wider organizational setting as our know-how was limited in terms of strategy (case B) and software selection (case A). By inviting the CEO, the head of Sales and other experts from the business departments, we were able to enrich our findings as well as to reveal relevant, process- and technology-related pain points in a workshop (case B). We complemented our data by conducting semi-structured interviews (one offline and seven online) on different levels at company A, including the two CEOs and founders, the COO, four department managers as well as a trainee. These interviews lasted between 20 and 90 minutes depending on the experience and responsibility of the interviewee and covered questions ranging from the individual software usage and acceptance to personnel and strategic issues, such as digital skills and the market environment. By analyzing and coding these with MAXQDA (VERBI Software GmbH, 2019), we were able to further refine our lightweight, architecture-based method by setting priorities as well as our understanding of the internal structure and external factors. In addition, we conducted a subsequent online workshop with the departments that were likely to be most affected by the transformation to identify internal capabilities and prepare the development of the digitalization strategy and roadmap.

Through ongoing reflection during the BIE stage, we evaluated and revised our findings regarding a lightweight, architecture-based method for the development of a digitalization strategy in SMEs engaging in several discussions with the COO (case A) and the head of IT (case B). We also discovered an initial understanding of relevant design principles presented in the results section. For example, during the workshops and interviews it became clear, that personal and political interests of other departments could influence the success of the DT. From a management perspective, it also became apparent that resource limitations must be considered in the development process, and the benefits of a detailed presentation must be weighed up against the costs. Failed IT projects in the past (case B) also showed, that layer-specific dependencies should be considered in the planning process, and that internal changes as well as those in the market environment require a constant questioning of the status quo.

In the reflection of learning, we reviewed our method and the design principles through interdisciplinary discussions with a group of researchers from different fields, including information systems, strategic management, psychology, and organizational science. For instance, we adapted our initial approach slightly after our first meeting with company B for the use in company A, divided the development process into relevant and optional steps (see Table 1) and gave greater consideration to the importance of sensitizing and involving employees from other departments.

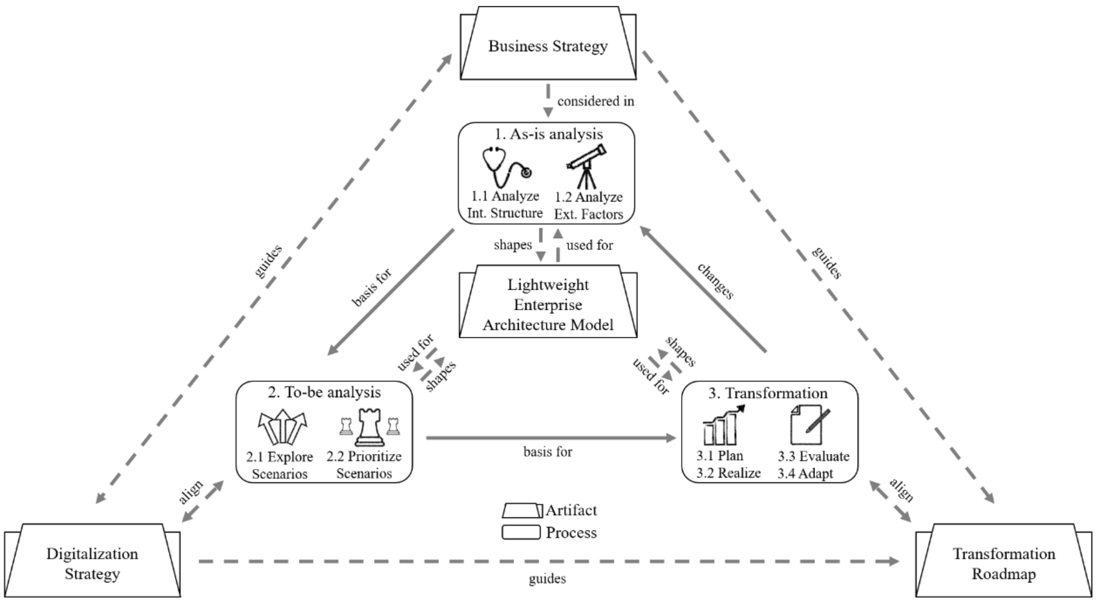
In the formalization of learning stage, we formalized the initial design principles representing design knowledge emerging from the application of ADR. With our method, we supported the decision-making basis for the management (case

A) and the IT department (case B) and provided a set of reusable visualizations for the employees involved in the digitalization process. Considering the principle of generalized outcomes, these findings contribute to the development of digitalization strategies in other SMEs.

4 RESULTS

Based on the findings of the two investigated companies, we propose a method (Figure 2) and the underlying LEA model (Figure 3) for the development of a digitalization strategy in SMEs, with a special focus on a lightweight visualization of the EA. We provide an overview of required and optional steps (Table 1) as a guideline, which may vary in tool usage or relevant entities (e.g., not all companies have subsidiaries), and finally present four design principles.

Figure 2. Digitalization Strategy Development Method for SMEs



4.1 Steps to Develop a Digitalization Strategy

4.1.1 Preparation

First of all, it is necessary to determine who is responsible (0.1) for obtaining information, designing architecture-based views, and developing the artifacts (e.g., to-be scenarios, digitalization strategy, transformation roadmap). This could be done, for example, in the form of a RACI (responsible, accountable, consulted, informed) matrix. Depending on the organizational roles, this can range from the IT and its management to specialist and leading functions from other departments to the top management.

If already developed and spread within the company (e.g., as discussed in management meetings), taking the business strategy into account (0.2) helps to prevent shortsightedness in the development process. It can have a decisive influence on the subsequent design of the digitalization strategy by providing useful business information and industry insights. In this context, a business model canvas (Osterwalder & Pigneur, 2010), which serves as a strategic management and lean startup template, supplemented by a value proposition canvas (Osterwalder et al., 2014), can provide an understanding of the core activities of the company as a basis for the development of a business strategy. Both strategies influence each other and mutually provide implications for their further development.

4.1.2 As-Is Analysis

Starting with the development process of the digitalization strategy, an as-is analysis of the internal structure and external factors is crucial to gain a deeper understanding of the existing architecture and the need for necessary changes. It is important not to look only at the individual components of the architecture, but to also understand their interrelations.

The internal analysis (1.1) of the organization and its capabilities as well as the (business) processes can be linked to the existing software and hardware landscape to develop a better understanding of potential dependencies. This helps to reduce medium- to long-term costs caused by inefficiencies and inappropriate IT investments. Depending on the company, it may be also important to map organizational and technical dependencies with suppliers and customers (see also 1.2) and their interfaces when it comes to selecting, developing or implementing new software. Documents such as organization and capability charts, hardware and software lists, and process descriptions can help to gain a comprehensive picture of the internal structure. As an illustration, it can be advantageous to map the company's software solutions and their dependencies to primary and secondary activities in Porter's generic value chain (Porter, 1985) tailored to the enterprise. The significance of required changes can be pictured, for example, as simple traffic lights (e.g., urgent need for change, needs to be checked, meets requirements). In the case of a multi-divisional organization with several departments, it can also be helpful to represent these as swim lanes and to map existing software to the business activities (e.g., ranging from sales to invoicing and maintenance).

The external view (1.2) comprises the exploration of the business ecosystem as well as the identification of promising and emerging (digital) technologies and IT innovations as well as macroenvironmental forces. For example, joint product development with customers and suppliers can have a significant impact on software selection as part of developing the digitalization strategy. One effective tool for this is Porter's five competitive forces that determine industry profitability (Porter, 1985), which can serve as the starting point for visualizing the market environment, supplemented, for example, by industry reports. This perspective can also provide interesting information about which technologies and software competitors use. Relevant technologies should be identified to support decision-making for further transformational planning. To gain a comprehensive overview of available and emerging technologies, we propose the use of instruments such as the Gartner Hype Cycle for Emerging Technologies (Gartner Inc., 2020) or the screening of current industry and technology reports. Additionally, a macroenvironmental analysis allows to reveal important implications, such as legal or political requirements, for the formulation of the digitalization strategy. For that purpose, the PEST(EL) (Aguilar, 1967) and the SWOT (Weihrich, 1982) analyses are popular and easy-to-use tools to support decision-making. After an initial draft of the internal structure and external factors has been prepared, additional employees from the business departments should be involved to discuss and enrich these findings. This may also help to sensitize employees to technical and organizational changes planned as part of the transformation.

4.1.3 To-Be Analysis

In the next step, promising to-be scenarios (2.1) need to be explored as a foundation for the DT, based on the aggregated visualizations developed in steps 1.1 and 1.2. Accordingly, setting the knowledge gained in relationship to each other is important, as it helps to address gaps and pain points of the current state. Additionally, it supports prioritization and again sensitizes for the transformation process. To identify potential cross-departmental dependencies, the to-be scenarios should be presented to other departments.

After creating a comprehensive overview of the current state, the next step is to prioritize transformation measures, taking available resources and capabilities into account, and select the most promising scenario to develop the business-aligned digitalization strategy (2.2) based on these results. As strategies are developed consciously and purposefully and may be additionally stated explicitly in formal documents (Mintzberg, 1987), the design of a digitalization strategy may include limited transformation goals like achieving cost savings or enhancing the customer experience, but it might also comprise extensive changes which aim at facilitating new business models (D'Cruz et al., 2015). Selected tools, presentation software, and easy-to-understand visualizations can contribute to the understanding of the intended goals and necessary changes at this point. To cover all relevant aspects of the internal and external analysis, we suggest creating presentation software slides for all of the relevant entities of the LEA model (Figure 3), including pain points, gaps, and possible solutions. In particular, the feasibility, risks, and costs of the planning scenarios must be considered at this point (Hanschke, 2010).

4.1.4 Transformation

To operationalize the digitalization strategy, a transformation roadmap tailored to the company and its capabilities must be developed in close coordination with ongoing and planned company-wide projects (3.1). The goal here is to close the gap between the actual state and the target state and to present (visualized) plans and measures to stakeholders (Hanschke, 2010).

Table 1. Steps of Developing a Digitalization Strategy

0 Preparation
0.1 Define roles (r)
I: (-); **O:** Overview of involved people, tasks, and responsibilities; **T:** RACI matrix, project planning tools and methods
0.2 Consider business strategy (r)
I: Business strategy documents, business vision and mission; **O:** Overview of strategic business goals; **T:** (-)
1 As-is analysis
1.1 Analyze internal structure (r)
1.1.1 Layer 1 (Organization)
O1: Analyze organization (r) **I:** Archival material such as organizational charts and exports from human resources (HR) software; **O:** (Over-)view(s) and data of relevant organizational aspects; **T:** RACI matrix, stakeholder mapping/analysis
O2: Analyze processes (r) **I:** Archival material such as process descriptions (from business departments); **O:** (Over-)view(s) and data of relevant processes; **T:** Process modeling tools and techniques (e.g., BPMN, eEPC)
O3: Analyze projects (r) **I:** Project descriptions (from business departments, e.g., controlling); **O:** (Over-)view(s) and data of relevant past, ongoing and planned projects; **T:** Organization charts, RACI matrix, stakeholder mapping, project planning tools and methods
O4: Analyze capabilities (r) **I:** Archival material and exports from HR software (from business departments, e.g., HR); **O:** (Over-)view(s) and data of (business) capabilities; **T:** Capability charts, resource and capability analysis
1.1.2 Layer 2 (Technology)
T1: Analyze software and interfaces (r) **I:** Archival material, such as software lists (from business departments, e.g., IT); **O:** (Over-)view(s) and data of implemented and conceivable software including interfaces and specifications; **T:** Software maps, life cycle graphics
T2: Analyze hardware and infrastructure (r)

I: Archival material, such as hardware lists (from business departments, e.g., IT); **O:** (Over-)view(s) and data of existing and conceivable hardware and infrastructure including specifications and costs; **T:** Hardware maps, life cycle graphics
T3: Analyze technologies (r) **I:** Archival material, such as technology lists (from business departments, e.g., IT); **O:** (Over-)view(s) and data of technologies in use; **T:** Life cycle graphics, technology maps
1.2 Analyze external factors (r)
1.2.1 Layer 3 (Business Ecosystem)
B1: Analyze customers (r) **I:** Industry reports, archival material, lists of customers (from customer relationship management (CRM) software or business departments, e.g., sales); **O:** (Over-)view(s) and data of relevant customers and their interaction with the company; **T:** ABC analysis/clustering, market analysis
B2: Analyze competitors (r) **I:** Industry reports, lists of competitors (from business departments, e.g., management or sales); **O**: (Over-)view(s) and data of relevant competitors (as benchmark); **T:** ABC analysis/clustering, market analysis, benchmarking analysis
B3: Analyze suppliers (o) **I:** Lists of suppliers (from ERP software or business departments, e.g., procurement, or suppliers); **O:** (Over-)view(s) and data of suppliers (of suppliers) incl. (technical and organizational) dependencies; **T:** ABC analysis/clustering, market analysis
B4: Analyze subsidiaries (o) **I:** Archival material such as organizational charts (e.g., from management or subsidiaries); **O:** (Over-)view(s) and data of subsidiaries incl. (technical and organizational) dependencies; **T:** Benchmarking analysis
B5: Analyze partners (o) **I:** Lists of partners (e.g., from management, IT, or partners); **O:** (Over-)view(s) and data of relevant and potential partners; **T:** ABC analysis/clustering, market analysis
(B6: Investigated Company) For comparison only
1.2.2 Analyze macroenvironmental forces (r)
I: Business strategy, industry reports and market insights (from management and business departments); **O:** Overview of macroenvironmental forces;

T: SWOT, PESTEL
1.2.3 Analyze emerging technologies & IT innovations (r)
I: Gartner Hype Cycle of Emerging Technologies, fairs, industry reports and insights (from business departments, e.g., IT or research and development); **O:** Overview of (relevant) emerging technologies and IT innovations; **T:** Life cycle graphics, technology maps
2 To-be analysis
2.1 Explore to-be scenarios (r)
I: Developed set of aggregated visualizations from the as-is analysis (layer 4) that reveal dependencies, show pain points and support prioritization; **O:** To-be scenarios which consider layers 1-4 including the macroenvironmental forces, business strategy, and emerging technologies and IT innovations; **T:** (-)
2.2 Prioritize scenarios (r)
I: Explored to-be scenarios; **O:** Prioritized scenarios including a visualization of orchestrated strategic transformation measures incl. personnel and technological aspects to develop the digitalization strategy; **T:** IT roadmap graphic, maturity models, stakeholder analysis
3 Transformation
3.1 Plan (r)
I: Digitalization strategy, data and views from the LEA model; **O:** Transformation roadmap coordinated with other departments incl. identified (key) performance indicators; **T:** KPI analysis, IT roadmap graphic, RACI matrix, project planning tools and methods, risk analysis, make-or-buy analysis, precedence diagrams
3.2 Realize (r)
I: Transformation roadmap, data from implemented projects; **O:** Project plans and documents incl. capability, personnel and risk planning; **T:** KPI analysis, project planning tools & methods (e.g., Kanban, Scrum, Waterfall)
3.3 Evaluate (r)
I: Transformational notes and discussions; **O:** Overview of necessary changes in the LEA model, the digitalization strategy and transformation roadmap, recommendations for action; **T:** KPI analysis
3.4 Adapt (r)
I: Necessary changes and recommendations for action from steps 3.2 and 3.3; **O:** Adapted LEA model, digitalization strategy and transformation roadmap; **T:** (-)
I = Input; O = Output; T = Tools (exemplary) optional steps = (o); required steps = (r)

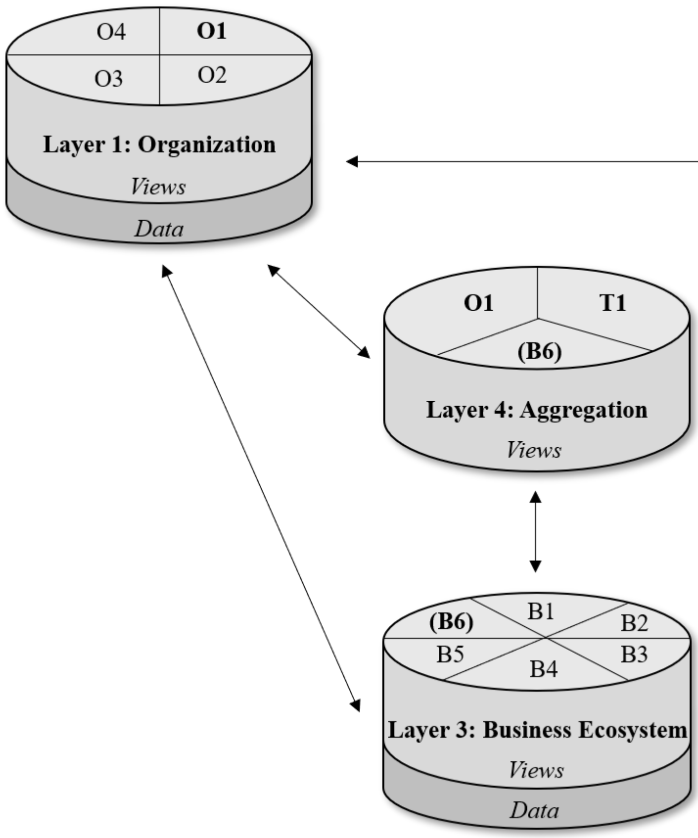
For this, it is necessary to allocate resources, weigh risks, and determine who is responsible for the realization of the (sub-)projects underlying the transformation. Here again, a RACI matrix can be used to define responsibilities. The realization (3.2) of the transformation and its (sub-)projects can be organized and done with the help of agile, plan-driven, or hybrid methods, depending on the stability of the project environment and the risk of scope change. In some cases, especially when dealing with new technologies or complex software, it might be necessary to draw on external know-how. If this applies, a selection of possible partners must be made, and their advantages and disadvantages in terms of costs, expertise and capacities must be considered. In any case, the transformation process needs to be evaluated (3.3). This evaluation focuses on the constant monitoring of derived measures in the (overall) project realization, including the assessment of (key) performance indicators. In addition, the up-to-dateness of the LEA model, the digitalization strategy, and the transformation roadmap should be constantly checked and, if necessary, adapted (3.4) in order to be able to react quickly to potential internal and external changes and new requirements.

4.2 LEA Model for SMEs

During the execution of the individual process steps, the LEA model is continuously filled and modified. The main advantage on using the LEA model is its ease of use and quick adaptability. It realizes the idea of "everyone is going to be an architect" (Horlach et al., 2020), which has its roots in the concept of architectural thinking (Winter, 2014). As the acquisition of EA software as well as its familiarization can be resource-intensive in terms of time and costs, we suggest using presentation software or other easy-to-use tools that are already known in the company. Given that some information might be available before other information, its aggregation in form of visualizations (layer 4) can also be done process-accompanying to a certain extent. Moreover, while some information can be obtained through CRM or ERP exports, or industry reports and archival material, other information may only be accessible through interviews, discussions and workshops. Here, spreadsheets, graphic programs, presentation software, and (interactive) whiteboards can help to include this data into the discussions. This can even include handwritten drawings. In order to develop a comprehensive set of relevant data and easy-to-understand visualizations, the most important artifacts of the company must be set in relationship with each other (Winter & Fischer, 2006).

The following LEA model serves as a basis for creating a grounded digitalization strategy and for deriving adequate measures within the course of the transformation itself. With its proposed entities, it is based on the structure of relevant layers from the EA management (e.g., Winter & Fischer, 2006) and on the insights gained during our research project. Relevant data and visualizations can be set in relationship (dependencies) within the individual layers as well as among each other. Due to their modular character, they can be individually supplemented depending on the needs of the company.

Figure 3. Lightweight Enterprise Architecture (LEA) Model for SMEs



Layer 1 (Organization) captures internal process flows, personnel, and internal capabilities to implement projects and drive change, which can support the identification of essential organizational and process-related transformational needs;

for example, an integration of available personnel and capabilities for project planning (O1 + O 3 + O4) or an illustration of process flows to uncover optimization potential in interdepartmental operating processes (O1 + O2).

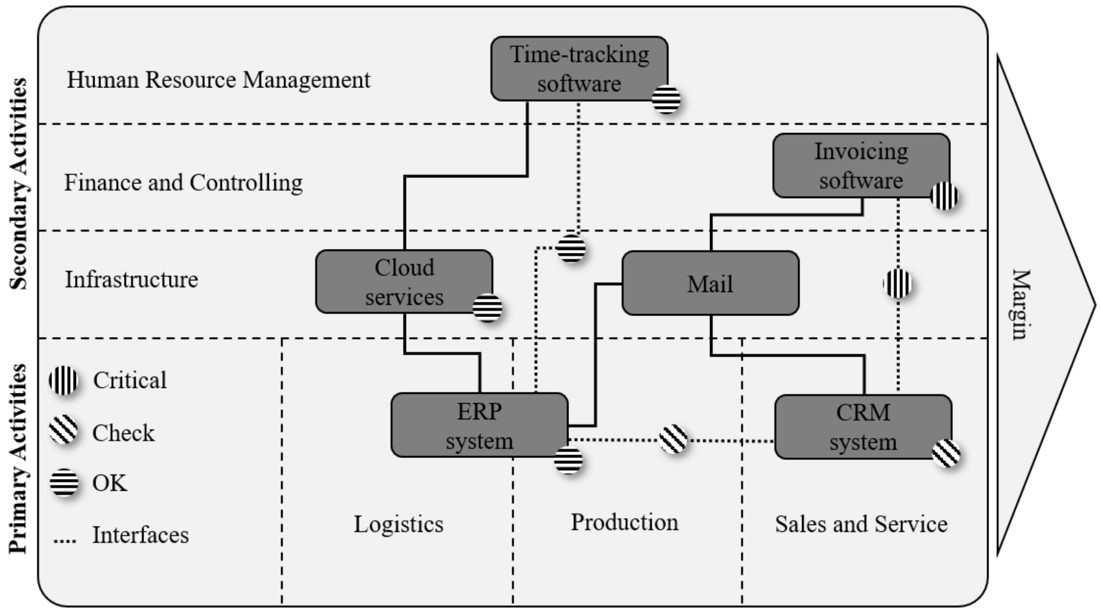
Layer 2 (Technology) contemplates technologies in use to show innovation potential. In addition, software (including interfaces) as well as hardware and infrastructure aspects have to be considered, as they can have a significant impact on the competitiveness of a company. Views on the interconnection between used software and technologies such as augmented reality (T1 + T3), or lists of implemented or conceivable software on premise vs. the cloud (T1 + T2) may be displayed at this point and connected with findings from the analysis of emerging technologies and IT innovations.

Layer 3 (Business Ecosystem) comprises the investigated company and its business ecosystem. It supports a comprehensive view of external market participants, which can be used, for example, as a benchmark or to show dependencies (e.g., software interfaces) in the supply chain or in product innovation. Here, details of the market may also be included. This layer reflects combined views such as the market share of the company in relation to competitors (B1 + B2 + B6) or an ABC analysis of the most relevant suppliers (B3).

Layer 4 (Aggregation) represents the combination of data and views of the first three layers. In particular, this can help in decision-making as part of the to-be analysis and serve as a basis for argumentation when communicating necessary changes in the organization.

Figure 4 shows a simplified example of the link between organizational aspects (O1) and software used (T1) in the company investigated (B6), combined with a status display in the form of traffic lights, which we used in the course of the as-is and to-be analyses.

Figure 4. Example of Layer 4 (B6 + O1 + T1)



4.3 Design Principles

As "prescriptive statements that indicate how to do something to achieve a goal" (Gregor et al., 2020, p. 1622), design principles serve as an "abstract blueprint that describe an information systems artifact" (Gregor & Jones, 2007, p. 322). By reflecting on the results of the ADR project and by considering research from the areas of EA (e.g., Haki & Legner, 2021; Horlach et al., 2020) and DT (e.g., Bordeleau et al., 2021), we developed four design principles fostering the development of a lightweight, architecture-based digitalization strategy in SMEs:

An *interest integration across departments and hierarchies (1)* helps to sensitize for upcoming changes in the organization and software landscape, reveal personal and political interests, and make relevant technological and process know-how available in the process of developing a digitalization strategy. Referring to Winter's architectural thinking (Winter, 2014), it also helps to understand why the transformation makes sense not only from a management perspective, but also for the individual employee and the team.

The *visualization of cross-layer dependencies (2)* in the sense of EA, in contrast to non-architecture-based methods, emphasizes drawing a comprehensive picture for the underlying transformation. This supports creating awareness for the necessity of changes among stakeholders. Taking into account different architectural layers, this also facilitates the prioritization of actions to be taken in the departments affected by change when developing the digitalization strategy and its associated roadmap based on the actual state (as-is) as well as the target state (to-be).

An *orientation on usefulness (3)* requires that the effort as well as the costs for the creation of the architectural views underlying the digitalization strategy are always considered in relation to their benefits. In companies with a low number of employees, it is important to question whether the use of complex EA software is worthwhile and leads to business value (Ross & Quaadgras, 2012). It may seem useful to build on lightweight presentation slides, sketches, or simple handwritten notes to visualize EA layers and its dependencies.

With a *continuous review and adjustment (4)* of the digitalization strategy, the transformation roadmap, and its underlying architectural visualizations, we emphasize the need to react flexibly to internal and external changes—understanding a digitalization strategy and transformation roadmap not as a static or unchanging artifact but as one that is dynamic, as its stability is only conditional (Orlikowski & Iacono, 2001) and it incorporates dimensions beyond the technological aspect as an ensemble (Sein et al., 2011).

5 DISCUSSION

By proposing a lightweight, architecture-based method, we aimed to provide support and guidance for SMEs in the development of a digitalization strategy. In contrast to existing frameworks with little practical relevance for SMEs and potentially resource-intensive implementations of EA software, we developed a more lightweight, visualization-oriented, and pragmatic solution. Although (external) experience in the use of tools can be an advantage, we offer a development process that does not require much previous knowledge in EA modeling.

However, we also observed some frictions in this method between theoretical modeling and practical applicability. Despite the lack of an elaborated business strategy (case A and B) and without an existing IT department (case A), it was nevertheless possible to build on the knowledge of the responsible IT person(s). In smaller companies, such a person with knowledge about the technical properties of IT systems might not be available. While the business strategy is usually anchored in the heads of the management, it might not be written down in detail (case A) or communicated to all stakeholders in the company, even though it may contain important insights (e.g., of the business ecosystem and technology trends) at an early stage of developing the digitalization strategy. In many companies, a classic organizational chart only partially reflects the internal structure of the company. A flexible view of the organization layer enables a representation of highly agile, cross-functionally scaled organizations.

As we attempted to keep the LEA model as generic as possible, its entities must be adapted depending on the size, structure, and branch of the company. This illustrates that not all of the steps in developing the digitalization strategy are mandatory for every company. Furthermore, the status quo must be constantly scrutinized to avoid decoupling between the mere formulation of a strategy and its implementation. Beyond this, the underlying transformation process does not necessarily imply the use of new technologies such as virtual or augmented reality (case B), but often requires basic work like redesigning the software and hardware landscape (case A). Finally, using the ADR method, the underlying involvement may also be seen as a validity threat due to the natural subjectivity that accompanies this process of working closely together. This is addressed through triangulation and the inclusion of other external researchers when collecting, coding and analyzing the data. Knowledge gained from companies A and B needs to be developed further by investigating companies of different sizes and industries in a second research wave to increase the data validity and generalizability of the results.

6 CONCLUSION AND FUTURE WORK

In this paper, we present our research approach and findings of creating a lightweight, architecture-based method for developing and implementing digitalization strategies in SMEs. The method and the underlying LEA model create coordinated, comprehensive visualizations of relevant views, including internal processes and external influences. A structured collection of data and the uncovering of dependencies between IT and business through the enterprise architecture lens helps to establish priorities when developing a digitalization strategy while supporting transparency and documentation (Winter & Fischer, 2006). In contrast to more complex, resource-intensive, and highly abstract frameworks, we developed a visualization-oriented and pragmatic solution tailored to the requirements of SMEs. The steps we provided for developing the digitalization strategy may serve as a guideline for practitioners, helping them to rethink their strategy, organization, and technology use within the context of digital entrepreneurship. Finally, the four design principles contribute to the theoretical body of knowledge on developing digitalization strategies in SMEs. As the investigation of developing digitalization strategies in SMEs from an EA perspective is still in its infancy, we hope to engage other researchers to build upon our knowledge in this promising field of research.

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– THIRD PUBLICATION –

Between Agility and Growth: (Re-) Designing the IT Landscape of a Digital Gazelle in the Online Marketing Industry

Nils J. Tschoppe, Jan K. Tänzler, and Paul Drews

In L. Iandoli & C. Gibaldi (Eds.), *Case Studies in the Age of Digital Entrepreneurship: How Digital Technologies Are Transforming the Entrepreneurial Process in Existing Business and Start-Ups*. Edward Elgar Publishing

TEACHING CASE

Note: This book chapter has been slightly adapted from its original version, which was published by Edward Elgar Publishing in two parts: a description of the teaching case (pp. 130–144) and a teaching note (pp. 230–237). The fictive case is based on one of the companies from the digital entrepreneurship research project and serves to transfer the insights gained to the classroom. It is suitable for integration in the middle or at the end of a course on digital entrepreneurship. A time frame ranging from five to six hours is recommended, depending on the size of the group. In sum, the teaching case helps students to understand the socio-technical challenges faced by fast-growing digital startups, with particular emphasis on digital infrastructure development.

Table 1. Timetable

Task	**Time**	**Total Time**
Familiarization with the relevant literature	60–120 minutes	60–120 minutes
Optional: as a self-study reading assignment (duration depends on each individual)	*(60–120 minutes)*	
Introduction to the case study and discussion of the learning objectives	30 minutes	60 minutes
Discussion of the facts of the case and discussion of the questions	30 minutes	
Optional: introduction in a plenary	*(60 minutes)*	
Processing of the case in small groups	90 minutes	90 minutes
Optional: processing in a plenary	*(90 minutes)*	
Discussion of the results	45 minutes	90 minutes
Summary and discussion of the lessons learned	45 minutes	

Case Learning Objectives

After working through the case study, students should be able to

1. identify the stakeholders and their interests that are affected by the organizational and technical changes, and determine the strengths and weaknesses of a company's IT landscape,
2. develop a roadmap to drive the transformation of the IT landscape with a particular focus on software,
3. identify investment priorities based on the strategic analysis conducted in the previous points,
4. understand the challenges faced by fast-growing digital companies.

Case Summary

The online marketing company "Marketing Beats" was founded in 2012 by two master of business administration students. Despite regional challenges, such as the shortage of skilled workers outside of conurbations, the company has grown in recent years and now has about 130 employees. This success story has led the company to be confronted with new challenges. Growing personnel structures, cross-departmental communication, and an increasingly complex IT landscape pose the risk of causing the "digital gazelle" to lose its agility. The necessary process optimization and the redesign of the IT landscape are new strategic challenges the company has to face. The loss of customer information, redundant customer data, a lack of support when planning projects, and a high level of documentation effort present the company with the task of finding a new solution for its loosely integrated software. Students are asked to develop solution proposals for the company's IT landscape, taking into account the impact of such a redesign on the company's processes and structure.

TEACHING CASE – DESCRIPTION FOR STUDENTS

Introduction

In 2012, the company "Marketing Beats" was founded by two friends, Stephen and Peter, in a medium-sized city in the immediate vicinity of the Munich metropolitan region. Originally, the two founders, who had already been in contact for many years through the local soccer club, wanted to earn some money on the side using Google Ads. The fact that the work was also fun was a bonus. After a short time, however, they both realized that there was enough potential for them to start their own business in online marketing. That was the starting point for the foundation of the company "Marketing Beats." Although the metropolitan region of Munich was not far away, they decided to stay in their hometown, which is a sign of the founders' down-to-earthness and strong attachment to their roots.

In the early years, several factors ensured rapid company growth. First, Stephen and Peter worked almost around the clock. The money they earned was immediately reinvested. In this way, they were also able to hire staff early on in order to accelerate further growth. The two founders also tackled problems and challenges in a hands-on manner, which proved to be beneficial for the positive development of the company and saved valuable time. The two were also able to draw on the expertise of the university's startup network. In addition, two other factors played an important role in the rapid growth of the company. On the one hand, both founders managed to attract the right people to the company at the right time. For example, they hired an accountant early on who is still with the company after ten years. On the other hand, both founders complement each other very well. While Stephen is more of a salesman and excels at communicating with customers, Peter is more analytical and always keeps an eye on the company's figures, and he used to do some programming himself. Ultimately, however, luck with regard to the acquisition of customers and the development of the industry in general has also played a small role in the development of the company.

After completing some initial successful projects for customers from the region, the company positioned itself primarily in the sports sector and managed to acquire important clubs from the 1st and 2nd German soccer leagues as customers.

However, this one-sided customer structure was also perceived as a risk, and so the company increasingly tried to acquire other customers outside the sports sector. Today, the sports sector still forms an important pillar for the company, but the customer structure now consists of around 150 customers from different sectors, such as food and beverage, online retail, and the manufacturing industry. This risk diversification and its ability to respond to changes in the market at short notice ensures that the company has been able to grow successfully even in times of crisis, such as at the height of the COVID-19 pandemic in 2020.

Since its founding in 2012, the company has always been able to grow by contracting about ten extra employees per year and now employs nearly 130 people, including many IT- and marketing-savvy students and graduates of the local university. This digital native company can be classified as a "digital gazelle," as it has been characterized by rapid company growth over a limited period of time (e.g., Acs & Mueller 2008; Birch, 1987; Henrekson & Johansson, 2010). Despite its rapid growth, the company has been able to maintain many positive characteristics that have contributed to its growth since the beginning. For example, it continues to cultivate its startup spirit (e.g., with regular sports and cooking events), has created positive conditions for remote working from the very beginning, and is still characterized by a high degree of agility and flexibility, which makes it possible to respond quickly to changing market conditions. Furthermore, the company is customer-oriented and very well connected in the region. The two founders have also been able to maintain their down-to-earth attitude despite the rapid growth.

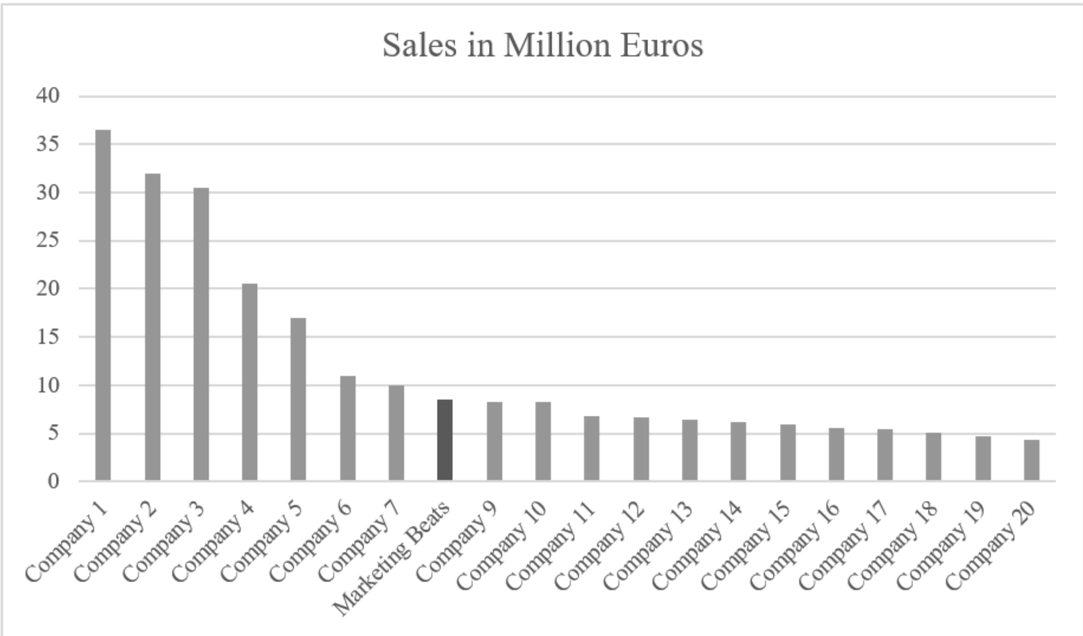
The company's rapid growth has also led to major internal and external challenges that Stephen and Peter are now facing. However, the two founders are not alone in this. The constant adaptation of the strategy and organization of digital companies in particular to the changing environment is an important success factor not only for young companies and is discussed in the literature under the name of digital entrepreneurship (e.g., von Briel et al., 2021; Nambisan, 2017; Nambisan et al., 2019; Recker & von Briel, 2019). Internally, it is important to meet the demands for optimized cross-departmental communication and project handling while taking department-specific requirements into account, without losing too much of the company's original agility through standardized processes. Externally, the company must respond to increased customer expectations, such as changes in project scope, at short notice, and adapt its processes accordingly while building a suitable data infrastructure for this purpose. Basically, IT is seen as a strategic topic by the CEOs. With these challenges in mind, Stephen and Peter are now asking themselves exactly what they need to do to pave the road for a successful future.

Industry and Business Overview

Market Position

With a turnover of approximately €8 million, Marketing Beats is one of the 50 largest German internet agencies. The 20 largest German internet agencies have an average turnover of €20 million. In the digital advertising/communication category, Marketing Beats ranks as number 8 in Germany (Figure 1).

Figure 1. Germany’s Largest Internet Agencies (Digital Advertising & Communication)

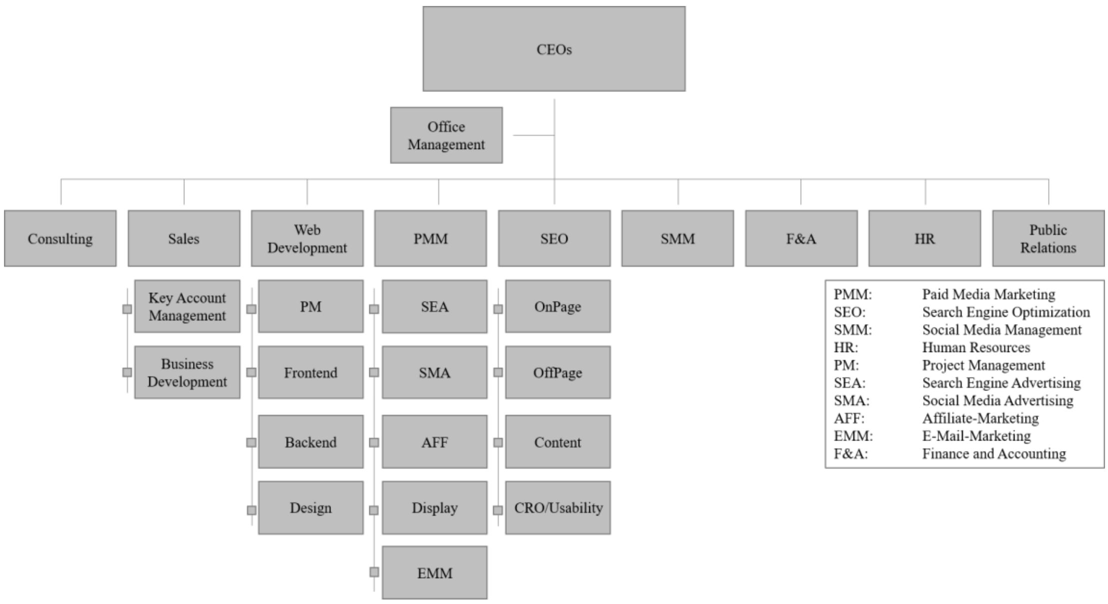


Marketing Beats maintains good relations with other internet advertising agencies of a similar size and continues to be strongly anchored in the region with many local customers. Nevertheless, this provides only limited information about which new software solutions are suitable for the company. While some companies continue to use primarily free and open-source software which is often poorly integrated, others resort to highly individualized and proprietary software, or even develop a largely integrated IT landscape.

Corporate Structure

Each of the department heads (e.g., search engine optimization (SEO), paid media marketing (PMM), social media management (SMM), web development, sales) reports directly to the two CEOs, Stephen and Peter, each of which has an assistant. Some of these departments are also broken down into further areas. For example, the sales department includes key account management and business development, each of which is headed by a team leader. Nevertheless, the sales department is also a separate area with its own employees, who are not assigned to key account management or business development. Stephen and Peter emphasize that all employees can also contact the CEOs directly in urgent cases, which reflects the flat hierarchy of the company. Finally, there is the office management department, which is responsible for the internal organization (e.g., of company events). The company is organized as follows (Figure 2):

Figure 2. Marketing Beats' Organizational Chart



Problem Description

Background

The company's IT landscape is in need of improvement. This was revealed as part of a previous situation analysis focusing on the company's environment and customer processes and the software solutions in use. In two workshops with the CEOs, among others, an overview of the status quo of the software used in the company was obtained, and its optimization potential was uncovered. The insights gained were condensed through semi-structured interviews with selected department heads and specialists. This had different objectives: On the one hand, against the backdrop of upcoming organizational and technical changes, employees were involved in the planning process, which led to an awareness of the transformation. It was also possible to draw on their expertise. On the other hand, several pain points were identified that affected both the entire company and individual departments. The company does not have a dedicated IT department. For example, backups or the setting up of IP telephony are carried out by an external service provider. In addition, two experienced employees from web development department support the technical introduction of new software solutions. The focus of the redesign of the IT landscape is on the integration of existing software solutions or their replacement, as well as the associated process optimizations.

Missing software interfaces currently lead, among other things, to a lack of transparency and miscommunication in customer project implementation as soon as several departments are involved. In addition, master data are not managed centrally, relevant customer information is sometimes lost, and invoicing is more time-consuming than necessary. In addition, the recording of billable hours and the planning of effort (e.g., by using Excel spreadsheets) are largely independent of project communication and documentation. To save costs, group accounts in the Optimal Collaboration (OC) project management software are also used for project execution, which results in unnecessary spam and a lack of clarity in terms of project responsibilities, and slows down the company's performance.

Across the different departments, three software suites are used to coordinate communication with the customers and within projects. The individualized and outdated OC project management software is used by the online marketing departments (PMM, SEO, SMM). Because of this customization, an update would involve a great deal of effort and would still not fulfill the requirement of an integrated IT landscape. In this context, the integration of the Funnel customer relationship management (CRM) software, which is currently only used by the business development department and the CEOs, also comes into focus. The benefit of the second project management software Yeera, which is used exclusively by the web development department, also needs to be scrutinized. Although it fulfills the requirements of agile project management (e.g., with a Kanban board to visualize and optimize the workflow), it is hardly integrated into the customer processes and the rest of the IT landscape.

Now, it is time to plan the redesign of the IT landscape with a focus on the implementation of new software, which is scheduled for the coming year. In addition to the condensing of information, promising software solutions are to be identified, a cost-benefit analysis is to be carried out, and the preferences of the individual departments are to be weighed up. To this end, a transformation roadmap must be developed for the upcoming rollout of new software solutions. To accomplish this, the following checklist was used in the analysis:

- identification of the departments involved
- survey of the current IT landscape
- interdepartmental collaboration on customer projects
- identification of the critical pain points
- identification of the requirements with regard to the new system(s)

Departments Involved

As part of the transformation, some departments are more affected by the redesign of the IT landscape than others. Accordingly, the main focus lies on the following departments.

- *Online marketing departments (PMM, SEO, SMM)*. These departments are responsible for online marketing. For example, the SEO department alone is composed of more than 20 employees. As a full-service online marketing company, its services range from search engine advertising and optimization to native and display advertising and social media and content marketing. The OC project management software is primarily used for this purpose.

- *Web development*. This department deals with the design and maintenance of customer websites. It is the only department that works agilely in sprints and uses a Kanban board. The Yeera software is used for this purpose. The OC project management software is only used to fill in invoice templates, which are later forwarded as PDF documents to the finance and accounting (F&A) department. Supplementary software, such as Masterplan and Bestfeature, are also only used in this department. With approximately 27 employees, it is one of the largest departments.
- *Business development*. Customer acquisition, as well as the planning and implementation of events, webinars, and other events, in which other departments may also participate, is the responsibility of the business development department. Initial customer communication is carried out via the Funnel CRM system, which also allows the statistical evaluation of the sales pipeline. This department is not involved in customer project execution. Due to missing software interfaces between Funnel, OC, and Yeera, valuable information is sometimes lost.
- *F&A*. This department is responsible for accounts receivable and accounts payable. The personnel structure and the software used in F&A have hardly changed in recent years. In particular, the associated automatic creation of dunning notices and monthly recurring invoices should be taken into account when redesigning the IT landscape.

The following departments must also be considered in the transformation:

- *Sales*. Sales is the link between customer acquisition (business development) and project execution (the web development and online marketing departments). Among other things, the department takes care of obtaining the final project approval from the CEOs, organizes internal kick-off meetings for the respective projects and handles the preparation of offers.

- *Consulting*. This department primarily provides consulting services. However, if two or more departments are involved in a project, one employee from consulting takes over the interdepartmental coordination. This person also takes care of the consolidation of the individual reports, ensures quality assurance and the documentation of the results, and creates the monthly invoice form for the online marketing departments in Excel, which he or she sends to the F&A department.

Overview of the Current IT Landscape

An overview of the software used in the company, which comes into focus when redesigning the IT landscape, is provided below:

- *Optimal Collaboration (OC)*. The version of this project management software is outdated and can no longer be updated, as it has been heavily customized over time. It is used by the online marketing departments as well as by the sales and consulting departments for documenting and executing customer projects. Many employees are dissatisfied with this software and find it time-consuming and impractical.
- *Yeera*. The second project management software is used exclusively by the web development department for customer projects because of its Kanban functionality, among other things. According to the web development department, creating tickets is also easier than in OC and best suited for project work. Other departments, however, find this software confusing; the use of this software by the entire company is therefore considered unlikely.

- *Funnel*. This CRM software was introduced by the CEOs to get a better overview of current leads. Currently, only the business development department and the CEOs work with this tool. An interface with OC does not exist. Although the information is relevant for the sales department, it continues to use OC in order to avoid additional hurdles in its close cooperation with other departments.
- *Debtware*. This software is used for accounts receivable (i.e., to create invoices for customers). An interface with the project management software to create an invoice directly based on the projects is not integrated.

In addition, other software is used, which may have an impact on the upcoming transformation of the IT landscape:

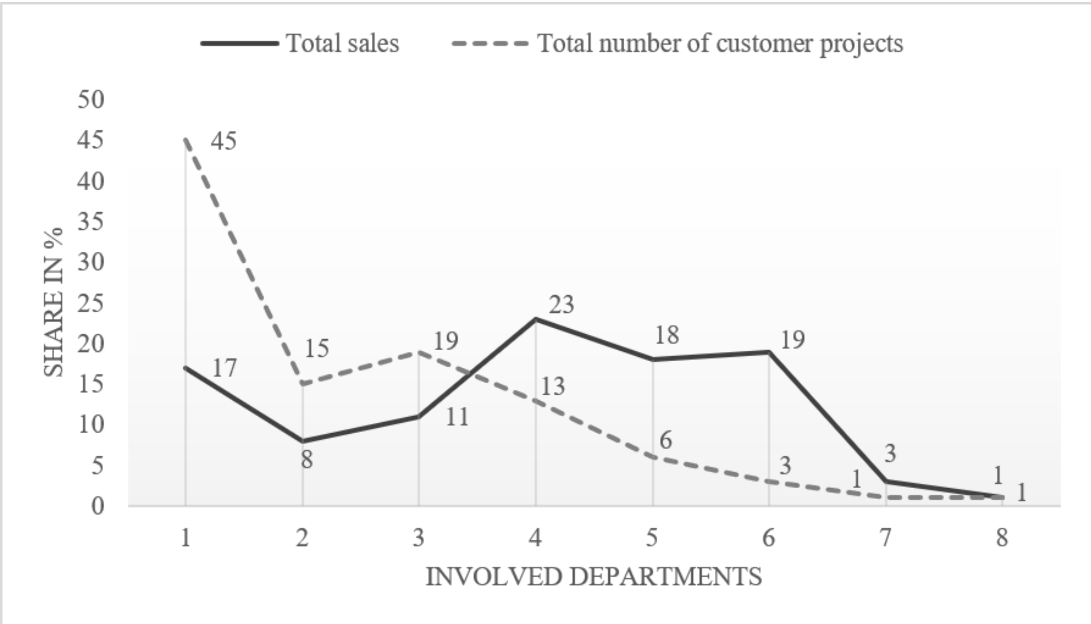
- *Creddison*. This software is used for accounts payable and was introduced a few months ago to simplify the accounts payable process. However, Creddison does not currently offer accounts receivable.
- *Masterplan*. This software is used solely by the web development department for internal resource planning.
- *Bestfeature*. This software is used exclusively by the web development department for the product backlog management.
- Rocketchat. It is a free chat program for internal company communication, which is used across departments and does not interface with other software.

The file server, Excel spreadsheets, and Google Drive are also used to exchange files across departments. In addition, essential processes, such as the calculation of projects, are built on Excel spreadsheets. The data protection-compliant use of Google Ads requires the Google Workspace as well, which is used intensively by the SEO department in particular.

Interdepartmental Collaboration (Customer Projects)

Previous analyses revealed that 45% of the company's projects are exclusively realized by only one of the departments (Figure 3). These projects, however, make up only 17% of the total revenue. Most of the revenue (>70%) comes from about 40% of the customer projects, which are supported by 3–6 different departments. Therefore, interdepartmental projects, in particular, contribute to the success of the company. This also highlights the relevance of an integrated IT landscape that supports communication between the departments. In addition, the special requirements of the web development department (such as Kanban boards) must be taken into account in the planning process, but that should not have a significant impact on the design of the entire IT landscape.

Figure 3. Comparison of Total Sales With the Total Number of Customer Projects



The information collected during customer acquisition is entered into Funnel by the business development department. Invitations to events and the distribution of newsletters are also planned here. If customer acquisition is successful and customers request Marketing Beats for a project, a sales ticket is created in the OC software. Related documents are stored on the file server sorted by customer. In the next step, contact with the respective department, including a rough price estimate, is initiated by the sales department. For the purpose of a company-wide overview, the lead is simultaneously entered into Excel spreadsheets. The rest of the process differs according to the number of departments involved.

- *Only the web development department is involved*. If only the web development department is involved in the project, it is created in Yeera after an initial customer meeting together with the sales department. However, the initial sales ticket in the project management software (OC), which contains basic information about the customer project, still exists and is not connected to Yeera. Subsequent communication with the customer is documented in Yeera, and the progress of the project is recorded there. For internal departmental resource planning, a customer entry is also created in the Masterplan software. The completion of the invoice form is again carried out in OC (e.g., on a monthly basis depending on the project's progress). This is forwarded to the F&A department, which prints it out and enters the data into Debtware to send the invoice to the customer.
- *Only one of the online marketing departments is involved*. After the initial customer meeting together with the sales department, the project is created in the project management software (OC) by one of the online marketing departments. However, the sales ticket (in the OC) continues to exist and is also used for supplementary customer discussions, which means that valuable information can be lost. Relevant information is copied from the sales ticket onto the ticket of the respective online marketing department at the beginning of the project and at irregular intervals. Cross-departmental resource planning for project implementation takes place via Excel spreadsheets. Minutes of customer meetings and reports are stored on the file server. Invoices are generated via an Excel spreadsheet linked to OC and forwarded to the F&A department by e-mail.

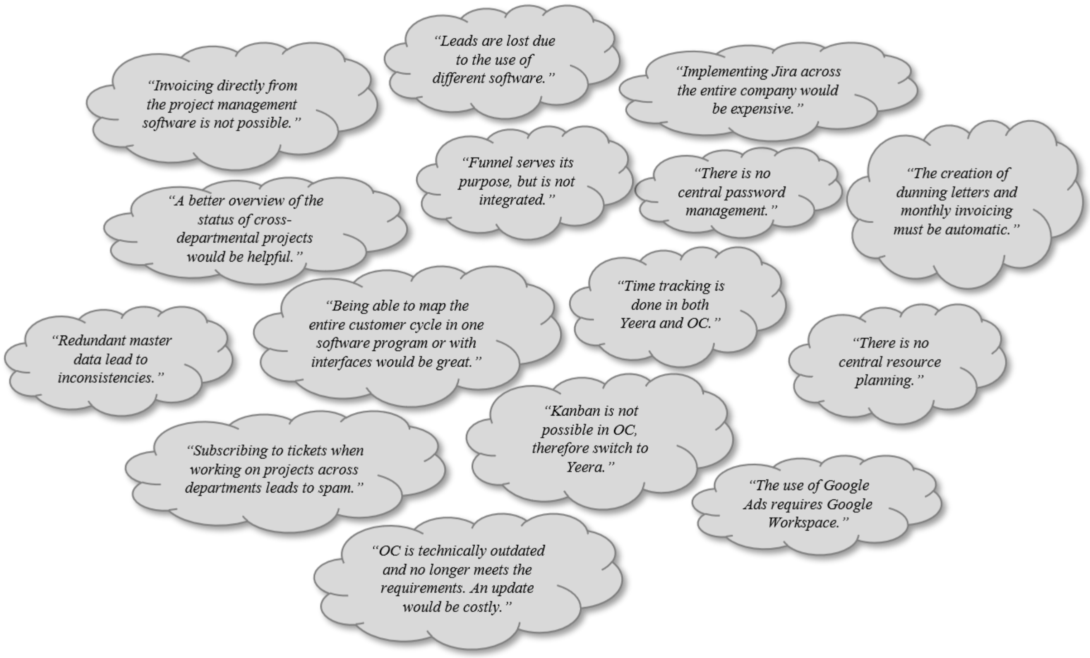
- *More than two online marketing departments are involved*. If a customer is served by more than one department, an internal consultant is usually called in to handle communication between the departments involved and to attend customer meetings. Action planning, as well as input on the strategy, is recorded in Google Drive; further arrangements are made via the project management software (OC), by e-mail, or in person. Each department now creates its own OC ticket for this customer project (to document customer communication and internal departmental project progress). This is highly problematic as all project participants are required to subscribe to the respective projects of the other departments. There is no filtering option, so every piece of information (no matter how unimportant) is communicated to all the project participants, resulting in spam. For example, an SEO employee receives the customer communication from the social media department, even if it is only the headline of a social media post. Quality assurance and the documentation of the (partial) results are also recorded in a separate OC ticket by the consultant. The consultant also carries out the reporting and saves it on the file server. Finally, he or she fills out an Excel invoice form and sends this by e-mail to the F&A department.
- *More than two online marketing departments and the web development department are involved*. Building on the above process of when more than two online marketing departments are involved, the web development team also creates its own project in the Yeera project management software. Since master data cannot be maintained in Yeera, the contact persons from the web development department cannot be stored centrally. The web development team does not participate in cross-departmental action planning due to agile project execution in sprints. The documentation of the web development subproject is performed in Yeera. In order to assign a task to the web development department, the other departments have to create a ticket in Yeera themselves. Thus, integrating the web development team into

the customer projects is another challenge. Also, a separate project report is created via Yeera by the web development department. The consultant fills out the Excel invoice form for the online marketing departments involved on a monthly basis and e-mails it to F&A. Once the web development department has also completed and forwarded its invoice form, F&A creates the invoice and sends it to the customer.

Identified Pain Points

The overarching goal is to design an integrated, clear, and easy-to-use IT landscape that supports sustainable growth and the original agility of the agency in the best possible way. During the interviews and workshops, a large set of pain points with optimization potential was identified, which needs to be taken into account when designing the IT landscape. Some of the challenges—mostly rooted in the rapid growth of the company—are illustrated in Figure 4.

Figure 4. Pain Point Cloud



Processes must be kept as lean as possible. While in the early years non-integrated software solutions were quite appropriate and, for example, quality assurance was carried out by the same person who programmed the website, the increasing communication between customers and the departments involved now requires a certain degree of standardization.

Requirements Regarding the New System and Its Implementation

From the preceding discussions, different wishes and priorities of the respective departments including advantages and disadvantages of the software used were revealed. The use of on-demand cloud-based software (software as a service) should also be discussed in this context. However, some central requirements became clear, which are presented below:

- *Information loss*. To prevent information loss and improve internal communication, the new IT landscape should enable better exchanges of information between Funnel and the project management tool(s). A lot of information is currently lost due to the lack of software interfaces, especially with regard to the business development department.
- *Project overview*. When designing the IT landscape, it should be taken into account that it is currently not possible to have an overview of the subproject status in projects involving several online marketing departments and the web development team, especially since two project management tools are used.
- *Task assignment*. The transparent assignment of tasks (in the tool or by e-mail) is desired by many employees and should be included in the decision. Rocketchat, the internal chat software, has certainly proven itself several times in the past. However, it is conceivable to integrate a chat function into the new software solutions.
- *Project evaluation*. The central evaluation of all projects according to the costs, status, involved actors, and priority, among others, should be supported.
- *Documentation*. The documentation within the projects is a central aspect. This takes up a lot of time and should be recorded in the software as intuitively as possible and with as little effort as possible.

The linking of project files belonging to the project, whether internally within the software or on the file server, must also be taken into account.

- *Invoicing*. If the redesign of the IT landscape requires a replacement of the accounts receivable software Debtware, it must still be possible to automatically generate invoices for projects that run over several months. Currently, the web development department takes about 3–4 hours to create invoices at the end of the month, which are not billed. Since the tax advisor of the company also uses Credisson and it works well, there are no plans to switch here.
- *Master data*. Customer data should be managed as centrally as possible, so it can be used by all departments during projects.
- *Time recording*. Central time recording is desired. Currently, this is done both in OC and Yeera, depending on the department, which makes evaluation difficult.
- *Knowledge management*. Information on the implementation of projects, on customers, and, for example, on the storage of passwords should, if possible, be made accessible to all departments and collected in a wiki, for example.
- *Costs*. Against the backdrop of the grown structures and requirements, the CEOs are willing to invest more in the IT landscape. However, from the CEOs' point of view, introducing Yeera for the entire company does not seem to make sense and would also be very cost-intensive. In addition, other departments find this tool unclear, partly due to political reasons, and are reluctant to use it. The web development department, on the other hand, is convinced by this tool and justifies its decision, among other things, with the use of Kanban boards or working in sprints. Overall, it is important to justify the benefits of new software investments. It should be taken into account that both bad investments and the retention of the widely outdated IT landscape could quickly result in six-digit costs for the company.

> “Ultimately, the added value must be right,” say the founders. Accordingly, different scenarios have to be weighted up.

When planning and redesigning the IT landscape, particular care must be taken to ensure that no (customer) data are lost. Performance slumps should also be avoided by piloting the changes in individual departments, if necessary. The cost of (internal) training and measures to raise awareness among employees affected by the upcoming transformation should be taken into account. Ultimately, the original agility based on the company’s size must be largely maintained through lean process design, clear project responsibilities, and efficient software use. In this context, several solutions for designing the new IT landscape are conceivable, which can range from the replacement or new implementation of individual software solutions to a holistic integration, and they should be considered, in particular, against the background of a cost-benefit analysis. It is important to make a prioritized selection but, at the same time, to show alternative paths that take into account the interests of the company as a whole, as well as the interests of the departments.

TEACHING CASE – QUESTIONS

The following questions will guide students when working through the case:

a) An overview of the strengths and weaknesses of the company with reference to the current IT landscape, as well as the opportunities and risks associated with its redesign, can help raise employee awareness and derive necessary measures as part of the transformation. Following this, what might a SWOT analysis look like?

b) How do the interests expressed by individual departments affect the design of the new IT landscape? Point out organizational and technical challenges that need to be taken into account in the context of redesigning the IT landscape, and sort them according to their relevance to the upcoming transformation.

c) The transformation can range from the selective replacement or procurement of software to comprehensive integration. Which software solutions come into question here and why? Analyze their pros and cons by developing a list of features for comparison.

d) What could the to-be IT landscape look like? For this purpose, landscape models and "process support matrices," mapping departments in terms of processes and software, can be used complementarily, for example.

e) How would you proceed with the rollout of the new systems/software? Develop a transformation roadmap, including involved departments, (sub-)projects, and a timeline. In doing so, also consider the associated training efforts required with regard to the departments as well as the possible, temporary parallel operation of the old and new software.

TEACHING CASE – INSTRUMENTS

SWOT Analysis

SWOT analysis is an instrument of strategic planning (e.g., Learned et al., 1965; Weihrich, 1982). It can also be used to derive strategies for IT alignment or development. With the help of SWOT, both an internal analysis of **s**trengths and **w**eaknesses and an external analysis of **o**pportunities and **t**hreats can be systematically carried out and visualized. The general approach starts with an environmental and business analysis. Results can be visualized in a matrix. Various strategic consequences can then be derived from the combination of the analyses.
The following strategies are available to companies (see Weihrich, 1982):

- *Opportunities/Strengths*. Here, it is important for the company to pursue new opportunities that are a good fit with the company's strengths.
- *Opportunities/Weaknesses*. Here, it is important for the company to eliminate weaknesses in order to take advantage of new opportunities.
- *Threats/Strengths*. Here, it is important for the company to leverage strengths in order to avert risks or threats.

- *Threats/Weaknesses*. Here, it is important for the company to develop defense strategies to prevent existing weaknesses from becoming the target of threats.

Figure 5. Structure of a SWOT Analysis (Adapted From Weihrich, 1982)

		Internal Factors	
		Strengths	**Weaknesses**
External Factors	**Opportunities**	*SO-Strategy (maximize strengths & maximize opportunities)*	*WO-Strategy (minimize weaknesses & maximize opportunities)*
	Threats	*ST-Strategy (maximize strengths & minimize threats)*	*WT-Strategy (minimize weaknesses & minimize threats)*

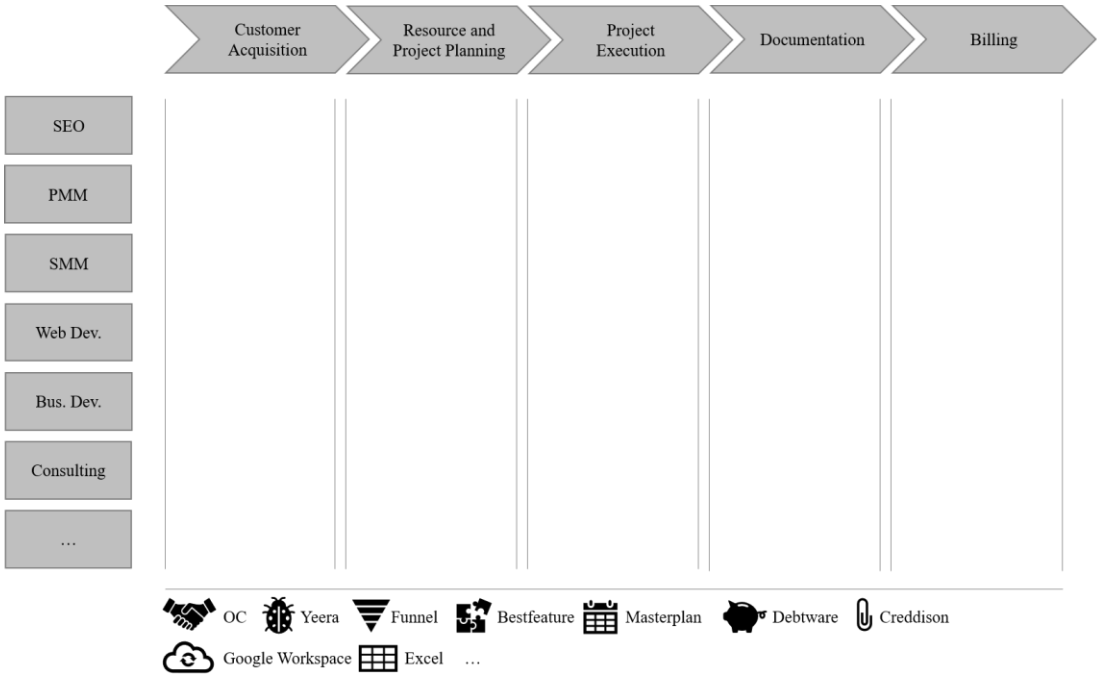
Landscape Modeling

Landscape models (see, e.g., Hanschke, 2010) are used to depict different states of the IT architecture. In each landscape model, a distinction can be made between the actual, the planned, and the target state. The level of detail of the landscape model decreases with the progression from the ACTUAL state through the PLANNED state to the TARGET state:

- The ACTUAL state refers to what the current IT landscape looks like and where there is potential for improvement.
- The PLANNED state is the roadmap for how to implement the desired changes. Mostly, the planned state also includes a fixed time horizon.
- The TARGET state describes what the future vision of the IT landscape looks like. In most cases, concrete steps are formulated as to how the state is to be achieved. The target state is the preferred state, which, however, cannot be implemented in every case due to various influences.

Here, a "process support matrix" can help, among other things, to map software to the company's processes.

Figure 6. Process Support Matrix (Example)



TEACHING CASE – SOLUTIONS

Approach to Solving Question A

Table 1. SWOT Analysis with an IT Focus (Example)

	Strengths - Industry know-how and product portfolio of the departments - Communication (agility through flat hierarchies) and networks - IT affinity of the (young) employees	**Weaknesses** - Missing software interfaces and outdated software in the IT landscape - Processes in need of optimization - No IT department
Opportunities - New software solutions on the market - New technologies (e.g., SaaS/cloud software) - Remote work (digital leadership)	- New software solutions promote agility in the company (e.g., improved communication) - Use of new technologies (e.g., use of on-demand cloud-software) - Remote work can increase the attractiveness of the company for applicants (e.g., to penetrate new markets). - IT-savvy employees can assist with software training	- Use of cloud solutions to compensate the lack of IT know-how (e.g., backups) - Optimized workflows/process optimization through an integrated IT landscape (e.g., with better software interfaces) - New software solutions can lead to cost reductions in the long term (e.g., simplified project documentation)
Threats - Maintaining the status quo cripples performance - Wrong software selection leads to high costs (in the long run) - Rollout can lead to operational impairments	- Employees and competitors can provide helpful information in terms of software selection -Piloting of the changes in individual departments as part of the redesign of the IT landscape in order to avoid performance slumps	- External consultants can be consulted to avoid mistakes in software selection and implementation - Establishment of an internal “transformation unit” to deal intensively with software selection and implementation

Approach to Solving Question B

One way to prioritize company-wide and departmental requirements is to divide them into critical, relevant, and other factors:

Table 2. Critical Factors in the Redesign of the IT Landscape (Example)

	Company-Wide	**Online Marketing Departments**	**Web Dev. Department**	**F&A Department**	**…**
Critical (3 points)	- Redundant customer master data - Overview of project status and changes in cross-departmental projects	- Documentation effort/familiarization time regarding new projects is high - Google Ads requires Google Workspace	- Kanban functionality is required	- Autom. invoicing - Autom. dunning	…
Relevant (2 points)	- Statistical evaluation of the projects - Central time recording/resource planning/task assignment - Spam in cross-departmental projects	- Project management software technically obsolete - Spam in cross-departmental projects	- Invoicing effort is relatively high - Integrated resource planning	- Software interface with project management software/ integrated invoicing	…
Other (1 point)	- Knowledge management (wiki)/central storage of passwords	- Software interface with sales/business development	- Software interface with sales/business development	- A single software program for accounts receivable and accounts payable	…

The issues that receive the highest scores should be prioritized. Business process modeling and notation (BPMN) (see, e.g., Dumas et al., 2018) can be used, for example, complementarily in the context of planning the IT landscape. It supports obtaining an overview of the relevant business processes as well as the software used within them. For example, the customer cycle from customer acquisition to project execution to customer support could be analyzed, taking into account the software solutions used therein as well as the departments involved.

Approach to Solving Question C

A list could include features such as interfaces to the existing IT landscape, costs, CRM and Kanban functionality, project and resource planning, automated invoicing, et cetera. Various tools can be used as part of the process of identifying software solutions that are potentially relevant for the company. This can be done by analyzing industry reports, interviewing specialists, or using tools such as the Gartner Magic

Quadrant. As an example, the Gartner Magic Quadrant provides an overview of CRM (Gartner 2021a) or enterprise resource planning (ERP) (Gartner 2021b) software currently used on the market.

Approach to Solving Question D

“Process support matrices” and landscape models can help to move from an ACTUAL state to a TARGET state. Often, implementation planning is represented using a sequence of landscape diagrams. An overview of planned projects per quarter to achieve the desired IT landscape could be created here. The current IT landscape and the desired IT landscape should be visualized along with (annual) interim statuses. For example, Hanschke (2010) offers some practical examples, which could be helpful for solving this task.

Approach to Solving Question E

After outlining the initial situation, including department-specific requirements for IT and external influences such as future trends and changes in the market and competition, and after creating a picture of the to-be IT landscape including improvements and, if necessary, risks for the coming years, the next step is to answer the question of how this can be achieved as part of the roadmap development. This should include a visualization or list of which projects, together with their associated costs and risks, will lead to the target state being achieved, and which solutions can already be built on (pros and cons).

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– FOURTH PUBLICATION –

Digital Gazelles: Challenges of Digital Startups During Phases of High Growth

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ABSTRACT

To investigate the challenges that high-growth digital startups ("digital gazelles") face, we conducted an exploratory study of this under-researched class of enterprises at the intersection between information systems and entrepreneurship research ("digital entrepreneurship") and propose a digital gazelle definition. We base our findings on an interview study with high-ranking representatives of 14 digital gazelles of different company ages and from different countries and industries. By following a grounded theory approach, we identified nine key challenges across the three areas of management, organization structure, and technology/systems. Building on this, we aim to better capture the strong link between the management and the digital technology use of startups in the digital age. Digital gazelles' leaders can draw on our results to prepare their organizations for further growth.

1 INTRODUCTION

Emerging and established digital technologies occupy a prominent position in information systems (IS) research and their intersection with the entrepreneurship discipline—recently coined as digital entrepreneurship. In this context, digital technologies demonstrate enormous potential to innovate, disrupt, and transform entire business areas (Nambisan et al., 2019; Sahut et al., 2021; von Briel et al., 2021). Understood as key drivers of organizational transformation (Bailey et al., 2022; Bharadwaj et al., 2013; Yoo et al., 2012), digital technologies can significantly support rapid business growth through innovation (Huang et al., 2017) and their strategic use can help small firms survive in a competitive environment (Chan et al., 2020).

However, the actual impacts of digital technologies, especially on rapidly growing organizations—called "gazelles" in the literature (Acs & Mueller, 2008; Birch & Medoff, 1994; Henrekson & Johansson, 2010)—are largely unexplored. To study high-growth digital organizations ("digital gazelles"), we draw on this concept and seek to extend it to better capture the specifics of these companies. Here, we focus on digital gazelles as startups and small businesses in the range of 10 to 100 employees during their phases of high growth. In this size range, we expect major growth-related organizational and technological changes and related challenges. Digital gazelles, in our understanding, are "grown or born digital" (Tumbas et al., 2015) and rely heavily on digital technologies—such as cloud, blockchain, digital platforms, artificial intelligence (AI), and the Internet of Things (IoT)—as core enablers and components of their business or operating models. Consequently, we expect digital gazelles to face different challenges compared to "regular" (non-digital) gazelles. In our study, we therefore aim to understand digital gazelles' specific challenges during rapid growth, with a special focus on how digital technologies support organizational agility and enable rapid business growth at different stages of development. Thus, we address the following research question:

What are the challenges digital gazelles face during phases of high growth?

Our findings contribute to the digital entrepreneurship literature in two ways. First, we make a terminological contribution by introducing and defining the concept of digital gazelles. Second, we identify the specific challenges digital gazelles face during phases of high growth. An improved understanding of the managerial, organizational structure-related, and technology- and systems-related challenges may help founders and managers of digital gazelles better cope with increasing complexity during phases of rapid growth.

2 THEORETICAL AND CONCEPTUAL FOUNDATIONS

2.1 A Socio-Technical Systems Perspective on Entrepreneurial Growth

From a socio-technical perspective, organizations are inherently intertwined with technologies (Leavitt, 1965). As multivariate systems, they consist of "four interacting and aligned components—task, structure, actor, and technology" (Lyytinen & Newman, 2008, p. 594). Here, the social system represents, among others, the relationships between people and authority structures, whereas the technical system deals with processes, tasks, and technologies. These systems are independent of each other, but interact correlatively; their output is the result of the joint interactions of both (Bostrom & Heinen, 1977). Thus, social and technological interactions are recursive, as "users shape the technology structure that shapes their use" (Orlikowski, 2000, p. 407), and are to be considered in an environmental context (Lyytinen and Newman 2008). In this context, the strategic alignment of information technology (IT) with business needs is not to be understood as an event but as "a process of continual adaptation and change" (Henderson & Venkatraman, 1993, p. 473). Since digital technologies (e.g., a cloud-based, scalable digital infrastructure to sustain organizational agility along with the collection, analysis, and evaluation of business data to support (strategic) decision-making) can be understood as enablers of business growth, a closer look at the individual growth phases of startups and small businesses thus requires a strong consideration of digital technologies. This leads to the need for a holistic view of social and technical aspects and their synergistic relationships in small digital organizations during phases of rapid growth.

In 1994, Birch and Medoff coined the term “gazelle” for high-growth firms that contribute substantially to the net job growth in the economy. These gazelles can be found in all industries, such as health care, textiles, and even cookie-making, with “high tech” making up only 2.5% of such companies, as gazelles are “predominantly appliers of technology, not creators of it” (Birch & Medoff, 1994, p. 164). While most of the gazelles start very small—with 1 to 19 employees—when they enter phases of rapid growth, some start with an employment size of more than 100 employees (Birch & Medoff, 1994). One year later, Birch et al. (1995) operationalized the term “gazelle” as “a business establishment which has achieved a minimum of 20% sales growth each year over the interval, starting from a base-year revenue of at least US$100,000.” This is more in line with a recent Organization for Economic Co-operation and Development (OECD) definition of high growth, which measures high growth (>20% per annum over a three-year period) by the number of employees or by turnover (OECD, 2008).

However, the definitions of high-growth companies and gazelles are inconsistent in the literature, as high growth “is multidimensional in nature [and] can be achieved in a variety of ways” (Delmar et al., 2003, p. 37). Other authors call small high-growth firms “flyers” (Gallagher & Miller, 1991), refer to gazelles as a subset of high-growth companies that are up to five years old (OECD, 2008), or distinguish between gazelles and high-impact firms (Acs et al., 2008). For the latter, with an average age of 25 years, expanding employment is combined with rising revenue (Acs et al., 2008). This includes a definition of gazelles as rapidly growing firms with 20–499 employees in the year of entering phases of high growth, which separates them from small, slow-growing firms with less than 20 employees (mice) and large firms with more than 500 employees (elephants) (Acs & Mueller, 2008). Moreover, different growth indicators (e.g., increase in the number of employees or growth in sales, or as x percent of the fastest-growing firms in the country) are proposed to measure gazelles. Alternately, it is debated whether there should be a size or an age limit for gazelles (Henrekson & Johansson, 2010). In summary, shared characteristics in these definitions are a growth indicator, such as employees or sales growth, usually expressed as a percentage per annum, and a coherent growth period that is usually between 3 and 5 years. A threshold of 10 employees is recommended to identify the beginning of a growth period (OECD, 2008).

Finally, as is widely accepted, organizations undergo different stages of evolution and revolution when aging and growing (Greiner, 1998). Birch and Medoff (1994) noted that gazelles in 1993 on average consisted of 61 employees. Considering this, and given our research focus on organizations with 10 to 100 employees, most gazelles fit into small business growth models (e.g., Churchill and Lewis, 1983; Scott and Bruce, 1987; Steinmetz, 1969). These generally include aspects of (top) management style, organizational structure, and (formal) systems. In these stages of development, a plethora of socio-technical challenges needs to be addressed "as people, planning, and systems gradually increase" (Churchill & Lewis, 1983, p. 10).

2.2 The Digital Gazelle

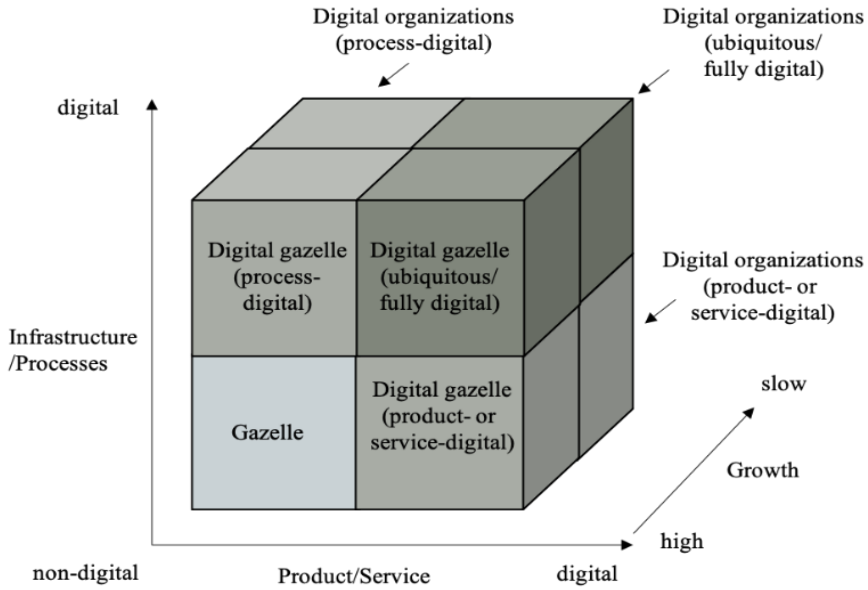
To transfer the concept of gazelles to the digital age and to better distinguish between digital and non-digital challenges during phases of high growth, we first need to determine what makes an enterprise "digital," as its understanding and expression varies widely in the IS literature (e.g., Baiyere et al. 2023; Rodriguez and Piccoli 2018). To this end, digital technologies, which occupy a prominent position in the process of entrepreneurial growth (Lehmann & Rosenkranz, 2018; Nambisan, 2017; Steininger, 2019; Tumbas et al., 2018), must be taken into account to understand what makes an enterprise digital. Viewed as "combinations of information, computing, communications, and connectivity technologies" (Bharadwaj et al., 2013, p. 471), digital technologies can fundamentally transform and scale business models (Tumbas et al., 2015), significantly enhance operations and processes, and "shape the business infrastructure and influence new organizational logic and patterns of coordination within and across" (Bharadwaj et al., 2013, p. 480).

In terms of organizational logic, digital technologies enable "new forms of collaboration and coordination, such as non-hierarchical, boss-less, or agile organizations" (Bailey et al., 2022, p. 2). Here, elements in a heterarchical (i.e., non-hierarchical) organizational structure are potentially equal and not ranked in contrast to hierarchical organizational structures where these tend to be subordinate and ranked (Crumley, 1979). In this context, adopting agile practices can support firms in increasing flexibility and speed (Gerster et al., 2018; Horlach et al., 2020). However, strict adherence to agile practices and methods, for example, can also have adverse effects (e.g., on innovation activities or the development of products), as these may function as a "control imperative," and a sense of collective ownership can lead specialists to become generalists (Annosi et al., 2022). In addition, digital technologies support enterprises in sustaining agility by establishing technology-enabled processes, evaluating product performance and monitoring changes, engaging with external communities, or combining internal and external resources to develop services or products (Chan et al., 2020).

In terms of innovation, organizations may also develop ambidexterity at different levels (e.g., firm or business unit), which is positively associated with firm survival (O'Reilly III & Tushman, 2013). Here, "organizational ambidexterity refers to the ability of an organization to both explore and exploit—to compete in mature technologies and markets where efficiency, control, and incremental improvement are prized and to also compete in new technologies and markets where flexibility, autonomy, and experimentation are needed" (O'Reilly III & Tushman, 2013, p. 2). Hence, digital technologies are crucial for the design of business models that can be considered digital if "digital technologies trigger fundamental changes in the way business is carried out and revenues are generated" (Veit et al., 2014, p. 48). In line with this, another crucial factor is reflected by the challenge of building a digital infrastructure, defined as "digital technology tools and systems (e.g., cloud computing, data analytics, online communities, social media […]) that offer communication, collaboration, and/or computing capabilities to support innovation and entrepreneurship" (Nambisan, 2017, p. 1032), while enabling a greater reliance on data-driven (algorithmic) decisions (Alaimo & Kallinikos, 2022; Vial, 2019).

Building on the aforementioned IS and entrepreneurship literature and paying close attention to Steininger's (2019, p. 377) model of typical co-occurrences of IT use in entrepreneurial business models, and, in particular, the two pillars of infrastructure and product ("a company's bundle of products and services") of entrepreneurial business models (Osterwalder et al., 2005, p. 18), we propose to distinguish gazelles from digital gazelles in terms of the degree of an integrated digital infrastructure (process-digital) and offered products and/or services (product- or service-digital). This contrasts digital gazelles as high-growth organizations from other slow- and moderate-growing digital and non-digital organizations (Figure 1).

Figure 1. Classification of Digital Gazelles



Following this, we define digital gazelles as "*all enterprises primarily offering digital products and/or services and/or relying on an integrated digital infrastructure, with an average annualized employee and/or sales-growth greater than 20% per annum, over a three-year period starting from 10 employees or US$100,000.*" Note that our definition deliberately allows digital gazelles to be active in traditional industries and excludes a limit on company age and size despite focusing on startups and small businesses in this study.

3 RESEARCH METHODOLOGY

We conducted a qualitative exploratory study to improve the understanding of the digital and non-digital challenges of digital gazelles at the intersection between IS and entrepreneurship. Using grounded theory (Strauss & Corbin, 1998), we sought to identify and categorize these challenges, giving special attention to the impact of digital technologies on the three areas of management, organizational structure, and technology/systems. This approach was particularly useful as "grounded theory can also be used for developing non-theory (conceptual ordering or elaborate description)" (Jones & Noble, 2007, p. 93). In doing so, we drew on a cross-sectional sample of 14 digital entrepreneurial organizations. To achieve a certain level of heterogeneity, we sought small, digital, rapidly growing organizations from different countries with an employee or sales growth rate of more than 20% per annum over several years. These were primarily in a size range between 10 and 100 employees, as we expected major organizational and technological changes there (e.g., in professionalizing (digital) leadership, introducing new organizational and agile structures, or building an integrated digital infrastructure). All companies exhibited a high level of familiarity in dealing with digital technologies (e.g., cloud solutions).

Following this, by drawing on the concept of Tumbas et al. (2015), we differentiated between "born digital" and "grown digital" organizations, as we expected different technological prerequisites when digital gazelles enter stages of high growth. While born digital organizations are by nature agile and are already embedded in digital technologies and infrastructures when they enter stages of growth, grown digital companies have to develop an integrated digital infrastructure over time due to their partially paper-based processes (Tumbas et al., 2015). Moreover, we distinguished between software-centric and hardware-centric business models, as we anticipated differences in organizational structure (e.g., in terms of agility) and technology use (e.g., in terms of data-driven decision-making). In addition, by referring to the "born global phenomenon" (Oviatt & McDougall, 1995), we differentiated between "grown global" and "born global" startups. As digital technologies (e.g., platforms) enable early-stage startups' international endeavors (Nambisan et al., 2018), these seize the opportunities of globalization in early or later growth phases compared to locally or country-wide operating startups.

Supplemented by secondary data (e.g., websites and press reports, financial and funding statements, social media posts), we conducted semi-structured interviews with one suitable representative from each company (Table 1).

Table 1. Sample of Digital Gazelles

#	F	E	Country	Interview	D	G/B	SW/HW	g/b	Industry
A	2009	150	GER	CEO	63	G	SW	-	Marketing
B	2015	36	GER	CEO	73	B	SW	g	eCommerce
C	2014	59	GER	Co-founder	41	B	SW	g	Advertising
D	2015	85/35*	GER	CFO	70	G	HW	g	Electronics
E	2015	98	GER	Co-founder	61	B	SW	b	Fashion
F	2015	198	GER	COO	51	B	SW	b	Marketing
G	2014	58	NZL	CEO	54	B	SW	b	Marketing
H	2018	22	NZL	CEO	53	B	SW	b	Software
I	2007	87	NZL	CEO	54	G	SW	g	Market research
J	2017	65	NZL	CEO	53	B	SW	b	Accounting
K	2014	50	NZL	Co-founder	62	B	HW	g	Automotive
L	2008	25	NZL	CEO	55	G	SW	g	Payroll
M	2018	40	FRA	CEO	55	B	SW	b	Education
N	2019	40	EST	Co-founder	60	B	SW	b	Last mile delivery

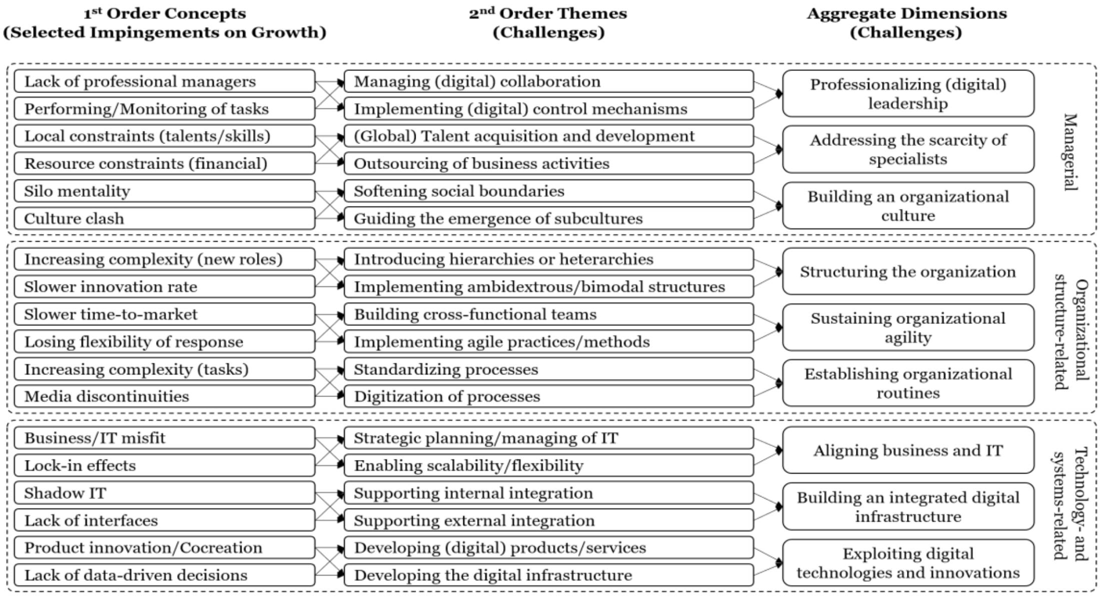
= company; F = founding year; E = employees; D= duration (in minutes); * = highest number of employees vs. end of 2021; G/B = grown/born digital; SW/HW = software-/hardware-centric; g/b = grown/born global; - = operates only regionally/country-wide

This supported "to obtain both retrospective and real-time accounts by those people experiencing the phenomenon of theoretical interest" (Gioia et al., 2013, p. 19). The interviewees consisted of the (co-)founders or chief executive officers (CEOs) of the companies, or long-term employees with a strategic focus from the C-suite (e.g., the chief operating officer (COO) or the chief finance officer (CFO)). While all companies at least partly used cloud solutions to operate their businesses, the companies differed in the maturity of their digital infrastructure and in their use of digital technologies for their business model. For example, company M had a high degree of digitalization in all areas; its business model was primarily based on offering digital certificates and learning units. For platform and product development and processing, blockchain technology as well as digital technologies, such as virtual reality (avatars) and gamification, were used. With its fully integrated digital infrastructure, including collaboration tools and cloud solutions, the company was capable of operating 100% remotely and relied on data-driven decisions. In contrast, company A's business model mainly focused on online services, such as website development and search engine optimization, while the company also offered offline consulting services and was comparatively less integrated in its infrastructure, as some processes were still paper-based and not all applications were fully integrated in a cloud environment. Although the company relied heavily on social media, its digital technology usage and depth were more limited compared to company M.

The research process included several cycles of iterative data collection and analysis. Through a previous three-year research project with company A, we were able to gather initial evidence on growth-related challenges for digital gazelles (e.g., sustaining their organizational agility) and their technology use. Building on initial insights and reviewing the literature on gazelles and the growth phases of startups and small businesses, this was the starting point for the development of the interview guideline for the first semi-structured interview with the CEO of company A. This guideline was then adapted for the interviews that followed.

All interviews were transcribed and analyzed using the qualitative data analysis tool MAXQDA by following the grounded theory steps of open, axial, and selective coding (Strauss and Corbin 1998). In this process, we identified initial concepts, abstracted these by developing categories (themes), and related them to each other. As we wanted to open up the data to all potentials and possibilities within them, we started with open coding the impingements of growth, related challenges, and characteristics of digital gazelles. The data gathered and analyzed from company A served as the baseline for coding the subsequent interviews. Building on our initial concepts and associated tentative categories, we applied axial and selective coding to first develop and relate our categories (e.g., technological or managerial challenges) to each other. Then we integrated and refined them to finally reveal a set of nine overarching key challenges digital gazelles face during phases of high growth. By aligning them with selected dimensions of small business growth models, the aggregate dimensions were classified into managerial, organizational structure-related, and technology- and systems-related challenges. In this process, to make the data structure visible, we used the methodology of Gioia et al. (2013) (Figure 2).

Figure 2. Challenges of Digital Gazelles During Rapid Growth



4 FINDINGS

In the following sub-sections, we present our findings by elaborating on the managerial, organizational structure-related, and technology- and systems-related challenges that digital gazelles face during phases of rapid growth (Figure 2).

4.1 Managerial Challenges

In our study, we observed three managerial key challenges of digital gazelles (M-I to M-III), deepened by associated sub-challenges (e.g., M-Ia). First, the high growth of digital gazelles has led to challenges in terms of professionalizing (digital) leadership (M-I) in a short time. Given their propensity to have their employees work mostly remotely (with the exception, of course, of physical activities, such as rental car maintenance in the case of company K), digital gazelles needed to orchestrate digital collaboration (M-Ia) and find the right (digital) tools and control mechanisms (M-Ib) to support this. For example, companies F and J introduced the objectives and key results (OKR) framework to support leadership from a distance. This was accompanied by traditional challenges, as evident in company I, which faced a leadership crisis at 20 employees, as it needed strong leadership but could not afford professional managers. Moreover, differences in the preference for digital working were noticeable: while some companies, such as companies A and D, emphasized the advantages of a presence culture, other companies, such as company B, switched from a company of presence to a fully remote company because of local constraints, while company N dispensed with a physical office from the beginning. This highlights the need to integrate online and offline leadership and to support it with targeted measures, reward systems, and control mechanisms.

Second, alongside the traditional challenge startups face in finding and retaining human talent, most digital gazelles depended heavily on acquiring business and IT talents to develop and sell their software and hardware products and services due to their high degree of digitalization. To address the scarcity of (business and IT) specialists (M-II), digital gazelles increasingly leveraged global recruitment and remote working (M-IIa). For example, this was of particular interest to company E for which people from 25 nations worked, as its rapid growth would not have been possible in this form due to local constraints in Germany and its subsidiary in the Netherlands. Moreover, some of the gazelles, such as companies A or D, developed their own "talent development programs," or so-called "academies," to support the development of business and IT know-how. Furthermore, some of the digital gazelles outsourced some of their business activities (M-IIb) to address the lack of human resources or to achieve cost advantages. This was evident, for example, in company G, which outsourced its Tier 1 support to the Philippines and parts of its software development to Sri Lanka.

Third, building an organizational culture (M-III) that supported efficient communication and collaboration was essential for most of the digital gazelles. In this context, the founder's role and professional background were not only crucial for choosing and implementing new systems but also for shaping the organization during the founding period and softening social boundaries (M-IIIa) between teams and employees as organizational complexity increased due to more roles and functions in later stages. This had a lasting impact on the organization and its culture and can be related to the concept of imprinting (Marquis & Tilcsik, 2013). Accordingly, the majority of digital gazelles placed a high value on building a strong organizational culture (e.g., through the function of people/culture managers) in the early phases. In this context, most digital gazelles placed less emphasis on hierarchies and, despite the possibility of working remotely to a significant extent, regularly organized joint activities and events to strengthen the corporate culture. For example, company E rented a large chalet in Austria for six weeks to promote creativity, innovations, and team cohesiveness, where all employees were invited to work from there and to get to know each other as they were able to work almost 100% remotely. In addition, the organizational growth of company F was accompanied by increasing cultural challenges, as the "sworn family" began to develop subcultures (M-IIIb). Thus, the corporate culture becoming more heterogeneous was a major challenge for company F and harmed organizational performance and agility when new managers hired employees who better represented their own personal values but did not fully identify with the corporate identity.

In summary, globalization efforts and digital collaboration presented digital gazelles with the challenge of professionalizing leadership in both online and offline realms, which required the implementation of control mechanisms in the early phases of growth, particularly when introducing a middle management layer. While talent acquisition spanned all phases of growth, companies A or D, for example, did not begin to develop explicit "talent development programs" until late stages, although skills development played a significant role in earlier stages as well. This was also evident in cultural topics. Most digital gazelles placed high value on team-building activities that support (informal) communication and collaboration early on but were, in later stages, confronted with growth-accompanying challenges as subcultures emerged, which significantly hampered organizational agility and performance.

4.2 Challenges Related to the Organizational Structure

Moreover, we identified three key challenges of digital gazelles related to the organizational structure (O-I to O-III), deepened by associated sub-challenges (e.g., O-Ia). First, the challenge of structuring the organization emerged (O-I). Due to a rapidly increasing number of employees and, thus, organizational complexity, digital gazelles needed to introduce hierarchies or heterarchies in a short time (O-Ia). In this context, new demands on communication, collaboration, and leadership arose as responsibilities changed and new functions and roles emerged. Furthermore, in some cases, the evolving of ambidextrous structures was evident (O-Ib). On the one hand, several digital gazelles (e.g., company F or N) increasingly relied on ambidextrous structures to support product innovations in the sense of the separation between exploitation and exploration when the companies had achieved more mature organizational structures compared to their early stages of growth. On the other hand, bimodal IT structures were rudimentary and only introduced in a few cases due to size (as shown in company E, where three employees were responsible for IT infrastructure issues and the majority of IT was divided into product and innovation teams).

Second, sustaining (the initial) organizational agility (O-II) as a startup while complexity increased due to growing organizational structures was crucial for the ability of digital gazelles to stay competitive. In line with the challenge of introducing new (heterarchical) organizational structures, most digital gazelles increasingly promoted the cross-functionality of teams (O-IIa), as was evident, for example, in company I or H. Moreover, many of the gazelles relied at least partially on agile practices and methods (e.g., Scrum, Kanban, daily meetings, and burndown charts for sprints) tailored to their business needs. In this context, implementing agile practices and methods (O-IIb) supported digital, borderless, and asynchronous collaboration while maneuvering through turbulences of fast-paced internal and external changes. Working, among others, with the agile business operations decision-making framework, the CEO of company N promoted the need to implement agile practices, tailored to the department's needs. In this context, weekly sprint planning was understood as a general orientation, which came along with the task of synchronizing the individual teams. In the case of company J, almost the entire company worked in the same sprint cycle with regular standups each morning, on the one hand and without the pressure of having to deliver on fixed weekly deadlines on the other. Thus, the company did not strictly adhere to agile methods, but rather internalized a holistic agile philosophy, adapted to the respective needs of the individual departments.

Third, digital gazelles faced the challenge of establishing organizational routines (O-III). In this context, they needed to find a balance between formal rules and case-by-case decisions that matched the growing organizational complexity (e.g., through new employees, processes, and structures and, thus, avoiding over-organization or “bureaucratization”). On the one hand, standardized processes (O-IIIa) promoted organizational agility through the more efficient distribution and processing of tasks, but on the other hand, they posed the risk of slowing them down through “bureaucratization.” During this continuous rebalancing, companies needed to (re-) position themselves within the continuum between mutual adjustment and standardization while picking up the chances of digitizing processes (O-IIIb) to overcome media discontinuities and to support efficiency and integration.

In summary, with growing organizational complexity, several challenges of structuring the organization arose. While, in some cases, implementing ambidextrous structures supported digital gazelles in sustaining their agility and innovation rate, this development was primarily observed in later stages due to their size. In some cases, organizational growth also led to the development of cross-functional teams and included the implementation of agile practices and methods. This also aligns with the growing need for standardizing and digitizing processes in the early stages of growth to avoid long-term costs due to high integration efforts.

4.3 Challenges Related to Technologies and Systems

Finally, three technology- and systems-related key challenges of digital gazelles were identified (T-I to T-III), deepened by associated sub-challenges (e.g., T-Ia). First, to ensure scalability and flexibility in the face of high growth and to avoid long-term costs due to a loss of organizational agility and non-integrated software solutions, digital gazelles needed to plan IT strategically to align IT with business needs (T-I). This was particularly evident in grown digital gazelles, although it also occurred in born digital gazelles with their comparatively higher proportion of software as a service (SaaS) and cloud solutions from the beginning. For example, with its fragmented IT landscape, lack of interfaces, partially paper-based processes, and increasing complexity in communication and collaboration due to a rising number of cross-departmental customer projects, company A faced the threat of losing organizational agility and significant financial losses due to processual inefficiency over the next few years. In this context, planning and consolidating the IT infrastructure (T-Ia) at a size of approximately 100 employees became a strategic decision for company A, which led to the introduction of a cloud-based enterprise resource planning (ERP) system as a part of the development of a digitalization strategy. Additionally, since digital gazelles must ensure the scalability, flexibility, and integration of their digital architecture (T-Ib) to support rapid growth, short-sighted planning of the digital infrastructure significantly inhibited organizational agility in some cases and led to high long-term costs through the high integration efforts of processes, software, and interfaces.

Second, building an integrated digital infrastructure (T-II) was a major challenge particularly for grown digital gazelles, as internal communication and collaboration became more complex and the interaction (as well as integration efforts) with customers, suppliers, and partners increased over time. Since systems and software integration was crucial for many internal (T-IIa) and external business processes (T-IIb), their strategic planning was often led by the C-level (e.g., evident in company A) and supported by external service providers or by internal, IT-savvy employees or enterprise architects, especially in the early growth phases.

Third, exploiting digital technologies and innovations (T-III) was crucial for developing (digital) products, services, and the digital infrastructure. While, in some cases, digital technologies and software solutions were assigned a primarily supporting role, in most cases, their high relevance for developing (digital) products, services (T-IIIa), and the digital infrastructure (T-IIIb) became clear. For example, cloud technology was used extensively in all cases. Its significance for the integration of processes and systems could also be associated with the use of AI for data analysis and decision-making. Moreover, while company M used blockchain technology to enable global cryptocurrency payments, other companies used remote technologies to take advantage of globalization opportunities (e.g., outsourcing business activities).

In summary, major differences between born digital gazelles, with their higher proportion of digital processes and cloud solutions from the beginning, and grown digital gazelles in terms of business–IT alignment challenges were evident. While born digital gazelles in the early stages of rapid growth already had a digital infrastructure that generally supported scaling and integration efforts, the integration of heterogeneous IT systems and the path to the cloud presented grown digital gazelles with greater challenges, particularly in later stages. Since digital technologies were important enablers of growth (e.g., supporting collaboration or creating opportunities for enhancing the business model), their adoption reached all phases, from inception to maturing resources.

5 DISCUSSION AND CONCLUSION

Through our study, we contribute to the relatively young body of digital entrepreneurship literature by 1) introducing and defining the concept of digital gazelles and 2) developing a better understanding of their challenges during phases of high growth.

First, based on the extant literature on high-growth enterprises ("gazelles") and digital technologies with their enormous potential to innovate, disrupt, and transform entire business areas, we make a terminological contribution to the research vocabulary by introducing and defining the concept of digital gazelles. These can be distinguished from "regular" gazelles by their relatively higher degree of an integrated digital infrastructure and digital products and/or services. Moreover, in light of the recent discourse on digital x (Baiyere et al., 2023; Rodriguez & Piccoli, 2018), our findings also provide theoretical fuel for questioning whether a company should be considered digital or not. For example, company M stood out with its 100% digital products and services, its intensive use of digital technologies such as blockchain and virtual reality, and its integrated cloud infrastructure that enabled data-driven-decision making and allowed completely remote operations when needed. This contrasts with, for example, company K, which was also entirely in the cloud and developed its own software but had a high proportion of offline activities in the area of car sharing.

Second, we identify nine overarching key challenges of high-growth digital organizations ("digital gazelles") in the early phases of growth, focusing on the three areas of management, organization structure, and technology/systems. Next to the challenges that regular gazelles face—such as finding and retaining human talent, accessing financial capital to accelerate growth, and exploring new business opportunities with scarce resources (Chan et al., 2020; Davila et al., 2003)—digital gazelles, also need to manage digital collaboration, adapt their internal processes and organizational structure, rethink their technology adoption and use, and scale their digital infrastructure at pace to prevent from a loss of organizational agility. Here, for example, major differences in the development of the digital infrastructure and organizational structure between born and grown digital gazelles emerged.

From a practical perspective, our findings enable the founders and managers of digital gazelles to better anticipate current and future challenges to better prepare their organizations for the next phases of rapid growth. For example, one such challenge comprises carefully planning and developing the digital infrastructure with respect to its scalability as the organization grows, its level of integration to enable data-driven decisions (e.g., for the placement of marketing campaigns), and digital tool selection to prevent a growth-related loss of organizational agility.

Of course, our study also has limitations. While our sample includes digital gazelles in several countries and industries, we based our analysis on a single voice per company. Moreover, despite our attempts to carefully scope the companies in our sample based on a precise definition, we still found that a number of "gray areas" remained. Notably, there was sometimes a challenge in drawing a clear boundary between digital and non-digital gazelles (e.g., when there was a high reliance on physical activities or products to provide digitally enabled services). In addition, it remains debatable to what extent digital gazelles can provide their products or services without a digital infrastructure, and exceptions (such as franchises) should be given greater consideration. There were further scoping challenges with respect to fluctuating growth figures over time, with growth figures that were at the very limit of or even beyond our boundaries (e.g., exceeding 100 employees in the latter growth phases (companies A and F), or with strong disconnects between the extent of sales and employee growth figures (company L)), leaving it unclear whether a particular phase was one of low or high growth. While all these "gray areas" constitute threats to the validity of our findings, we are confident that there is no outlier in our sample that would go against the spirit, if not the letter, of a digital gazelle.

Future research could focus on the impact of digital technologies on the rapid growth of startups (e.g., sustaining organizational agility). Moreover, as digital technologies can be understood as key drivers of organizational transformation, our findings further lead to the conclusion that most dimensions of established small business growth models, such as that of Churchill and Lewis (1983), are still useful but need to be refined with respect to management, organizational structure, and technology/systems to accommodate technological advancement. Finally, our findings can also be used as input for future theorizing on digital gazelles (e.g., exploring socio-technical tensions during phases of rapid growth).

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– FIFTH PUBLICATION –

Disentangling the Digitality of Startups From an Enterprise Architecture Perspective

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ABSTRACT

In this paper, we pick up the recent discourse on "digital x" and advance the field of digital entrepreneurship by disentangling the digitality of startups from an enterprise architecture (EA) perspective. In doing so, we provide a taxonomy based on the development process of Nickerson et al. (2013) and Kundisch et al. (2022) to better distinguish between startups with a high and a low degree of digitality. Here, by drawing on architectural layers, related design objects, and their dependencies, we differentiate between two primary (i.e., distinctive) and three secondary (i.e., supportive) dimensions of digitality. Finally, we demonstrate the taxonomy's applicability to real-world startups.

1 INTRODUCTION

In today's shift from entrepreneurship to digital entrepreneurship, digital technologies (DT) open up a wide range of opportunities for startups to innovate and transform entire business models as well as to exploit (global) business opportunities by developing or improving products and services (Kollmann et al., 2022; Nambisan, 2017; Sahut et al., 2021; von Briel et al., 2018). At the same time, DT hold the potential to "fundamentally shape all aspects of organizing" (Bailey et al., 2022, p. 1) by enabling new opportunities for collaboration and innovation both internally (e.g., by supporting cross-departmental and agile collaboration) and externally (e.g., by supporting customer engagement) (Bailey et al., 2022; Chan et al., 2020). Therefore, DT, such as cloud computing, blockchain, digital platforms, 3D printing, artificial intelligence (AI), and the Internet of Things (IoT), can be classified in terms of their function (i.e., application or infrastructure) and scope (i.e., "cyber" or "cyber-physical") (Baier et al., 2023).

Due to the symbiosis between DT and the venture creation process, the question arises as to what makes startups digital. More specifically, the terminological heterogeneity of "digital x" and "information technology (IT) x" found in the tension between digitalization and digitization is echoed in the recent academic discourse (Baiyere et al., 2023; Rodriguez & Piccoli, 2018). Here, in contrast to the comparatively narrow focus on DT of the digitization approach, a socio-technical perspective on digitalization is proposed that looks at the "broader individual, organizational, and societal context" (Legner et al., 2017, p. 301). This aligns, among others, with the article of Wessel et al. (2021), in which they distinguish between digital and IT-enabled transformation, as well as with the view of Ross (2017), who argues that "digitization is an important enabler of digital, but all the digitization in the world will not, on its own, make a business a digital company." However, the definitions and the inclusion and exclusion criteria (e.g., underlying digital artifacts, technologies, and infrastructure) used to define the "digital" in digital startups are manifold and lack a common understanding.

With our study, we aim to address this research gap and propose to disentangle the notion of "digital" in the startup realm by advancing the understanding of “degrees of digitality” through an EA lens. By holistically viewing the organization and its environment and by paying special attention to the alignment of business and IT (Aier & Winter, 2009; Bui, 2017; Kurnia et al., 2021; Simon et al., 2013), EA provides a solid basis for opening the black box of “digital” and for clarifying startups’ degree of digitality by offering well-established concepts, frameworks, and relevant design objects. Thus, to advance the field of digital entrepreneurship and the digital x discourse, we followed the taxonomy design process of Nickerson et al. (2013), which was extended by Kundisch et al. (2022). In this context, the following research question served as the guideline for our study:

How can we leverage the EA perspective for disentangling the digitality of startups?

2 THEORETICAL FOUNDATIONS

The discourse on “digital x” and “IT x” provides a general understanding of the terminological diversity of “digital” while highlighting the need for an unified terminological basis in theory and practice (Baiyere et al., 2023; Rodriguez & Piccoli, 2018). To point out the advantages of disentangling startups’ digitality from an EA perspective, we provide an overview of existing concepts and definitions from the digital entrepreneurship literature as a first step. Then, we present an overview of the current state of EA research as well as its frameworks and definitions to develop a better understanding of related EA layers and design objects as a basis for developing the taxonomy.

2.1 Existing Concepts for Disentangling Startups’ Digitality

Definitions of digital entrepreneurship (e.g., Kollmann et al., 2022; Nambisan, 2017) and DT (e.g., Baier et al., 2023; Vial, 2019) provide initial insights about how to classify startups in terms of their digitality from a technology perspective. For example, Kollmann et al. (2022) present nine interchangeable terms to describe the phenomenon of digital entrepreneurship, thereby noting the relevance of DT. Moreover, Baier et al. (2023) provide a taxonomy that allows for a better understanding of what constitutes DT by classifying a total of 92 DT. They distinguish DT in terms of their role and scope, which provides useful insights into the relevance of these technologies for disentangling startups' digitality. The prominence of DT in this context is often reflected by their importance for infrastructure- and business model-related aspects (Nambisan et al., 2019; Steininger, 2019; Veit et al., 2014). Here, digital infrastructure can be defined as "digital technology tools and systems […] that offer communication, collaboration, and/or computing capabilities to support innovation and entrepreneurship" (Nambisan, 2017, p. 1032). From a business model perspective, Veit et al. (2014, p. 48) define a business model as digital "if changes in DT trigger fundamental changes in the way business is carried out and revenues are generated." Moreover, Steininger (2019) builds on the three business model pillars (product/service, infrastructure management, and customer interface) from Osterwalder et al. (2005) to define digital business models and startups.

However, while these approaches contribute to disentangling the "digital" in digital startups by grounding the term in a long list of diverse DT, the heterogeneity of classifications leaves some blurriness. Furthermore, business-IT alignment and DT pervasion are not addressed, although these play an important role in the digital evolution of startups.

2.2 Digital Startups From an EA Perspective

An EA view of the organization and its environment demonstrates the significance of DT for startups in its socio-technical intertwining with internal and external business processes (e.g., cross-departmental collaboration, customer and supplier interaction), business units, strategic goals, etc. This view also highlights the importance of aligning business with IT and paying special attention to the interdependencies of architectural layers (Aier & Winter, 2009). In this context, architecture represents "the fundamental organization of a system, embodied in its components, their relationships to each other and the environment" (Institute of Electrical and Electronics Engineers Computer Society, 2000, p. 3).

Bui (2017), Haki and Legner (2021), and Rahimi et al. (2017) provide up-to-date overviews of the scope of EA and of influential publications, underlying definitions, frameworks, and design objects (artifacts) in this field. EA frameworks, such as the Open Group Architecture Framework (The Open Group, 2018) and the Federal Enterprise Architecture Framework (Chief Information Officers Council 2013), offer practical guidance on aligning business with IT. Moreover, Bui (2017) makes a distinction between business (organizational structures, strategies, and models) and technical (hardware and software infrastructure) EA layers, while Winter and Fischer (2006) distinguish between business, process, integration, software, and technology (or infrastructure) layers. Here, key elements from the business model perspective (e.g., a view on products/services and customers) are taken into account and extended by more deeply considering the organization and its environment as well as technology and process dependencies. Bradley et al. (2011) and Ross (2003) highlight different stages of EA maturity, thus indicating the relevance of business–IT alignment for startups and the taxonomy development process. The EA perspective helps to overcome a purely technical understanding of "digital" by stressing the need to also consider the complex intertwining of DT with the organization. Hence, it adds a socio-technical perspective for disentangling startups' digitality while providing a structured approach to incorporate related design objects and their dependencies in this process.

3 TAXONOMY DEVELOPMENT PROCESS

We aim to disentangle the "degree of digitality" of startups from an EA perspective for advancing the discourse on "digital x" (Baiyere et al., 2023; Rodriguez & Piccoli, 2018) and its implications for classifying digital startups. For this purpose, we followed the extended taxonomy design process of Kundisch et al. (2022), which builds on the taxonomy development method of Nickerson et al. (2013) and the design science research method by Peffers et al. (2007). As taxonomies represent "classification systems that help researchers conceptualize phenomena based on their dimensions and characteristics" (Kundisch et al., 2022, p. 421), adopting this approach allows us to better distinguish between startups with a high degree of digitality and those with low digitality. Moreover, the iterative nature of the method, which includes multiple conceptual-to-empirical and empirical-to-conceptual cycles, grounds theory building, where theory is understood as "a set of constructs linked together in relationships that are supported by theoretical arguments (i.e., mechanisms) that seek to explain a focal phenomenon" (Eisenhardt, 2021, p. 148).

To avoid a large number of (un)related characteristics and, thus, "naive empiricism" (Nickerson et al., 2013), we sought for "digital" in an entrepreneurial context as a meta-characteristic, meaning that "all the following characteristics and dimensions of the taxonomy must relate to this meta-characteristic" (Kundisch et al., 2022, p. 429). Regarding the definition of ending conditions, the method will end when "both objective and subjective conditions have been met" (Nickerson et al., 2013, p. 348). Here, the objective ending conditions entail that no new dimensions or characteristics were added in the last iteration and that no dimensions or characteristics were merged or split in the last iteration. The subjective ending conditions are met when the taxonomy is concise, robust, comprehensive, extendible, and explanatory. However, when considering the multitude of potential dimensions that emerge during the iterations, it is important to note that robustness must be considered in its tension with the need for integration, which puts greater emphasis on other subjective ending conditions, such as conciseness and extendibility. Finally, the evaluation goal is to classify startups' degree of digitality, as "characteristics and dimensions serve as a scheme to classify" (Kundisch et al., 2022, p. 432).

3.1 Design and Development

In designing and developing the taxonomy, we went through five iterations (conceptual-to-empirical/ empirical-to-conceptual). During this procedure, we constantly revised the taxonomy by adding, updating, and deleting characteristics and dimensions based on new empirical and conceptual insights.

Iteration I. By following a conceptual-to-empirical approach, we started to screen relevant literature from the IS, entrepreneurship, and general/strategic management disciplines. We searched the databases for peer-reviewed articles in high-ranked journals (Table 1) and selected conference proceedings, such as the International Conference on Information Systems and the European Conference on Information Systems, with "digital" in their titles, focusing on the term's association with “entrepreneurship,” “startups,” “SMEs (small- and medium-sized businesses),” “business models,” “infrastructure,” and “technologies.” In addition, we conducted a backward reference search to create a more comprehensive overview of existing (and relevant) definitions, concepts, dimensions, and characteristics for disentangling startups’ digitality.

Table 1. Selected Journals Included in the Review (Adapted From Steininger, 2019)

Information Systems	**Entrepreneurship**	**General/Strategic Management**
European Journal of Information Systems	Entrepreneurship: Theory and Practice	Academy of Management Journal
Information Systems Journal	Journal of Business Venturing	Organization Science
Information Systems Research	Strategic Entrepreneurship Journal	Journal of Management
Journal of Information Technology	International Small Business Journal	Strategic Management Journal
Journal of Management Information Systems	Journal of Small Business Management	Administrative Science Quarterly
Journal of the Association for Information Systems	Research Policy	Management Science
Journal of Strategic Information Systems		
Management Information Systems Quarterly		

Besides benefiting from this body of knowledge, this process allowed us to consider pertinent literature reviews whose “primary purpose [was] to synthesize and interpret the body of literature in a given domain” (Schryen et al., 2017, p. 557). For instance, Steininger (2019) describes typical co-occurrences of IT use in entrepreneurial business models to distinguish between digital, IT-mediated, IT-facilitated, and IT-bearing startups. By picking up the articles of Wessel et al. (2021) and Baiyere et al. (2023), distinctive characteristics were later integrated into the taxonomy, for example reflected in the “digitality of processes.” While this first iteration served as a sound basis for developing the taxonomy from a technology and business model perspective, qualitative attributes, such as robustness and explainability, were not met in this iteration.

Iteration II. We continued with an empirical-to-conceptual approach. In this iteration, we drew on two entrepreneurial organizations from a former interdisciplinary three-year research project on digital entrepreneurship in which we collaborated with 21 local companies. Despite having developed a comprehensive dataset of the architectural layers of company α, supported by additional insights from company β, there was still no conceptual clarity to serve as a basis for a concise classification of startups' degree of digitality. For an overview of the companies examined in the empirical-to-conceptual iterations (II and IV), see Table 2.

Table 2. Sample of Companies Examined During the Iterations

#	F*	Industry	C*	E*	Interview(s)/ Discussion(s)	Secondary/Archival Data (Selected)	I*
α	2009	Marketing	GER	150	2 x CEO (I & D) 1 x CEO (I) 4 x Manager (I) 1 x Employee (I)	Rich business process and EA descriptions from the three-year research project; multilevel workshops on digital transformation strategy with two out of four CEOs responsible for IT and operations	II
β	2015	Electronics	GER	85/35*[1]	CFO (I) COO (D)	Rich descriptions of the challenges faced during digital transformation, lecture presentation and discussions with the COO on strategy and IT	II
γ	2017	Accounting	NZL	65	CEO (I)	Press reports, website, financial and funding statements, and social media posts	IV
δ	2015	Energy	USA	42	COO (I)	Documentation of technology approach, software and system architecture, and platform roadmap	IV
ε	2019	Logistics	EST	40*[2]	Co-founder (I)	Press reports, website, and financial and funding statements	IV
ζ	2018	Education	FRA	40	CEO (I)	Press reports, website, product descriptions, financial and funding statements, and social media posts	IV

= company; F* = founded; C* = Country; E* = number of employees (end of 2021); I* = iteration; *[1] = highest number of employees vs. end of 2021; *[2] = end of 2022

Iteration III. We proceeded with a second conceptual-to-empirical approach, paying greater attention to the discipline of EA as it provides a structured approach to viewing startups from a technological, business, or organizational perspective. Here, we screened the literature in search of EA definitions, concepts, theoretical boundaries, and design objects in selected IS journals (Table 1) as well as journals and conferences from related fields (e.g., Business and Information Systems Engineering, International Enterprise Distributed Object Computing Conference). Again, we performed a backward reference search. Moreover, we used layers and design objects from the EA discipline to inspire and develop our interview guideline for the following iteration as we sought to enrich the taxonomy through (technological) dependencies across layers. When aligning dimensions from the technology and business model perspective with EA layers and related design objects, for example, the articles by Fritscher and Pigneur (2011) and Petrikina et al. (2014) provided a deeper understanding of underlying conceptual similarities and differences. In this process, we gave greater consideration to organizations' (EA) maturity (Bradley et al., 2011; Ross, 2003) and the integration layer in terms of business-IT alignment, which was later added to the taxonomy as a secondary dimension. Although a large number of related EA design objects proved suitable for classifying the digitality of startups, some of them (e.g., "location" and "roles") were only peripherally useful for that purpose; thus, they were excluded from further taxonomy development.

Iteration IV. Next, we conducted four additional semi-structured interviews with top managers of rapidly growing startups of varying ages, sizes, and nationalities as part of another empirical-to-conceptual approach. In the following, we provide a brief overview of these companies and their digital specifics.

Company γ: This software-centric company was selected due to its salient "digital-first" approach. Another reason was the company's need for a high degree of integration in its (agile) software development and sales activities. Moreover, the company's almost seamlessly integrated cloud infrastructure met the demands for flexibility and scalability during phases of rapid growth.

Company δ: This hardware-centric company was selected due to its strong business–IT alignment, a choice that builds on EA principles. At the same time, the company exhibited a high degree of DT pervasion in payment processing (blockchain) and platform development (cloud technology); it was also significantly supported by crowdfunding initiatives. This deepened the understanding of the importance of digital infrastructure integration and of the supporting role of DT in enhancing the business.

Company ε: This software-centric company was selected because it operated (almost) entirely virtually. The company did not have an office; customer meetings that demanded being physically present were held in coworking spaces or cafés. Moreover, the company showed a high degree of artificial intelligence (AI) know-how aimed at product development.

Company ζ: This enterprise was selected because it was able to operate fully digitally from the outset and showed a high degree of DT use (e.g., virtual reality, blockchain). Its business model was based on the development and offering of IT micro-certificates. Moreover, its highly integrated cloud infrastructure enabled increased reliance on data-driven decisions concerning product evaluation.

The semi-structured interviews supported the validation of the dimensions by offering a broader perspective on the use of DT in product development and operations (from a process perspective), leading to greater consideration of EA in the design of the taxonomy. Moreover, this provided useful insights on the cross-layer dependencies of business and technology from an EA perspective.

Iteration V. To ensure that both objective and subjective ending conditions had been met (Nickerson et al., 2013), we conducted another conceptual-to-empirical approach. Here, we repeated the classification of startups' degree of digitality by applying the taxonomy to the companies from iterations II and IV. In doing so, we were able to classify all the companies in terms of their degree of digitality based on their products/services and internal/external processes (primary dimensions) as well as to link the secondary dimensions to support the primary ones. Doing so provided a more detailed view of the organizations' degree of digitality. Finally, we developed a taxonomy that met the objective and subjective ending conditions.

3.2 Demonstration

Table 3. Iterative Taxonomy Development Process (Adapted From Baier et al. (2023))

I*	**A***	**D/C***	**Major Changes**	**EC* Selection (Not Exhaustive)**
I	C2E	3(+7)/ 1(+)5	Three primary dimensions from the business model pillars (product, customer [interface], and infrastructure management); seven secondary dimensions (e.g., key activities, value proposition, and partner); degree of digitality as main characteristic (with five digitality degrees [extensive to absent]); second-level grouping of dimensions	Subjective ending conditions not met: - not concise (not meaningful without being unwieldy or overwhelming) - not comprehensive (not all dimensions identified) - not robust (not enough to be of interest)
II	E2C	4(+8)/ 1(+5)	Adding one primary dimension (DT usage) and one secondary dimension (software integration)	Subjective ending conditions not met: - not explanatory (classification is impeded by a lack of descriptions)
III	C2E	5(+9)/ 1(+4)	Adding EA layers as primary dimensions (e.g., business, organization, and software) and integrating dimensions from the business model perspective; integrating degrees of digitality (low and absent) and adding definitions	Subjective ending conditions not met: - not concise (enough) - not explanatory (enough) Objective ending conditions not met: - adding and merging dimensions
IV	E2C	2(+3)/ 1(+4)	Consolidating product(s)/service(s) and internal/external processes as primary dimensions; digital infrastructure integration as secondary dimension (from integration layer); adding (relative/ domain-specific) DT pervasion to support a deeper understanding of the digitality of the primary dimensions; adapting definitions	Objective ending conditions not met: - merging and splitting primary dimensions of digitality
V	C2E	2(+3)/ 1(+4)	No further taxonomy modifications	All subjective and objective ending conditions met

I* = iteration; A* = approach (C2E = conceptual-to-empirical; E2C = empirical-to-conceptual); D/C* = dimensions/characteristics; EC* = ending conditions

In Table 3, we present an overview of which objective and subjective ending conditions were (not) met in each iteration and why. Moreover, we provide details of major changes during the taxonomy development process. By building on degrees of digitality as characteristics, we ensure that the elements are mutually exclusive and collectively exhaustive.

3.3 Evaluation and Communication

The evaluation of the final taxonomy, as well as of its previous versions, took place during the whole taxonomy development process and across all iterations. From the second iteration, as part of the interdisciplinary research project on digital entrepreneurship, digitality was examined from different angles, continuously scrutinized, and dimensionally and characteristically revised in the taxonomy. We conducted multiple discussions with researchers from related disciplines, such as organizational science, general/strategic management, entrepreneurship, and IS; these were enriched by discussions with students in related courses, which fed into the taxonomy development process. At the same time, cross-regional startups and SMEs offered in-depth, practical insights into their organizational structures and use of DT, which allowed us to refine the dimensions and characteristics. Later iterations of the taxonomy and its elements were presented in (international) research colloquia and validated through exchanges with other researchers from the EA field acting as evaluation partners.

4 FINDINGS

In this section, we present the taxonomy developed during the five iterations (Table 4) and apply the taxonomy to two of the startups in our sample (Table 5).

To disentangle the digitality of startups, we differentiated between primary (i.e., distinctive) and secondary (i.e., supportive) dimensions of digitality. Here, we drew on existing concepts (i.e., digital from a technology and business model perspective) and their underlying characteristics from the digital entrepreneurship literature, as well as on the notion of architectural layers and related design objects.

Table 4. Taxonomy of Startups' Digitality

		Degrees of Digitality (Characteristics)			
		Absent/Low	**Moderate**	**Advanced**	**Extensive**
Business Architecture (Primary Dimensions)	**Products/ Services**	(almost) no product/service is digitized	some products/ services are digitized	most products/ services are digitized	(almost) all products/services are digitized
	Internal/ External Processes	(almost) no processes are digitized	some processes are digitized	most processes are digitized	(almost) all processes are digitized
Integration Architecture (Secondary Dimensions)	**Digital Infrastructure Integration**	(almost) no internal/external process is digitally integrated (e.g., to support business needs such as data-driven decision-making or cross-departmental collaboration)	some internal/ external processes are digitally integrated (e.g., to support business needs such as data-driven decision-making or cross-departmental collaboration)	most internal/ external processes are digitally integrated (e.g., to support business needs such as data-driven decision-making or cross-departmental collaboration)	(almost) all internal/external processes are digitally integrated (e.g., to support business needs such as data-driven decision-making or cross-departmental collaboration)
Technology Architecture (Secondary Dimensions)	**(Relative) DT Pervasion: Products/Services**	(almost) no product/service is complemented by DT (e.g., 3D printing, IoT, drones, digital twins, virtual/augmented reality, virtual assistants)	some products/ services are complemented by DT (e.g., 3D printing, IoT, drones, digital twins, virtual/ augmented reality, virtual assistants)	most products/ services are complemented by DT (e.g., 3D printing, IoT, drones, digital twins, virtual/ augmented reality, virtual assistants)	(almost) all products/ services are complemented by DT (e.g., 3D printing, IoT, drones, digital twins, virtual/ augmented reality, virtual assistants)
	(Relative) DT Pervasion: Internal/ External Processes	(almost) no internal/external process is supported by DT (e.g., AI for data-driven decision-making, cloud computing to support digital collaboration)	some internal/external processes are supported by DT (e.g., AI for data-driven decision-making, cloud computing to support digital collaboration)	most internal/external processes are supported by DT (e.g., AI for data-driven decision-making, cloud computing to support digital collaboration)	(almost) all internal/external processes are supported by DT (e.g., AI for data-driven decision-making, cloud computing to support digital collaboration)

First, by giving special attention to the business architecture, we distinguished between two primary dimensions (products/services and internal/external processes). This highlights differences in the digital nature of products (e.g., developing/producing physical goods/products in contrast to developing software products or virtual games) and services (delivering "traditional" or online services), and the degree to which internal/external processes are digitized (compared to “paper-based” processes). Second, with regard to the integration and technology architecture as secondary dimensions, the a) degree of digital infrastructure integration and b) (relative) DT pervasion (of products/services and internal/external processes) supports the classification of startups’ digitality by giving greater relevance to the symbiosis of technology- and business-related activities. In this context, the degree of digital infrastructure integration (e.g., to enable data-driven decisions for the placement of marketing campaigns or the co-creation of products) highlights the need of aligning business with IT. Accordingly, startups that offer traditional goods or services can also exhibit a high degree of digitality when considering the secondary dimensions of digitality (e.g., through an advanced/extensive degree of DT pervasion). In contrast, startups that exhibit an advanced degree of digitality in their products do not necessarily rely on an integrated digital infrastructure (e.g., to align software development activities with other business processes due to cross-departmental customer projects) or use DT to support their business (e.g., relying on data-driven decisions enabled by AI).

While the classification of startups’ digitality by products/services (e.g., based on the value proposition/ product pillar of business models) and processes (e.g., based on key activities/ customer interface pillar of business models) is widely used, we deepen this view by adding secondary dimensions which pay special attention to the layers of EA. In addition to considering the business and technology architecture and related design objects, we highlight cross-layer dependencies (“integration layer”) against the backdrop of the prominence of business-IT alignment in IS research and propose to add the degree of DT pervasion (relative to other businesses in the domain). In contrast to the categorization of the startups’ digitality by the three business model pillars, we retain the product pillar, introduce an internal and external process perspective (which includes the customer interface), and give greater attention to business-IT alignment in terms of digital infrastructure integration. Finally, four degrees of digitality (absent/low, moderate, advanced, extensive) indicate the different characteristics of the respective primary and secondary dimensions to accommodate the digital nature of products/services, the digitization of internal/external processes, and the evolution of digital in general.

Table 5 illustrates the importance of adding secondary (i.e., supportive) dimensions to the primary (i.e., distinctive) dimensions by providing a deeper understanding of what makes a startup digital.

Table 5. Exemplary Application of the Taxonomy

	Company β	**Company ζ**
Products/ Services	Absent to low: selling tech and lifestyle products that contain (almost) no "digital elements"	Extensive: platform-driven delivery of IT micro-certificates supported by gamification
Internal/External Processes	Extensive: besides "blue collar activities," the company had the ability to operate (almost) fully remote due to highly digitized processes	Extensive: the company had the ability to operate fully remote due to highly digitized processes
Digital Infrastructure Integration	Advanced: while some software silos existed, most internal/ external processes were sufficiently integrated (e.g., to support the co-design of products with suppliers and to enable comprehensive data-driven decisions)	Extensive: the company's modularized approach (in terms of software solutions embedded in the digital infrastructure) significantly supported cross-departmental collaboration and to efficiently integrate the operations of its subsidiaries
(Relative) DT Pervasion: Products/Services	Absent to low: (almost) no product was complemented by DT	Extensive: (almost) all products were complemented by DT (e.g., virtual reality, blockchain)
(Relative) DT Pervasion: Internal/External Processes	Moderate: some of the processes were supported by DT (e.g., AI (experiments) for evaluating product performance, cloud computing for co-creation)	Extensive: (almost) all processes were supported by DT (e.g., blockchain for payment processing, cloud computing for co-creation)

5 DISCUSSION AND LIMITATIONS

From a theoretical perspective, we advance the field of digital entrepreneurship in two ways. First, we enrich the discourse on digital x by adding "degrees of digitality" to the ontological foundations of digital(ity) in an entrepreneurial context. Here, we link the digitality of startups to EA by considering common layers (business, integration, and technology architecture), related design objects, and their dependencies. Second, with our taxonomy, we provide a direction for how startups can be classified in terms of their degree of digitality while addressing the inherent terminological heterogeneity of the term "digital." Here, we extend the discourse on digital x by introducing primary and secondary dimensions of startups' digitality. In addition, from a practical perspective, this paper supports drawing a line between different types of digital startups as it highlights that companies offering physical goods can also vary in their digitality and being considered as "digital startups."

This study has also some limitations. First, from a methodological perspective, it seems promising to develop the literature review systematically and to include "grey literature" to gain a deeper understanding of existing concepts. Moreover, to demonstrate the validity of the taxonomy dimensions, this may be supported by more empirical data (e.g., in-depth case studies or interviews) of startups from different national systems of innovation and of different ages, growth stages, and sizes. Second, from a terminological perspective, further research in the entrepreneurial context may enrich our findings through a more integrated and, thus, holistic perspective of digital and IT. In this context, consideration can be given to quantifying the dimensions of digitality related to maturity models (e.g., 0 = absent/low; 1 = moderate; 2 = advanced; 3 = extensive), and to what extent an above-average score across all dimensions contributes to the classification of a digital startup, or not. Third, given the increasing accessibility of DT (e.g., cloud technology) for startups, this leads to the question whether startups with an advanced/extensive degree of digitality in products/services can operate without an advanced/extensive degree of digitality in internal processes (searching for the "black swan").

Finally, we suggest three fruitful avenues of future research on digital startups and, thus, on digital entrepreneurship. First, as DT hold the potential to permeate entire organizations and their ecosystems, it seems important to further examine startups' digital or IT-related challenges (e.g., aligning business with IT or building an integrated digital infrastructure that supports scalability and flexibility) at different stages of growth. Second, due to the availability of best practices as well as the embedding in entrepreneurial ecosystems (e.g., startups guided by venture capitalists or angel investors), it is interesting to question whether all future (high growth) digital startups are, on an abstract level, technologically identical and what influence regional and national systems of innovation, and globalization have on this. Third, when digital startups grow rapidly, socio-technical tensions may arise which may be examined in more detail from an EA perspective. This can provide practical guidance for startups while enriching the fields of IS, organization science, and digital entrepreneurship.

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– SIXTH PUBLICATION –

Adapting Growth Models for Digital Startups: Empirical Evidence and Directions for Digital Entrepreneurship Research

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ABSTRACT

We contribute to digital entrepreneurship research by adapting growth models to better reflect the dynamics of entrepreneurial growth trajectories and increasing digital technology pervasion in digital startups. By grounding our findings in a dataset that includes interviews with founders and executive managers of 24 digital startups from eight countries, we propose three directions for advancing theory that supports a better understanding of the complexity and ambiguity of digital startups when growing. Directions I and II aim at revising and extending established growth models to support research on attributes that better capture the increasing digital technology pervasion in digital startups. In direction III, we explore seminal research on dynamic states that contradict the dominant view of deterministic stages in growth model research and illustrate the need to integrate both approaches when designing new theoretical growth models by presenting four archetypes of digital infrastructure evolution.

1 INTRODUCTION

Digital entrepreneurship research lies at the intersection of entrepreneurship and information systems research and deals with the transformational power of digital technologies (DTs) over entrepreneurial processes and outcomes (Kollmann et al., 2022; Lehmann & Rosenkranz, 2018; Nambisan, 2017; Steininger, 2019; Stephens & Miller, 2023). In this context, research on the dynamics of the growth trajectories of digital startups is of increasing theoretical and practical relevance (Lehmann & Rosenkranz, 2018; Nambisan, 2017; Tumbas et al., 2018). Here, DTs occupy a prominent position in the process of entrepreneurial growth (Lehmann & Rosenkranz, 2018; Nambisan, 2017; Steininger, 2019; Tumbas et al., 2018). They have the potential to fundamentally reshape organizations while fostering communication and collaboration (Bailey et al., 2022; Kretschmer & Khashabi, 2020; Yoo et al., 2012), enabling new venture creation processes (von Briel et al., 2018a), transforming and scaling entire business models (Giustiziero et al., 2021; Tumbas et al., 2015), and supporting and accelerating product and service innovations (Huang et al., 2017; Lyytinen et al., 2016; Nambisan et al., 2019; Steininger et al., 2022; Yoo et al., 2010).

However, digital entrepreneurship research has not yet incorporated the existing body of literature on growth models, although it serves as a promising inspiration for research on digital startups. To better understand the impact of DTs on the growth trajectories of digital startups, we thus build on seminal research on firm growth, which has a long tradition in the discipline of entrepreneurship and organizational research and has attracted much interest in theory and practice (Grover & Segars, 2005; Levie & Lichtenstein, 2010; Shane & Venkataraman, 2000; Wright & Stigliani, 2013). One of its streams deals with growth models and related concepts, such as life cycles, which are well established in both disciplines (Hanks et al., 1994; Levie & Lichtenstein, 2010; Mosca et al., 2021). Here, the information systems discipline, which views stage models as both theories and IT artifacts (Poeppelbuss et al., 2011), has made substantial contributions to research on firm growth, paying special attention to DTs in the organizational life cycle (Grover & Segars, 2005; Nolan, 1979; Solli-Sæther & Gottschalk, 2010; Tumbas et al., 2015).

During the metamorphosis from a loosely knit startup to a resource-mature company, firms face several challenges viewed as "dominant problems" (Kazanjian, 1988; Solli-Sæther & Gottschalk, 2010) or "crises" (Greiner, 1989; Nolan, 1979; Scott & Bruce, 1987), which can be linked to distinctive stages—or phases—in these growth models, each with its own characteristics (Adizes, 1979; Greiner, 1989; Scott & Bruce, 1987). Growth models support anticipating when and which key requirements and challenges are likely to occur and how these can be dealt with (Churchill & Lewis, 1983; Scott & Bruce, 1987; Solli-Sæther & Gottschalk, 2010). From a theoretical perspective, growth models support a better understanding of organizations' complexity and ambiguity when growing (Es-Sajjade et al., 2021). From a practical perspective, their implications can enhance organizational performance (Kazanjian, 1988) and enable founders and executive managers to better understand growth-related challenges to prepare their organizations for the transition from one stage to another (Scott & Bruce, 1987; Solli-Sæther & Gottschalk, 2010).

Thus, integrating research on growth models from entrepreneurship and organizational research with digital entrepreneurship can be a fruitful starting point for raising questions related to the timeliness of growth models in the age of digital startups, acknowledging the increasing DT pervasion and the need for a stronger consideration of the dynamics in entrepreneurial growth trajectories. As a starting point for developing future directions for digital entrepreneurship research on growth models, we defined the following research question:

How can growth models be adapted to better reflect the dynamics of entrepreneurial growth trajectories and increasing DT pervasion in digital startups?

To address this question, we adopted an abductive approach that is supported by an empirical dataset comprising interviews with founders and executive managers of 24 digital startups from eight countries. This study also draws on insights from a former three-year research project on digital entrepreneurship and an extensive literature search process on organizational growth and the influence of DTs at the intersection of entrepreneurship and information systems. We advance digital entrepreneurship research by making three main contributions toward adapting growth models, summarized as directions for future research.

First, we propose revising established growth models by capturing the increasing DT pervasion in digital startups and illustrate this through two key growth model attributes: organizational structure and managerial style (direction I). This supports a better understanding of new forms of organizing driven by DT, global collaboration, and leadership in the digital realm. Second, we call for the extension of established growth models with new attributes that better represent the increasing DT pervasion in digital startups. We illustrate this by digital startups' digital infrastructure (DI) evolution, highlighting the importance of a structure–technology fit when scaling digital startups (direction II). Third, we explore seminal research on dynamic states that contradict the dominant view of deterministic stages in growth model research. Here, we illustrate the need to intertwine stage-based and dynamic approaches when designing new theoretical growth models by providing four archetypes of DI evolution (direction III). Thus, our study serves as a starting point for theory development that questions the timeliness of growth models in the digital age.

2 THEORETICAL AND CONCEPTUAL FOUNDATIONS

2.1 Ontological Foundations of Digital Startups

The ontological foundations of "digital" (e.g., as in digital startups) are reflected and discussed in the latest digital x discourse (Baiyere et al., 2023; Rodriguez & Piccoli, 2018). This discourse aims to provide conceptual clarity on the term "digital" by highlighting two separate viewpoints on it, namely, "the digitization view [as] the idea of digital arising in the digitizing or technical sense, and […] the digitalization view [as] the idea of digital arising in the contextual (social, organizational, etc.) sense" (Baiyere et al., 2023, p. 3). This is critical for both field empirics and theory (Baiyere et al., 2023) as it reflects the conceptual blurriness of distinguishing between digital and non-digital startups in prior research and thus informs our research on the digital startups considered in the sample. Moreover, degrees of digitality that aim to better represent the digital shades of digital startups support a better understanding of digital startups' characteristics (Tschoppe & Drews, 2023). Research has also pointed out the relevance of distinguishing between grown and born digital organizations in terms of the role of DTs in the growth process (Tumbas et al., 2015, 2018). Thus, DTs, viewed as "combinations of information, computing, communications, and connectivity technologies" (Bharadwaj et al., 2013, p. 471) play a crucial role in distinguishing digital and non-digital startups. In this context, DTs may be classified in terms of their digital and physical input and output, illustrated by 3D and 4D printing (digital input, physical output) in contrast to 3D scanners (physical input, digital output), or virtual reality (digital input, physical output) (Baier et al., 2023; Berger et al., 2018). Moreover, DT may also play a crucial role in supporting business activities (e.g., cloud computing for enabling collaboration and communication, blockchain technology for financial transactions, or artificial intelligence to support data-driven decision-making) or enabling innovation and the development of digital artifacts as products and services (e.g., digital twins, drones, or virtual assistants). Through this lens, DTs shape organizational logic, enable new patterns and forms of collaboration and coordination (such as non-hierarchical or agile organizations), and support innovation (Bailey et al., 2022; Bharadwaj et al., 2013; Nambisan, 2017).

Building on this, we follow the definition of digital startups as "startups that have digital artifacts at the core of their business model for value creation and capture" (Lin & Maruping, 2022, p. 212). Here, we focus on one class of digital artifacts, namely DI, which can be defined as "the basic information technologies and organizational structures, along with the related services and facilities necessary for an enterprise or industry to function" (Tilson et al., 2010, p. 1). In the context of accommodating growth, a DI that supports a high structure-technology fit is crucial (Henfridsson & Bygstad, 2013; Koutsikouri et al., 2018), for example by enabling scalability and flexibility through cloud computing (Giustiziero et al., 2021). Accordingly, DTs and digital artifacts such as DI must be considered when theorizing on digital startups' growth trajectories.

2.2 Growth Trajectories of Digital Startups

The conceptualization of entrepreneurial growth trajectories grounded in a stage-based approach has a long tradition in entrepreneurship and organizational research (Levie & Lichtenstein, 2010). However, while growth model attributes such as organizational structure or managerial style are used to describe the characteristics of each stage, entrepreneurship research still discusses which growth indicators, such as sales or employee growth, or market share, are suitable for dissecting growth stages (Clarke et al., 2014; Delmar et al., 2003). While there is no specific requirement (e.g., number of employees or total of sales) when moving from one stage to another, size (in terms of number of employees) and the growth rate of both sales and number of employees are considered important indicators in most growth models (Levie & Lichtenstein, 2010). However, firm growth can be viewed as a multi-dimensional phenomenon, which indicates a heterogeneity of growth patterns relevant for a better understanding of the growth process (Delmar et al., 2003; Sternad & Mödritscher, 2022).

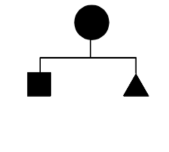
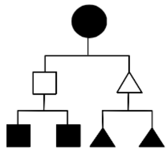
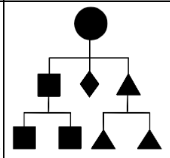
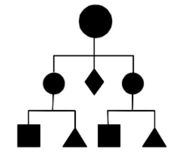
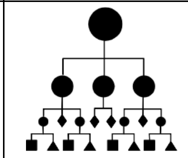
Besides the age of a company, which can serve as an indicator for considering a company a startup or not (though its definition is blurry and diverse in entrepreneurship literature), growth rate supports distinguishing between slow- and high-growth startups, which bears important implications on the need for a scalable and flexible DI that supports business needs. Moreover, DTs can accelerate the venture creation process in terms of reducing the time and effort required to develop prototypes and launch a viable product or service (von Briel et al., 2018b; Steininger et al., 2022). In this entrepreneurial context, "ventures are often metaphorically grouped based on their distinct behavioral patterns and characteristics" (Cristofaro et al., 2023, p. 1065). For example, high-growth firms may be called gazelles (Birch & Medoff, 1994) or digital gazelles (Tschoppe et al., 2023), while their characteristics support a better understanding of related challenges during phases of high growth and, thus, their transition from one stage to another. Moreover, this serves as a lens for a stronger consideration of dynamics in growth models. As gazelles are often characterized by high volatility due to constantly taking risks (Birch & Medoff, 1994; Headd & Kirchhoff, 2009), they may move quickly between small and large in both directions and face challenges from later stages sooner. In this context, a startup's organizational failure can be related to the concept of the liability of newness (Gilbert et al., 2006; Singh et al., 1986), providing a better understanding of organizational decline in growth models.

When related to stages, growth model attributes and their characteristics support anticipating future challenges during the evolution of startups, offering valuable insights for practice. This may include managerial challenges (Kindström et al., 2024), related skills in different stages (Mamabolo & Myres, 2020), or challenges related to organizational structure and systems (Gilbert et al., 2006). For example, increasing competition due to the generativity of DT, digital market convergence, and fluid organizational boundaries leads to the need of becoming more agile in order to survive (Salmela et al., 2022). Here, concepts of fully remote or fully agile organizations, organized in tribes and squads as cross-functional and self-organized teams (Gerster et al., 2018) challenge current assumptions of the development of organizational structure in established growth models. Moreover, challenges concerning the adaption of the organizational structure may arise after venture capital investments, potentially leading to being caught in a structure-conversion trap (Wimelius et al., 2023). Hence, environmental variables such as the availability of venture capital or technical workforce have the potential to significantly impact the growth of digital startups (Zaheer et al., 2019).

2.3 Beyond Growth Stages: A Dynamic States Approach

Some of the most extensive research on comparing attributes and stages of growth models is provided by Levie and Lichtenstein (2010). In their seminal paper, they examine more than 100 growth models and provide a list of 21 common attributes (e. g., extent of formal systems, organizational structure, managerial style). Table 1 shows the characteristics per stage of the organizational structure attribute, illustrated by four of the most cited growth models to demonstrate this attribute's evolution. Note that these vary in terms of their audience, and the illustration focuses on five stages though there is a plurality in terms of the number of stages found in other growth models. This deterministic view of entrepreneurial growth supports founders and executive managers of new ventures in anticipating challenges when preparing their organizations for further growth. Moreover, the notion of stages indicates qualitative changes and milestones in the growth process (Lin & Maruping, 2022). Here, the assignment to one particular stage serves as a reference point, whereby companies may exhibit characteristics of other phases as well and the importance of specific management factors may change when growing (Churchill & Lewis, 1983).

Table 1. Organizational Structure in Five Stage Growth Models

Attribute	**Stage I**	**Stage II**	**Stage III**	**Stage IV**	**Stage V**
Organization structure*[1]: Scott and Bruce (1987); 1702*[G]	Unstructured	Simple	Functional, centralized	Functional, decentralized	Decentralized, functional/ products
Organization*[1]: Churchill and Lewis (1983); 4425*[G]					
Structure*[2]: Galbraith (1982); 656*[G]	Informal; little need	Functions and hierarchy begin	Functional organization; division of labor centralized	Functional with overlays; division of labor decentralized	Matrix; profit center; decentralize
Organization Structure*[2]: Greiner (1989); 7374*[G]	Informal	Centralized and functional	De-centralized and geographical	Line-staff and product groups	Matrix of teams
*[1] = small business growth models; *[2] = general growth models; *[G] = Google Scholar citations (8/15/2024)					

However, recent criticism of growth models with predictable, deterministic stages has increasingly been put forth, as no particular stage-based model has become dominant, and there is no agreement how many stages or which attributes need to be considered in this process (Levie & Lichtenstein, 2010). This criticism is rooted in the lack of empirical validation of the deterministic stages in theoretical growth models and the consideration of non-linear, dynamic new venture creation processes (Clarke et al., 2014; Davidsson & Gruenhagen, 2021; Hanks et al., 1994; Solli-Sæther & Gottschalk, 2010; Sternad & Mödritscher, 2022). To better represent the dynamics of the venture creation process, Levie and Lichtenstein propose dynamic states as "open, complex adaptive systems that operate in disequilibrium conditions” (Levie & Lichtenstein, 2010, p. 332). Thus, dynamic states “can appear in any sequence, […] allowing different growth patterns to emerge” (Sternad & Mödritscher, 2022, p. 2).

The dynamics of the organizational growth process are reflected by an increasing research interest (Davidsson & Gruenhagen, 2021; Ingley et al., 2017; Sternad & Mödritscher, 2022), supported by initial endeavors to combine dynamic and static stages in small business life cycles (Matejun & Mikoláš, 2017). This has led to a call for more empirical research on the dynamics of entrepreneurial growth (Levie & Lichtenstein, 2010). Based on our findings, we noticed both evidence for supporting deterministic stages in growth models and the need for a more dynamic view of the growth process of digital startups. Thus, with our study, we aim to advance theory on entrepreneurial growth from two perspectives—stages and dynamic states theory.

3 RESEARCH METHODOLOGY

This study is part of a larger research endeavor on digital entrepreneurship. In total, we gathered 1394 minutes of interviews with founders and executive managers of 24 digital startups from eight countries (Table 2) to get a better understanding of the growth trajectories of digital startups. This empirical data was supported by a former three-year research project on digital entrepreneurship with companies A and G, which provided a deeper understanding of the characteristics and specific challenges of digital startups. An extensive literature search complemented this and informed our research on both growth models from organizational and entrepreneurship research and the influence of DTs on startups from digital entrepreneurship and information systems research (see steps of data analysis).

To develop future directions for digital entrepreneurship research on growth models, we adopted an abductive research design. This refers to the inductively derived findings from the empirical data and the deductively inferred findings from the literature research that served as a solid theoretical basis, accompanied by the practical insights gained through intensive collaboration (e.g., through workshops or action design research projects) with startups within the digital entrepreneurship research project. Empirical data and existing theory are thus considered in tandem, whereby the abductive nature of the research process supports a continuous revision and sharpening of the research design due to the shifting between inductive and deductive reasoning (Alvesson & Kärreman, 2011; Charmaz, 2006). In this process, the grounded theory methodology served as an appropriate tool for rigorously analyzing obtained data from the interviews with digital startups, as it guided us in better understanding the specific phenomena of their growth trajectories and, thus, developing theory where extant theory from growth model research did not apply (Gioia et al., 2013; Strauss & Corbin, 1998).

Steps of data analysis. We conducted seven iterations in the interplay of improving our theoretical understanding of entrepreneurial growth trajectories and DT pervasion in digital startups and in analyzing the empirical data. While we present these steps in a processual manner, reality and, thus, developing the directions was more complex, as, for example, the literature search process from the first iteration was continuously updated (e.g., with recently published papers from 2023 and 2024).

First, we systematically screened the entrepreneurship and information systems literature in terms of the role of DTs in startups and their growth trajectories. Initially, we were particularly interested in the differences between digital and non-digital startups (e.g., in terms of specific challenges and characteristics) and how DTs might support these in their growth efforts. Here, articles from databases such as the AIS eLibrary and leading entrepreneurship journals (e.g., *Entrepreneurship Theory and Practice, Journal of Business Venturing, Journal of Small Business Management, International Small Business Journal*) provided a deeper understanding of the ontological foundations of startups and the influence of DTs on these. We also searched the databases for peer-reviewed articles in high-ranked information systems journals (e.g., *Management Information Systems Quarterly, Information Systems Research, Journal of the Association for Information Systems, Journal of Management Information Systems, Information Systems Journal, European Journal of Information Systems, Journal of Strategic Information Systems, Journal of Information Technology*) and selected information systems conference proceedings, such as the *International Conference on Information Systems* and the

European Conference on Information Systems, focusing on “digital” in their titles and abstracts and related terms (e.g., startups, small and medium-sized businesses, venture creation process), including forward and backward reference searches. For example, we built on the concept of grown and born digital organizations, where the growth of the latter is “intrinsically linked to the crucial role digital technologies play” (Tumbas et al., 2015, p. 7). This concept later informed the DI approaches in the venture creation process and served as a starting point for the development of the DI evolution archetypes of digital startups.

Second, we drew on the findings from our collaboration with digital startups from the digital entrepreneurship research project, which allowed us to gather valuable insights into their growth trajectories. Here, companies A and G showed significantly high employee and sales growth rates over time, which informed us about growth-related challenges in terms of developing a DI that suits the companies’ needs by enabling scalability and flexibility. Empirical data from the semi-structured interviews with the CEO of company A and the CFO of company G were supplemented by (longitudinal) archival data (e.g., business process and enterprise architecture descriptions) from workshops and smaller research projects (e.g., developing a digitalization strategy for company A). Moreover, these interviews served as the starting point for the first round of data analysis, which resulted in the creation of initial code categories aimed at constructing a deeper understanding of DTs in relation to entrepreneurial growth. This coding was supported by the MAXQDA software.

Third, we included existing growth models from entrepreneurship and organizational research in the analysis that depict the organizational transformation of digital startups. Here, we conducted an additional systematic literature search which included leading journals from strategic management and organizational research (e.g., *Organization Science, Strategic Organization, Strategic Management Journal, Academy of Management Journal, Academy of Management Review*). This took place in two different directions. The first direction pointed to established growth models from entrepreneurship and organizational research. This included screening the literature in terms of established growth models and related terms, such as life cycle models and the venture creation process. The second paid greater attention to DT use and DI evolution during entrepreneurial growth. However, when transferring these findings to practice, we encountered difficulties in assigning the companies from the digital entrepreneurship project to a specific growth model and specific phases with prevailing challenges, resulting in the need to obtain more empirical data.

Fourth, we conducted 16 additional semi-structured interviews with founders and executive managers of digital startups. We acquired interviewees from additional countries, as we expected different perspectives on organizational growth and prerequisites depending on the region in which they reside (e.g., in terms of market restrictions in New Zealand). All interviews were supplemented by gathering secondary data (e.g., websites and press reports, financial and funding statements, social media posts). In this process, the grounded theory steps of axial and selective coding supported the abstraction of the developed open codes for later theory development (Strauss & Corbin, 1998). For example, we generated a series of second-order themes and assigned them to the attributes "organizational structure" and "managerial style" from established growth models to derive new challenges and patterns in the organizational development of digital startups. As a byproduct of coding digital startups' challenges and characteristics and relating them to stages of growth models, we noticed emerging patterns of DI evolution. Combining these with the existing body of knowledge from organizational and information systems research (e.g., grown or born digital organizations (Tumbas et al., 2015), architecture stages including (de-)centralized approaches (Ross, 2003)), we developed a set of four DI evolution archetypes that finally led to the third direction and a stronger consideration of the dynamics of entrepreneurial growth trajectories.

Fifth, while triangulating our findings from the previous iterations, we drew on the recent discourse on digital x that aims at disentangling the ontological foundations of digital and supported a better understanding of the nature of DT (Baier et al., 2023; Berger et al., 2018). Moreover, by questioning the timeliness of established growth models for digital startups, we gave stronger consideration to the dynamic states approach contrasting stages theory (Levie & Lichtenstein, 2010).

Table 2. Sample of Digital Startups

I*	#	F*	E*	Country (Branches)	Interview	D*	Industry
II	A	2009	150	GER (-)	CEO	63	Marketing
IV	B	2015	42	USA (ZAF)	COO	62	Renewable energies
IV	C	2015	37	GER (-)	CEO	73	eCommerce
IV	D	2014	59	GER (-)	Co-founder	41	Advertising
IV	E	2015	16	GER (-)	CTO	60	Tech
IV	F	2018	40	FRA (MGA)	CEO	55	Education
II	G	2015	85/35*[1]	GER (-)	CFO	70	Electronics
IV	H	2015	98	GER (NLD)	Co-founder	61	Fashion
IV	I	2013	33/18*[1]	GER (-)	COO	55	Medicine
IV	J	2014	58/55*[1]	NZL (CAN, USA*[2])	CEO	54	Marketing
IV	K	2018	22	NZL (AUS, ITA)	CEO	53	Software
IV	L	2007	87	NZL (USA, IRL)	CEO	54	Market research
IV	M	2017	65	NZL (AUS)	CEO	53	Accounting
IV	N	2014	52	NZL (-)	Co-founder	62	Automotive
IV	O	2008	25/22*[1]	NZL (-)	CEO	55	Payroll
IV	P	2019	40	EST (-)	Co-founder	60	Last mile delivery
IV	Q	2015	198/160*[1]	GER (USA, GBR)	COO	51	Marketing
IV	R	2021	30	GER (-)	Co-founder	52	Automotive
VI	S	2019	13	FIN (-)	CEO	62	Automotive
VI	T	2023	6	NIG (-)	CEO	51	Electrical engineering
VI	U	2011	30	EST (-)	Co-founder	78	Education
VI	V	2016	30/1*[1]	EST (-)	CEO	59	Robotics
VI	W	2015	201	FIN (USA, GBR, +6)	CMO	61	Process automation
VI	X	2018	35/7*[1]	POL (USA*[2])	CEO	49	IT recruiting

= company; I* = iteration; F* = founding year; E* = employees (total); D* = duration (min); *[1] = highest number of employees vs. date of the interview; *[2] = closed over time

Sixth, at the beginning of 2024, we conducted six additional interviews with founders and executive managers of digital startups to validate our intermediate findings. This included a rapidly growing, highly resource-matured listed company (W), a new venture that was right at the beginning of developing organizational structures and digital artifacts (company T), and another digital startup that showed significant growth rates in the beginning but later declined due to external factors (company X). In particular, the case of company X sharpened our understanding of the dynamics of organizational growth and decline, with special regard to the technological challenges in terms of redesigning the DI.

Finally, to ensure the quality of our data analysis, we again discussed the insights with researchers from related disciplines, such as strategic management and entrepreneurship, presented our findings in international research colloquia, and refined our code categories. This led to a point at which we noticed a theoretical saturation in terms of digital challenges and DI evolution of digital startups, as no new insights or concepts emerged within our data, reflecting a comprehensive and robust analysis.

4 FINDINGS

We advance research on entrepreneurial growth by capturing the increasing DT pervasion in digital startups, shedding light on the need for a more dynamic perspective on growth stages and related attributes. When coding our data, two dialectical findings emerged: one that calls for a revision or extension of stages and attributes in established growth models and one that supports “stage-less” theory building following the concept of dynamic states. To provide guidance and future directions for digital entrepreneurship research on growth models that better reflect the increasing DT pervasion in digital startups, we propose three avenues for theory advancement. In direction I, we provide guidance on how established growth models need to be adapted and illustrate this on the attributes organizational structure and managerial style. Direction II aims to extend growth models with new attributes. Here, we focus on the DI evolution in digital startups. Third, we call for the development of new growth models that combine stage-based and dynamic approaches, demonstrated by four DI evolution archetypes.

4.1 Direction I: Revise Attributes of Growth Models

Rationale. To illustrate the need to revise the attributes of established growth models, we drew on two of the most common attributes from the extensive growth model analysis of Levie and Lichtenstein (2010), organizational structure and managerial style, and contrast our empirical findings with established growth models. As the majority of the digital startups in our sample could be related to stages II to IV when referring to the growth models of Churchill and Lewis (1983) and Scott and Bruce (1987), we focused on these phases of entrepreneurial growth, which seemed most promising with regard to significant internal change. While interviews with the founders and executive managers allowed a retrospective on the venture creation process and, thus, stage I and its transition to stage II, we focused on the increasing organizational complexity and formalization efforts that reflect more than "just a few" employees in later stages. Moreover, as our focus lay on digital startups from stages II to IV, we only touched the resource maturity from stage V of small business growth models (e.g., Scott and Bruce (1987)) on the surface, which leaves room for theory building of more advanced firms that barely fit into the definition of a startup.

Empirical evidence. In general, we found rich and vivid evidence to confirm proposed characteristics of the organizational structure and managerial style attributes from established small business growth models in digital startups. However, when capturing the DT pervasion in digital startups, we also noticed new forms of collaboration and communication, and, thus, organizing and managing, as illustrated by the co-founder of company P:

"*We are a fully remote company and do not have a physical office. For client meetings, we meet in cafés or coworking spaces. Accordingly, leadership takes place almost exclusively in the digital space. Thus, the right choice of tools and their integration plays an important role for us.*"

When coding our data, we first unveiled the need to extend the organizational structure with a second, more cross-functional and agile view that manifests in greater product centricity and complements a managerial style that is better suited to these needs and allows teams greater autonomy and accountability (Table 3). This can be related to different forms of predominantly mechanistic (e.g., companies G and I) and organic system requirements (predominantly found in software startups, such as companies K and M) and, thus, the need to achieve a high structure-technology fit that supports these. Moreover, supported by DI, agile structures and related methods, such as Scrum or Kanban, were important enablers of organizational agility in the growth process (particularly in digital startups that developed software as a product or service).

Table 3. Code Categories of Growth Model Attributes

Dimension	**Selected Quote of Code Categories**
Organizational structure	Cross-functionality *"I tried having a leadership team comprised of the heads of the faculties, and that did not really work. The reason for that was you are still thinking functionally, and I really wanted the company to be cross-functional right at the core. That means all our chiefs had to be cross-functional in their role scope." (CEO, company L)* Agile *"We are organized fully digital. The framework is agile, of course, especially for the software team, but also for most of our teams, like the HR team or the marketing teams." (Co-founder, company P)* Scaling Agile *"We were very chaotic at times, but now we have more structure. In the future we want to discuss and maybe implement the Spotify approach." (COO, company Q)* Digital collaboration *"We have outsourced our Tier 1 support to the Philippines and part of our development team is based in Sri Lanka. Systems integration plays a key role in this." (CEO, company J)*
Managerial Style	Autonomy *"I think the major leadership role of the founders is to give the framework to supervise teams, but not tell them what they do." (Co-founder, company P)* Accountability *"We encourage autonomy and accountability within staff. So, you do not need leadership approval to do really anything." (CEO, company K)* Digital leadership *"Due to our offices in different countries, we have developed a strong remote culture. Almost everything can be done digitally. However, managing employees digitally is one of our biggest challenges." (CEO, company F)* Digital control mechanisms *"With a high degree of remote work, you need to be able to measure whether employees are actually doing what they are supposed to be doing. So, you need to make sure you have the appropriate reporting tools or processes in place. Like Google, we use OKR as our management framework." (CEO, company J)*

However, increasing resource maturity led, in some cases (e.g., evident in companies H and Q) to the need for scaling agility (e.g., by implementing the Spotify model as an approach that focuses on autonomy and accountability within tribes).

Second, we noticed a “trimorphism tendency” in some of the digital startups (e.g., companies C and Q), reflecting a continuous process of adapting organizational structures to internal (e.g., changes in management) and external change (e.g., changes in customer demand). Here, the process of eliciting an organizational structure and a related managerial style that optimally supports business needs resulted in switching from a hierarchical structure to a heterarchical or ambidextrous structure (e.g., that supports mechanistic needs in the human resources department while accommodating flexibility in product development) and vice versa within the same growth stage. This erratic process, shedding light on a more dynamic view of the growth trajectories of digital startups, could be observed starting in early stages of growth but manifested predominantly in later stages of growth, such as stages III and IV from small business growth models. In this context, we also observed startups with a higher resource maturity, as reflected by stage V, which conducted adaptions of their organizational structure (e.g., by implementing digital innovation units in addition to hierarchically structured departments).

Implications for digital entrepreneurship research on growth models. Revising established growth models that meet the specific characteristics of digital startups calls for a more differentiated view of related attributes, such as organizational structure or managerial style from established growth models, which better reflect new forms of collaboration and collaboration enabled by DTs and DI. This would indicate the need to revise stage-related characteristics of the managerial style (e.g., by paying attention to limited autonomy and accountability in early stages, as evident in company P, to extensive autonomy and accountability with a high degree of coordination in later stages, as evident in company H) or the organizational structure (e.g., in the form of developing cross-functionality in early stages, as evident in company C, to an extensive cross-functionality in later stages found in company L). Moreover, while the concept of heterarchies or ambidextrous structures is well established in organizational research, research on these and related concepts, such as holocracies, in digital startups is still in its infancy. Linking these to growth model research seems promising, as it may support digital startups in anticipating challenges in the next phases of growth. Moreover, a stronger focus on the erratic process of digital startups' organizational development is needed, reflecting a continuous process of re-evaluating and adapting the organizational structure to internal and external change. Finally, as we focus on two of the most common attributes in growth models, the investigation of other attributes (e.g., the extent of formal systems) seems promising when capturing the increasing DT pervasion in digital startups.

4.2 Direction II: Include New Attributes in Growth Models

Rationale. To extend growth models, it is necessary to grasp the DT pervasion in digital startups, bearing implications for designing new growth models that better represent technological advancement. In this context, combining information systems research on infrastructural development with growth model research seems promising (Steininger, 2019). Here, information systems research has already made important contributions in terms of the evolution of DI serving as a lens to extend established growth models with new attributes. However, this perspective is not adequately represented in most established growth models (e.g., referring to the extent of formal systems or systems and control attributes and related activities, such as the evolution from simple bookkeeping systems to budgeting systems, as found in Scott and Bruce (1987)).

Empirical evidence. We illustrate the need to include new attributes by means of digital startups' DI evolution, which is depicted in four dimensions and related code categories (Table 4). First, we noticed two dominant roles of DI in the venture creation process that had a significant impact on the socio-technical development and, consequently, the growth trajectories of digital startups. On the one hand, DI can be viewed as an integral part of realizing the business model, as was evident in companies F and P. The relevance of an integrated, cloud-based DI that supports data-driven decision-making, product innovations, collaboration, and communication is illustrated by the co-founder of company P:

“*In our case, everything is organized in a large system, including subsystems. Since all processes are digital and we work 100% remotely, this is very important for us.*”

On the other hand, DI can be considered a “means to an end.” For example, companies A and M assigned DI a more supportive function from the outset. While this understanding of DI as a means to an end significantly influenced the later evolution of the DI, a transition could be observed. Here, a business-aligned DI, along with a comparatively higher integration degree, became more relevant when digital startups grew and complexity increased. Moreover, this increasing relevance could be related to outsourcing activities (such as software development) and the opening of branches in other countries, which led to higher collaboration and DI integration efforts over time.

Second, in line with the dominant role of DI, different approaches to developing DI in the venture creation process were evident: a digital-first approach, where companies were able to operate entirely remote and relied extensively on cloud computing from the beginning, and a more progressive approach, where digital maturity was achieved over time. In this context, nearly all of the cases from our sample relied—to some extent—on cloud computing at the time of the interview to support their business activities. While companies such as F or W were fully in the cloud from the outset, others, such as companies A and M, started to shift software into the cloud in later stages.

Third, we noticed different efforts with regard to strategically aligning DI with business needs. While some digital startups stood out through intensive strategic planning of the DI to prepare the organization for further growth (e.g., through early hirings of enterprise architects, as evident in company B), others, such as company A, lacked strategic planning in terms of developing the DI until later stages, which led to a structure–technology misfit and the need to redesign the DI with high transformation efforts.

Table 4. Code Categories of Digital Infrastructure Evolution

Dimension	**Selected Quote of Code Categories**
Dominant role in the venture creation process	Integral part of realizing the business model *"This software [Notion] is my second brain. It changed my life and is an integral part of our business. All of our employees, our own mission, and every product is managed in it. Everything is managed by it." (CEO, company F)* Means to an end *"We grew as a business and acquired customers when we had no platform, no systems, no integration. The software will always grow in line with the business but it is not the driver of that growth, it is just the enabler. Now, we have three or four software tools for collaboration and customer communication that are pretty critical to our business and on that we heavily rely." (CEO, company M)*
Approach in the venture creation process	Digital-first approach *"From the beginning, we did not have a single process that was manual or on a piece of paper; instead, we took a digital-first approach." (COO, company I)* Progressive approach *"It has been a fairly gradual IT evolution in the sense that we've shifted our architecture several times to make it more sustainable or whatever is required." (CEO, company L)*
Strategic alignment	Lack of strategy *"Initially, we were quite opportunistic and did not plan IT strategically. We came to a point where planning and consolidating the IT landscape became a strategic decision, as we were threatened with performance losses in the 6-digit range over the next few years due to a lack of integration of our systems." (CEO, company A)* Strategic planning *"With more than 30 years of experience in the tech industry, including as CEO, I knew about the relevance of enterprise architecture. Our enterprise architect does a great job when it comes to developing our digitalization strategy, designing the IT landscape with interfaces, and operating our platform." (COO, company B)*
Architectural integration	Centralization tendency *"It was important to us that we set up the whole thing stringently, that we have clearly defined processes. To this end, we set up an ERP system very early on and constantly assessed its suitability for individual departments." (CFO, company G)* Decentralization tendency *"We prefer to stick with small best-of-breed solutions, to give it that name, rather than having such a holistic, integrated solution." (CEO, company C)*

Thus, challenges arose in carefully planning and developing the DI, with a special focus on enabling flexibility and scalability to prepare digital startups for phases of further growth. In particular, the degree of integration influenced the ability to rely on data-driven decision-making (e.g., for placing marketing campaigns) or to enable cross-country collaboration (e.g., with customers or partners).

Fourth, digital startups followed different approaches in terms of architectural integration. For instance, company W showed a high degree of DI integration in terms of a predominantly centralized software selection from the outset, in stage I, and in its transition to stage II, whereas company A developed a high degree of DI integration rather late in stages III to IV. In the context of organizational decline, this potentially led to digital "burdens," as illustrated by company X, which had a fully developed platform that was free to use but still resulted in high maintenance costs due to existing service agreements with the providers that hosted it.

However, our efforts to relate new attributes, such as DI evolution, to growth stages were only partially successful, as organizational decline or temporary stagnation (e.g., due to the Russo–Ukrainian war (company P), COVID-19 (company G), or shrinking market demand in general (company X)) led to the need to redesign the DI, as illustrated by the CEO of company X:

"*The platform that we work on is our own now. It cost us a lot of money, but now we can use it for free and it suits our needs very well. However, there were other systems such as Salesforce, which was quite costly for us. For a company with big dreams and a huge sales team it was very useful. However, for a company of seven people who we are struggling to keep, it does not have much value. We just switched it off and moved to Excel again. When we have money, we will switch on some ERP or whatever, but now we are small enough to do it in Excel.*"

Thus, while the DI evolution as an attribute may be described in terms of a low or high integration degree or maturity with regard to the characteristics of stages in established growth models, practice requires a more dynamic view of this. For instance, some of the startups were founded without much effort in architectural integration from the beginning (e.g., company A), or this was simply of less relevance during the venture creation process (company T). In contrast, others, such as company W or X, invested heavily from the beginning in an integrated and state-of-the art digital infrastructure (e.g., supported by comparatively high startup capital or extensive knowledge in business and IT development).

Implications for digital entrepreneurship research on growth models. Research on extending growth models with new attributes needs to address the increasing DT pervasion in digital startups when aiming to provide a more holistic picture of organizational development and related digital challenges (e.g., implementing an integrated DI that enables flexibility and scalability). Moreover, with regard to the liability of the newness, this bears practical implications for co-designing social and technical systems in terms of the organizational decline or rapid growth of digital startups. At the same time, extending growth models (e.g., by adding DI as an attribute) calls for the consideration of more dynamics in growth model design, whereby the interaction of DTs with established attributes (e.g., organizational structure or managerial style) needs to be paid greater attention for theorizing.

4.3 Direction III: Interweave Stages and Dynamic States Theory

Rationale. Revising and extending attributes with strong ties to DTs requires a more differentiated view of growth models and a stronger consideration of the dynamics in phases of rapid growth and decline. While research on entrepreneurial trajectories can be divided into two streams—a view on deterministic stages in growth models and the assumption of dynamic states in contrast—our empirical study implies the need to consider both when developing growth models for digital startups. To illustrate this, we enrich the discussion by providing four DI evolution archetypes of digital startups. These support theory advancement by highlighting the socio-technical dynamics in the venture creation process and provide implications for reconsidering theory on deterministic growth stages and related attributes.

Empirical evidence. When mapping the DI evolution as an attribute to the stages of established growth models, we noticed emerging patterns in the digital startups that resulted in developing archetypes and, ultimately, the need to pay greater attention to technological dynamics and variances. We clustered the digital startups in our sample according to the code categories and dimensions illustrated in direction II. Moreover, other factors, such as the availability and amount of startup or venture capital significantly influenced the way the DI of the digital startups evolved. In our sample, almost all digital startups relied—at least partly—on cloud computing to support business activities. Summing up our findings related to the DI evolution of digital startups, we identified four archetypes of DI evolution that reflect their early stages of organizational growth.

1.) The orchid bee. Like orchid bees, which emerge as fully mature and crucially fertile when born, these digital startups predominantly followed a digital-first approach and, thus, showed a high degree of DI maturity in terms of development and integration endeavors from the beginning. This archetype was often backed by significant amounts of startup or venture capital aiming at an early scaling of the business model and accommodating related challenges of enabling DI flexibility and scalability needed for rapid employee growth. Here, DI can be considered an integral part of realizing the business from the outset—both for supporting collaboration and communication and enabling digital product innovations. Moreover, this archetype shows a high degree of business-IT alignment and integration from the beginning, with a tendency to centralization. For example, the three founders of company W held several top management-level positions in large IT companies (such as IBM). Years of experience in developing organizations were accompanied by an early and multimillion-euro venture capital investment that supported setting up a state-of-the-art DI as the technological foundation for rapidly scaling the business model.

2.) The model pupil. This archetype also showed a high degree of DI maturity from the beginning, although the degree of integration and business-IT alignment varied and a clear tendency toward centralization or decentralization could not be observed across the sample. In contrast to the orchid bee archetype, startup capital was usually lower, while venture capital was proportionally acquired later or not at all. Here, choosing software solutions was characterized by a more explorative approach and less risk-taking in terms of comparatively lower DI investments from the outset. Nevertheless, DI could be characterized as an integral part of realizing the business model from the outset, both for communication and collaboration and for digital product innovations. Here, company F served as the role model for developing this archetype. It was characterized by a high degree of digital maturity from the beginning and was capable of operating 100% remotely, supporting the integration of its second branch. Moreover, it relied fully on cloud computing and had a high DT pervasion (e.g., using blockchain for payment processing and virtual reality in their products). However, while the business model required a digital-first approach, venture capital was only acquired in later stages of growth, and the investments in DI were comparatively lower compared to orchid bees, which resulted in extensive reliance on free and open-source software from the beginning.

3.) The architect. This archetype developed a high degree of DI maturity over time. The dominant role of DI was usually a means to an end from the outset and primarily supported the business in terms of collaboration, communication, or payment processing. While some digital startups clustered in this archetype paid greater attention to DTs for supporting business (e.g., relying on artificial intelligence for data-driven decisions) in later stages, the relevance of DI in relation to product development and innovations was comparatively lower. This archetype can be characterized by a strong focus on strategically developing DI to support business needs (e.g., in terms of achieving a high structure-technology fit by an early hiring of enterprise architects or establishing dedicated (IT) departments). For example, company B started its business by offering non-digital products in the energy sector. While a highly integrated and mature DI was not crucial during the venture creation process and early stages of growth, the founder made early professionalization efforts by hiring an experienced enterprise architect and setting up an IT department to better accompany the rapid growth of the company. In doing so, the company acknowledged the need for a strategic digital roadmap early, which included using blockchain for payment processing and artificial intelligence for enabling data-driven decisions.

4.) The late bloomer. This archetype was characterized by a comparatively more progressive development of the DI, which was predominantly considered as a means to an end from the outset. This usually was accompanied by comparatively late professionalization efforts and significant investments in DI. Here, venture capital was usually acquired in later stages or not at all. This archetype tended to experience a structure-technology mismatch in later stages of growth. While this was of comparatively lower relevance in early stages of growth, the lack of investing in and planning the DI for later growth stages (e.g., in terms of integration) often necessitated higher efforts in restructuring the DI and comparatively higher costs due to not matching the business needs adequately. For example, company A grew rapidly over time and can be characterized as a (digital) gazelle. In the early stages of growth, the company's software solutions (mostly free and open source) sufficiently suited the business needs. Because the company did not strategically plan for DI development until later stages, it was confronted with high losses due to missing interfaces, redundant data, and inefficient processes, which eventually led to restructuring the company's DI, including implementing an enterprise resource planning system when the company grew to more than 100 employees 10 years after founding.

As the organizations became larger and more complex, the demand for a mature DI that is aligned with business needs increased as well in all archetypes. The archetypes of digital startups' DI evolution thus focus on digital startups' early phases of growth, which correlate with stages I to III from small business growth models. However, while we were able to cluster most digital startups from the sample according to the archetypes, we also noticed characteristics of two archetypes in company I due to a merger and acquisition process. Here, a significant decline in the growth of the digital startup necessitated the streamlining of activities, which led to significant reconfigurations in the DI, including the need to adopt software solutions that interfaced with the merging company. Moreover, while company T could be classified as a late bloomer, the company's age was too young to exclude the possibility of becoming an architect archetype.

Implications for digital entrepreneurship research on growth models. The four archetypes of DI evolution serve as a starting point for theorizing on new growth models that build on a stage-based approach while allowing more variation in its characteristic features. This adds to directions I and II, which call for a more differentiated view of common growth model attributes, such as organizational structure and managerial style, and highlight the dynamics of DI evolution, paying special attention to the decline and rapid growth of digital startups. Moreover, these illustrate the DT pervasion in digital startups, with implications for new perspectives on organizational structure and related attributes considered in established growth models. To advance digital entrepreneurship research, we call for a stronger intertwinement of stages and dynamic states theory when designing new growth models that better represent the increasing DT pervasion in digital startups and the dynamics of their growth trajectories.

5 DISCUSSION AND CONCLUSION

Through our study, we respond to the call for more empirical data on the dynamics of entrepreneurial trajectories and advance digital entrepreneurship research by providing new insights into re-evaluating and adapting established growth models. We aim at better reflecting the increasing DT pervasion in digital startups and illustrate the crucial role of DTs in the venture creation process. In doing so, we provide three directions toward the future of growth models. First, we provide a direction for revising established growth models, highlighting the impact of DTs on the organizational structure and managerial style in digital startups. Second, we call for the extension of established growth models with digital attributes, such as DI evolution, to capture the emergent intertwinement of digital startups with DTs. Third, we highlight the need to interweave theory on stages and dynamic states when developing new growth models for digital startups. In doing so, we propose four DI evolution archetypes that encourage reflection on the dynamics of the venture creation process and, thus, the need to consider cross-stage characteristic features in these.

Contributions to theory and practice. Research on digital startups' characteristics and growth trajectories is also highly relevant for related disciplines, such as information systems, entrepreneurship, and organizational research. By offering pathways for theory development, we highlight the potential of DTs to fundamentally reshape organizations, paying special attention to new forms of collaboration and communication enabled by DI, and dynamics in the venture creation process.

However, when transferring theoretical frameworks as the interpretative backdrop of our analysis to the emerging data from the interviews, the process became dialectical. On the one hand, we were able to confirm evolving patterns from established small business growth models (e.g., Churchill and Lewis (1983); Scott and Bruce (1987)) and categorize the digital startups with relatively high accuracy to stages when coding our data. Although some companies exhibited several characteristics of different stages at the same time (in particular when growing rapidly), this would support an empirical underpinning of the growth models from a deterministic point of view and require a revision or addition of specific attributes that more comprehensively consider the influence of DTs. This also aligns with Lin and Maruping (2022) who state that "digitalization has implications for venture stages, but it does not invalidate the stage perspective of entrepreneurship" (p. 217).

On the other hand, with special regard to dynamic states theory, we also found evidence of why a deterministic view of growth model stages is problematic and, in line with the empirical findings of Sternad and Mödritscher (2022), firm growth cannot be reduced to a series of predefined steps. As pointed out by Levie and Lichtenstein (2010), there is "no agreement as to what the stages of growth are, how they progress, or why they shift" (p. 33). Accordingly, it remains unclear which growth model provides meaningful and evidence-based implications and upcoming challenges for which kinds of digital startups (e.g., depending on the industry or by contrasting mechanistic and organic systems). While the findings advance our understanding of growth by reflecting on the increasing intertwinement of organizations and DTs and the dynamics of entrepreneurial growth trajectories, they provide evidence for both stage-based models and dynamic states. For example, this may lead to theory advancement of digital startups' growth trajectories by building on stages that allow greater variation of attributes such as hierarchical, heterarchical or ambidextrous structures within the same stage, considering new attributes such as the DI evolution, and a greater consideration of the dynamics and organizational decline in this process. Thus, digital entrepreneurship research on growth models should build on and move beyond deterministic stages in established growth models.

Limitations. We drew on a dataset of interviews with 24 digital startups to better understand their growth trajectories and dynamics, paying special attention to

DTs in this process. However, critique concerning the sample size may arise. Although the digital startups included in the sample provide new insights to better understand this phenomenon, they only represent a small part of reality, and the related findings are based on a time-related observation, not on a longitudinal study. Another critique may be rooted in terms of framing the companies as digital startups, as some of them may be also considered small or medium-sized businesses based on their age and size. For example, company O, which was founded in 2008, might not be classified as a startup due to its age but still exhibited entrepreneurial characteristics representing early stages of growth models. In addition, company W, which was founded in 2015, employed more than 200 people in nine countries and showed significantly high growth rates and a high level of resource maturity; therefore, it could contrarily be characterized as a medium-sized company. However, referring to including these, companies with high resource maturity provided valuable insights to better understand entrepreneurial growth trajectories and the relevance of DI to support collaboration and communication. Moreover, while the interviews with the founders and executive managers of digital startups also offered a retrospective on the venture creation process, growth stages I and V were only touched on the surface. Here, supplemental data from the digital entrepreneurship research project complemented this top-down perspective and supported gaining a more comprehensive picture of all growth stages. Finally, while we provide guidance for revising established growth models and propose to interweave stages and dynamic states theory, we have not developed a growth model that combines both streams in this study.

Future research. In our study, we provide three future directions for digital entrepreneurship research on growth models. Direction I may benefit from a deeper investigation of other attributes (e.g., by paying greater attention to the extent of formal systems or product development) besides the organizational structure and managerial style to better grasp the increasing DT pervasion in digital startups. Related to direction II, research might pay attention to DI-related attributes in the process of entrepreneurial growth (e.g., using artificial intelligence for data-driven decision-making, or the degree of architectural integration). In direction III, our findings regarding DI evolution archetypes might be advanced by developing process models that look beyond the early stages of development (e.g., by conducting longitudinal research). This may lead to advancing theory on growth models by combining the deterministic mechanisms of growth stages with the concept of dynamic states to better represent the characteristics of digital startups and, thus, the dynamics in entrepreneurial growth trajectories.

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– SEVENTH PUBLICATION –

Pulling It Off Like a Crab? Navigating Tensions in High-Growth Startups

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Under Review

ABSTRACT

While studying startups' growth trajectories has a long tradition, research has only begun to investigate the specific challenges that high-growth startups face in the digital age. We investigate this phenomenon through a tension lens, which is particularly suitable for a better understanding of the underlying mechanisms and opposing demands in the process of rapid organizational change. Our findings build on a rich dataset that includes semi-structured interviews with founders and executive managers from 31 startups across nine countries. As a result, we contribute to entrepreneurship theory and practice in two ways. First, we introduce a model of the mechanisms at work during phases of rapid growth, highlighting the categorization of tensions across four dimensions—strategizing, organizing, technology, and people. Second, we provide first-hand empirical insights into how founders and managers navigate tensions in entrepreneurial high-growth settings.

1 INTRODUCTION

High-growth startups face multiple tensions. For instance, with increasing sales volume and employees, "problems of coordination and communication magnify, new functions emerge, levels in the management hierarchy multiply, and jobs become more interrelated" (Greiner, 1972, p. 40). Emerging evidence points to tension-laden processes in new ventures, such as legitimacy building and learning (Zuzul & Edmondson, 2017), exploration-exploitation dynamics (Es-Sajjade et al., 2021), shifting dynamic states (Sternad & Mödritscher, 2022), and multi-level change processes (Panayiotou et al., 2019). Consequently, effectively navigating these tension-laden processes represents a critical yet understudied challenge for high-growth startups, with significant implications for both entrepreneurial theory and practice.

Two literature streams inform our study. First, entrepreneurship research—especially on high-growth and digital ventures—illuminates the scaling process and its antecedents. For example, researchers distinguished startups from scaleups (Autio et al., 2018; Bohan et al., 2024; Cavallo et al., 2019; Coviello et al., 2024), identified drivers of rapid growth (Gaikwad, 2022; Hamilton & Ng, 2025; Lange et al., 2023), and highlighted challenges that arise as ventures expand quickly (Moedt et al., 2024; Tschoppe et al., 2023) including the critical role of digital technologies in this process (Griva et al., 2023; Huang et al., 2017). Second, organizational research studies provide a deep repertoire for understanding tensions—variously theorized as dialectics (Farjoun, 2019; Farjoun & Fiss, 2022; Langley & Sloan, 2012), paradoxes (Clegg et al., 2025; Lewis & Smith, 2022; Weiser & Laamanen, 2022), and trade-offs (Ehrig & Schmidt, 2021; Skog et al., 2021). This body of knowledge offers a powerful vocabulary and lenses for understanding competing demands during change processes, including entrepreneurial scaling.

However, across these streams, a critical gap remains. We have rich accounts of startups' growth challenges and mature theories of organizational tensions, but limited theorization of the *specific* tensions that high-growth startups in the digital age face and how they navigate them. With this study, we seek to bridge these two research streams and better understand the tensions in high-growth startups, how they unfold, and how they are managed. This led us to the following research question:

Which tensions emerge during phases of rapid growth
and how do startups navigate these?

To examine this research question, we employed a multiple-case design (Eisenhardt, 1989, 2021; Yin, 2003, 2018) across 31 fast-growing startups in nine countries. We conducted semi-structured interviews with startup entrepreneurs and analyzed the data abductively, iterating between emergent themes and tension literature. We identified four interrelated dimensions (strategizing, organizing, technology, and people) that capture the dynamic mechanisms through which tensions emerge and are managed during rapid growth.

This study advances entrepreneurship research on scaling in two ways. First, we theorize the specific tensions of high-growth startups. In particular, by building on the dynamic equilibrium model of organizing (Lewis & Smith, 2022; Smith & Lewis, 2011; Weiser & Laamanen, 2022), we propose an adapted model that aims to better explain the underlying mechanisms of tensions in rapidly growing startups. Second, we explain how entrepreneurs navigate these tensions. In particular, we provide a framework that categorizes tensions—and associated navigation mechanisms—across four interdependent dimensions: strategizing, organizing, technology, and people. Overall, these contributions reframe scaling from a sequence of discrete challenges to an inherently tension-laden process of organizing venture growth. For practice, our framework demonstrates decision-making dilemmas that startups' managers face. Leaders of rapidly growing startups may draw on our results to better anticipate and navigate increasing complexity- and growth-accompanying tensions and, thus, emerging conflicts that potentially lead to fundamental change[1].

[1] We approach this by using a metaphor related to marine biology. When fiddler crabs are threatened or grasped by a predator, they pull off—"autotomize"—their major claw as a costly escape mechanism (Darnell et al., 2018). This shall metaphorically serve to illustrate the transition of latent tensions becoming salient, leading to fundamental organizational change when managers face dichotomous options under the pressure of rapid growth and scarce resources.

2 THEORETICAL FOUNDATIONS

2.1 The Emergence of Tensions During Growth

Many scholars have contributed to understanding the challenges of rapid organizational change in startups. Classic growth-process accounts depict scaling not as linear improvement but as punctuated passages through relatively calm "evolutionary" periods and disruptive "revolutionary" crises (Greiner, 1972). Greiner's seminal model specifies how early creative, informal organizing gives way to more directed, then delegated, and later coordinated forms as firms age and expand. With a growing number of employees, formal systems and processes need to be implemented, as well as a new cadre of professional managers to mitigate increasing organizational complexity (Churchill & Lewis, 1983). Here, scaling, broadly defined "as an increase in the size of a focal subject that is accompanied by a larger-than-proportional increase in the performance resulting from the said subject, with "subject" referring to what is being scaled (e.g., number of products sold, number of customers, or number of markets served)" (Palmié et al., 2023, p. 2), places special demands on entrepreneurs. For instance, to sustain the ability to respond flexibly and at a fast pace to internal and external change, startups may implement agile practices and methods (e.g., Scrum, Kanban, daily meetings, burndown charts for sprints) (Salmela et al., 2022). However, strict adherence to agile practices can also have adverse effects (e.g., on innovation activities or the development of products) leading to tensions, as these may function as a "control imperative," and the sense of collective ownership can lead to specialists becoming generalists (Annosi et al., 2022).

Literature indicates at least three additional breeding grounds for tensions besides this organizing perspective. First, from a strategic perspective, contradictory strategic goals and demands may arise (Jarzabkowski et al., 2013), potentially leading to tensions when weighing up short-term with long-term measures (Berti & e Cunha, 2022). For instance, entrepreneurs are challenged to navigate the tension between exploration and exploitation (i.e., segregating exploratory units from traditional units) to promote innovations and achieve superior performance (Mathias et al., 2018; O'Reilly III & Tushman, 2013). At the intersection to IT investments, this might also create a strategic tension "between investing in digital artifacts for long-term value creation and exploiting them for short-term value appropriation" (Woodard et al., 2013, p. 537).

Second, the literature on organizational culture indicates that with growth subunits (e.g., in terms of hierarchical levels or teams) may emerge that reflect their own cultures (Warrick, 2017). Here, "difficulties in coordinating and integrating processes or organizational activities […] are often a result of culture clashes among different subunits" (Cameron & Quinn, 2006, p. 18), potentially leading to tensions. In this context, the concept of liability of newness (Stinchcombe, 1965) proposes that, amongst others, due to role conflicts and social challenges in early growth phases, "young organizations have a higher propensity to die than old organizations" (Singh et al., 1986, p. 171). For instance, tensions related to the old and new identity in light of a rapidly growing number of employees may arise (see, e.g., Corley & Gioia, 2004; Jacobs et al., 2021; Lindgren et al., 2015).

Third, digital infrastructures and technologies (e.g., cloud computing, artificial intelligence, or platforms) play a crucial role in achieving flexibility and scalability (Giustiziero et al., 2023; Nambisan et al., 2018). For instance, by leveraging their digital infrastructure, startups may "scale their business at an unprecedented pace" (Huang et al., 2017, p. 301). However, organizational boundaries may become blurred in this process, thereby creating constant competition for developing new control points (Tilson et al., 2010) and, thus, create opposing demands that ultimately result in conflict.

Given this, tensions can cut across organizational levels and domains during periods of change (Panayiotou et al., 2019; Werner et al., 2024). Framing these opposing demands as tensions provides a useful lens for analyzing how high-growth startups navigate the multifaceted challenges of rapid expansion and the coping strategies that emerge at different organizational levels.

2.2 A Tension Approach to High Growth

Tensions—such as between legitimacy building and learning—are known to be a useful analytical lens for explaining why some startups outperform others during growth (Zuzul & Edmondson, 2017). However, despite the rich body of knowledge on challenges and tensions in organizational growth, two issues—the under-theorization of tensions in high-growth startups and the empirical under-investigation of managements' responses to these—remain problematic.

On the one hand, tensions in high-growth startups are under-theorized. While literature offers both a multifaceted perspective on challenges and tensions in general (e.g., as previously illustrated by the four dimensions of organizing, strategizing, technology, and people) and a plethora of distinctive theoretical approaches to these (e.g., as paradox, contradiction, duality, dualism, dialectic, or dilemma (Berti & e Cunha, 2022; Farjoun & Fiss, 2022; Putnam et al., 2016; Smith & Lewis, 2011), leveraging these to the realm of high-growth startups has been—irrespective of the theoretical approach—widely neglected. Although there are initial studies on tensions in new ventures (see, e.g., Es-Sajjade et al., 2021; Sternad & Mödritscher, 2022; Zuzul & Edmondson, 2017), these are only considered from a high-growth perspective in exceptional cases (see, e.g., Lange et al., 2023; Tschoppe et al., 2023; Watkowski et al., 2025). For instance, it is widely accepted that the digital infrastructure—or digital technologies—occupy a prominent position in the process of scaling (see, e.g., Coviello et al., 2024; Griva et al., 2023; Huang et al., 2017). Given this, studies have dealt with paradoxical tensions of digital infrastructure (Tilson et al., 2010), exploration and exploitation tensions in the evolution of digital infrastructure (Montealegre et al., 2019), tensions in digital platform business models (Mini & Widjaja, 2019), or digital respectively information technology (IT) transformation tensions (Gregory et al., 2015; Viljoen et al., 2022; Wimelius et al., 2021). Further, Lyytinen et al. (2016) elaborated on social tensions in digital product innovations, while Wareham et al. (2014) reflected on the tension between the individual and collective. Other related studies focus on tensions in the context of digital transformation from the perspective of employees (Kratochvil, 2025) or examine tensions between followers and leaders in digital leadership (Eberl &

Drews, 2022). Although this contributes to a broader understanding of technological tensions, their manifestation within the context of startups—and especially within high-growth settings—remains under-explored and warrants a more systematic investigation.

On the other hand, our understanding of how entrepreneurs in high-growth startups manage tensions is limited. A better understanding of the multifaceted nature of tensions supports founders and managers of rapidly growing startups in effectively managing change, which can be understood as a key requirement to achieve short-term competitiveness and long-term survival (Lüscher & Lewis, 2008). For instance, to address paradoxical tensions, Poole & van de Ven (1989, p. 565) proposed acceptance, spatial and temporal separation, and synthesis as "four ways in which opposing theses, A and B, might be related." These represent one acceptance and three resolution strategies (Smith & Lewis, 2011). In this context, Putnam et al. (2016) provided a comprehensive list of widely accepted responses to tensions categorized by both-and, either-or, and more-than approaches, while Li (2021) added neither-and responses to this. Moreover, responding to emerging (paradoxical) tensions potentially leads to both positive and negative reinforcing cycles (Lewis, 2000; Smith & Lewis, 2011; Wimelius et al., 2021). Thus, the effect of tensions depends on organizational responses (Jarzabkowski & Lê, 2017; Wimelius et al., 2021). At the same time, resolving a tension might trigger another (Lewis & Smith, 2022). In addition, Lewis & Smith (2022) propose four zones—resolving, engaging, anticipating, and avoiding—that shed light on experiencing tensions and the paradox mindset as two delineating scales in the context of navigating tensions. However, research has only started to leverage tensions to high-growth entrepreneurship, which requires questioning existing approaches to navigating tensions in light of organizational change in rapidly growing startups.

3 RESEARCH DESIGN

3.1 Setting

Multiple-case study. We employed a multiple-case design (Eisenhardt, 1989, 2021; Yin, 2003, 2018) involving 31 cases of fast-growing startups across nine countries (Table 1). Paying special attention to rapid growth in different national systems of innovation (Lundvall, 2007), these were located in Denmark (1), Estonia (3), Finland (2), France (1), Germany (9), India (6), New Zealand (6), Nigeria (1), Poland (1), and the United States of America (1). The interviewees represented startups' (co-)founders, chief executive officers (CEOs), or long-time employees from the C-suite (e.g., the chief operating officer (COO), the chief financial officer (CFO), or the chief technology officer (CTO)).

Using purposeful case selection (Morse, 2007), we targeted startups that met two criteria: high-growth and a demonstrably lead in the advanced application of digital technologies. Here, we focused on high-growth startups in their critical growth phase between 10 to 100 employees, as we expected to discover major organizational change processes inhibiting contradictory elements across hierarchies and business areas. In terms of criteria for high-growth, we were guided by the classification of the Organization for Economic Co-operation and Development (OECD, 2008, p. 61):

> *"All enterprises with average annualized growth greater than 20% per annum, over a three-year period should be considered as high-growth enterprises. Growth can be measured by the number of employees or by turnover."*

However, we also included companies that have recently crossed this boundary through rapid growth (e.g., companies XXX and XXVII might be also coined medium-sized or even large in terms of their size, as they were achieving significant growth rates in a short period of time). Alongside, some startups have also crossed age boundaries such as being younger than 10 years in light of the manifold definitions of startups, but have recently shown rapid growth and continuous thriving for innovation as startup criteria (Kollmann et al., 2016).

TABLE 1. Sample of Startups

#	F*1	E*2	Country	Interviewee	I*3	Industry
I	2009	150	GER (-)	CEO	63	Marketing
II	2015	42	USA (ZAF)	COO	62	Renewable energies
III	2015	37	GER (-)	CEO	73	eCommerce
IV	2014	59	GER (-)	Co-founder	41	Advertising
V	2015	16	GER (-)	CTO	60	Tech
VI	2018	40	FRA (MGA)	CEO	55	Education
VII	2015	85/35*4	GER (-)	CFO	70	Electronics
VIII	2015	98	GER (NLD)	Co-founder	61	Fashion
IX	2013	33/18*4	GER (-)	COO	55	Medicine
X	2014	58/55*4	NZL (CAN, USA*5)	CEO	54	Marketing
XI	2018	22	NZL (AUS, ITA)	CEO	53	Software
XII	2007	87	NZL (USA, IRL)	CEO	54	Market research
XIII	2017	65	NZL (AUS)	CEO	53	Accounting
XIV	2014	52	NZL (-)	Co-founder	62	Automotive
XV	2008	25/22*4	NZL (-)	CEO	55	Payroll
XVI	2019	40	EST (-)	Co-founder	60	Last mile delivery
XVII	2015	198/160*4	GER (USA, GBR)	COO	51	Marketing
XVIII	2021	30	GER (-)	Co-founder	52	Automotive
XIX	2019	13	FIN (-)	CEO	62	Automotive
XX	2023	6	NIG (-)	CEO	51	Electrical engineering
XXI	2011	30	EST (-)	Co-founder	78	Education
XXII	2016	30/1*4	EST (-)	CEO	59	Robotics
XXIII	2015	201	FIN (USA +7)	CMO	61	Process automation
XXIV	2018	35/7*4	POL (USA*5)	CEO	49	IT recruiting
XXV	2012	25	DNK (USA)	Co-founder	68	Social
XXVI	2021	23	IND	CTO	56	Lifestyle
XXVII	2012	950	IND	CTO	67	Education
XXVIII	2022	60	IND (USA)	CEO	63	Fintech
XXIX	2019	43	IND	Co-founder	51	Education
XXX	2015	380	IND (USA, ARE)	CEO	54	Fintech
XXXI	2019	11	IND	CEO	57	Logistics

*1 = founding year; *2 = total number of employees; *3 = interview duration (in minutes);
*4 = highest number of employees vs. date of the interview; *5 = closed over time

While this broadened the focus on recently founded companies as startups, it provided valuable insights into the growth trajectories of young companies and accompanying social and technological challenges. In addition, we paid special attention to startups that can be considered digital (i.e., “startups that that have digital artifacts at the core of their business model for value creation and capture,” referring to the definition of Lin & Maruping (2022, p. 212)).

In the process of preparing and conducting the semi-structured interviews, we considered publicly available secondary data such as press reports, website, financial and funding statements, social media posts, YouTube videos, or product descriptions. In addition, we also incorporated internal documents—such as technology approaches, descriptions of the software and system architecture, and platform roadmaps—into the coding process which we gathered during or after the interview. This provided a more comprehensive picture of organizational change processes (e.g., when relating the acquisition of venture capital to fundamental organizational changes in light of rapid growth).

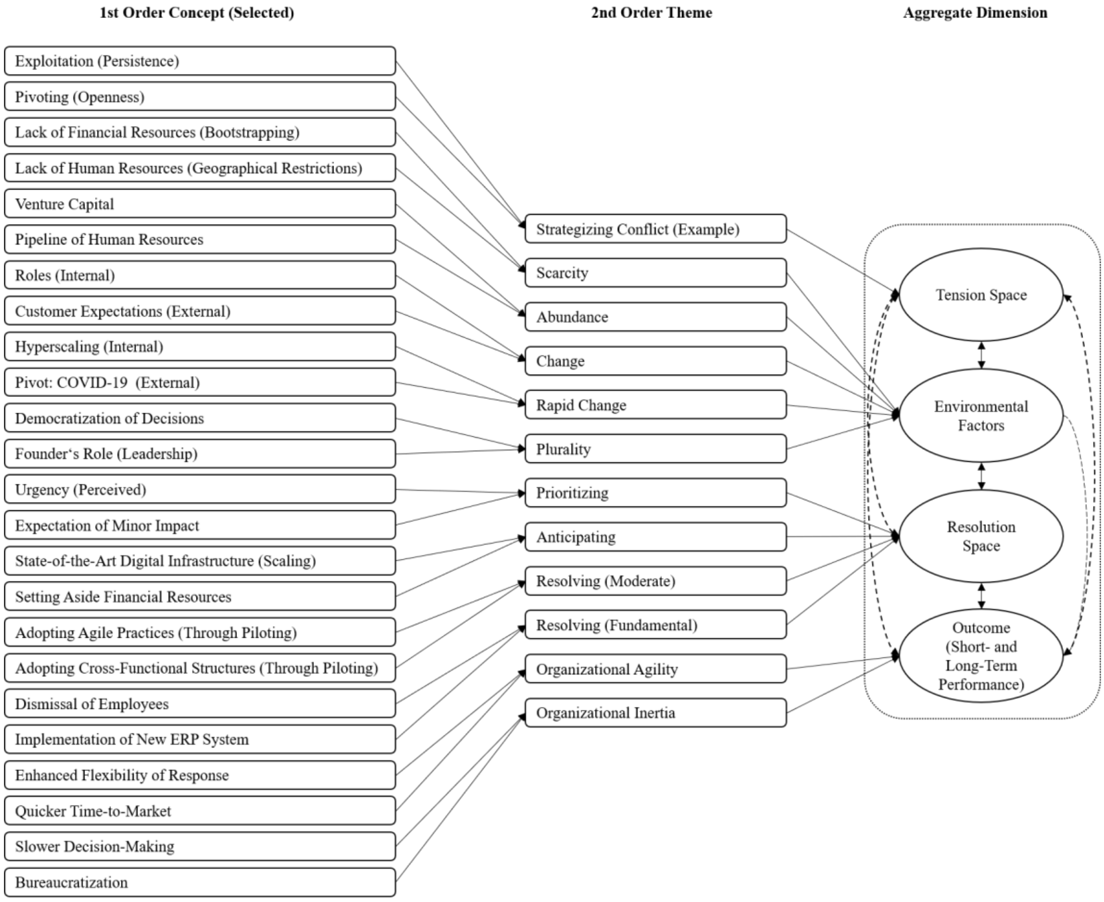
3.2 Data Analysis

Working abductively (Timmermans & Tavory, 2012), we iterated between emergent evidence and candidate theoretical lenses. Insights from the early interviews (in particular company I) repeatedly surfaced a managerial preoccupation with conflicts and contradictions during rapid organizational change processes. As several interviewees spoke about opposing demands, we adjusted both our questions regarding tensions and its mitigation strategies as well as integrating literature on tensions, contradictions, and paradoxes as candidate lenses (Timmermans and Tavory, 2012). We treated these observations as a prompt to mobilize tension, contradiction, and paradoxes as a sensitizing lens (e.g., Farjoun & Fiss, 2022; Lewis & Smith, 2022; Putnam et al., 2016; Smith & Lewis, 2011), using the underlying literature as a provisional theoretical vocabulary for what informants described.

Methodologically, we adopted a theory-elaboration approach (Fisher & Aguinis, 2017) to apply, refine, and extend tension theory in a broader sense (e.g., by paying special attention to Smith and Lewis’s (2011) dynamic equilibrium model of organizing) in the context of high-growth startups in the digital age. Theory elaboration is appropriate where a well-developed frame exists but requires sharpening to accommodate novel empirical settings, boundary conditions, or underlying mechanisms. Our analysis thus proceeded abductively: an exploratory mode of inference grounded in the reciprocal interplay among theoretical lenses, case evidence, and emergent conceptualization (Maxwell, 2012, 2013; Orton, 1997). As the data analysis was "closely tied to the writing process" (Bansal & Corley, 2012, p. 512), the theory narrative changed over time, which is, for example, reflected by focusing on growth-related challenges in the digital transformation process of company I to centering tensions in later stages of conducting interviews and designing interview guidelines.

The coding process of the transcribed interviews was supported by the MAXQDA software. While leveraging the rich body of knowledge on tensions from organizational research to high-growth entrepreneurship, we built, amongst others, on the dynamic equilibrium model of organizing (Lewis & Smith, 2022; Smith & Lewis, 2011; Weiser & Laamanen, 2022) from paradox research and the management of growth-related challenges "at the level of organizational subsystems (e.g., management, technology, structure)" (Whetten, 1987, p. 337). In combination with the emerging empirical data, this finally led to the development of four interrelated dimensions (strategizing, organizing, technology, people) in the interplay of deductive and inductive coding to better understand the underlying mechanisms of tensions. After multiple rounds of cross-checking our draft, we generated a revised set of first-order concepts that relate to these dimensions. During the data analysis process, we developed a set of second-order themes—such as scaling conflicts—categorized across the four dimensions and related to the aggregate dimensions. To illustrate this, we developed a data structure (Figure 1) according to Gioia et al. (2013).

Figure 1. Coding Structure (Simplified)



Finally, to achieve validity of results and due to initially approaching the phenomenon from different theoretical perspectives, we used multiple sources of evidence allowing triangulation in light of a large number of quotes and secondary data such as publicly available documents (Gibbert et al., 2008; Keller et al., 2021). Moreover, to create an in-depth picture of the underlying mechanisms of tensions, we used triangulation by discussing anonymized data with other founders and fellow researchers from different disciplines (for example, information systems, entrepreneurship, organization studies, and strategic management). In case of company VII, we brought this phenomenon to the classroom and discussed challenges and contradictions during the organizational change process with students by inviting the COO to the entrepreneurship seminar. Adding to this, initial findings were presented and discussed at international conferences and research colloquia. This, for example, led to valuable feedback on theoretically approaching tensions (e.g., from a paradoxical or dialectical perspective) and, thus, informed our understanding of this phenomenon through different lenses.

4 TOWARD A TENSION MODEL FOR RAPIDLY GROWING STARTUPS

The tension model aims at better depicting the underlying mechanisms and multidimensionality of tensions that startups navigate during phases of rapid growth. First, we elaborate on the model's five environmental factors that render latent tensions salient (E-I), affect their resolving when manifested in conflicts (E-II), and ultimately have an impact on the short- and long-term performance (E-III). Second, in the tension space, we focus on the categorization of emerging tensions (Figure 2). These are organized in the four interrelated dimensions of strategizing, organizing, technology, and people (T-I). Both, latent and salient tensions potentially affect scaling (O-I, O-II) and create varying degrees of urgency in addressing these (T-II). Third, in the resolution space, we unveil how managers accept, anticipate, or resolve tensions manifested in specific conflicts, potentially leading to a tangible or intangible solution (R-II) that ultimately affect scaling (O-III, O-IV). In light of this, we observed that the resolving process itself might create new salient tensions or event prevent/mitigate their emergence through anticipatory measures (R-I), while the specific outcome might additionally create new latent tensions (R-III). Finally, we illustrate the effect of the scaling performance on environmental factors (e.g., reducing scarcity through increased financial means) (O-V). Hence, the findings are structured according to the proposed model (Figure 3).

Figure 2. Categorization of Tensions

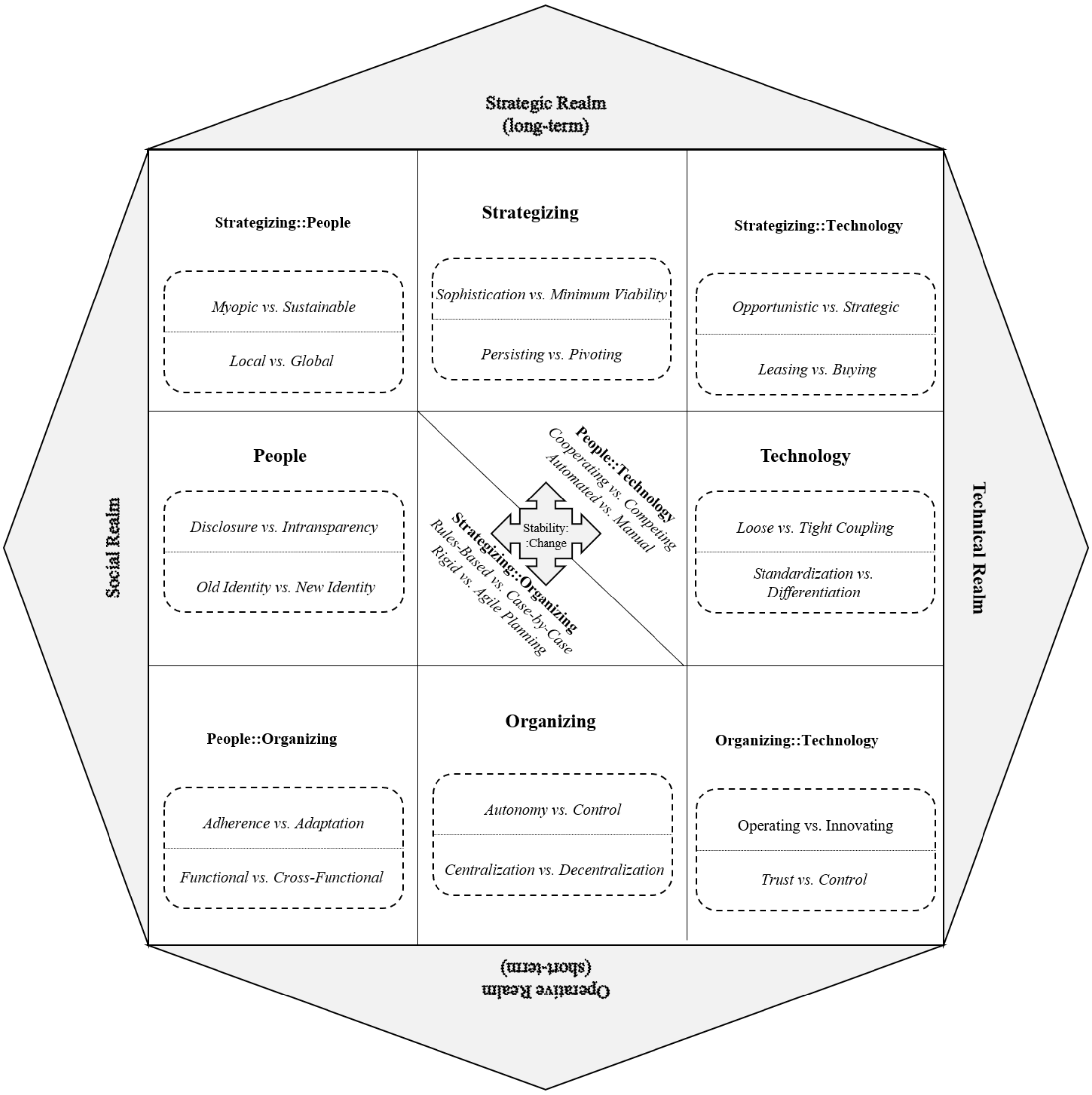
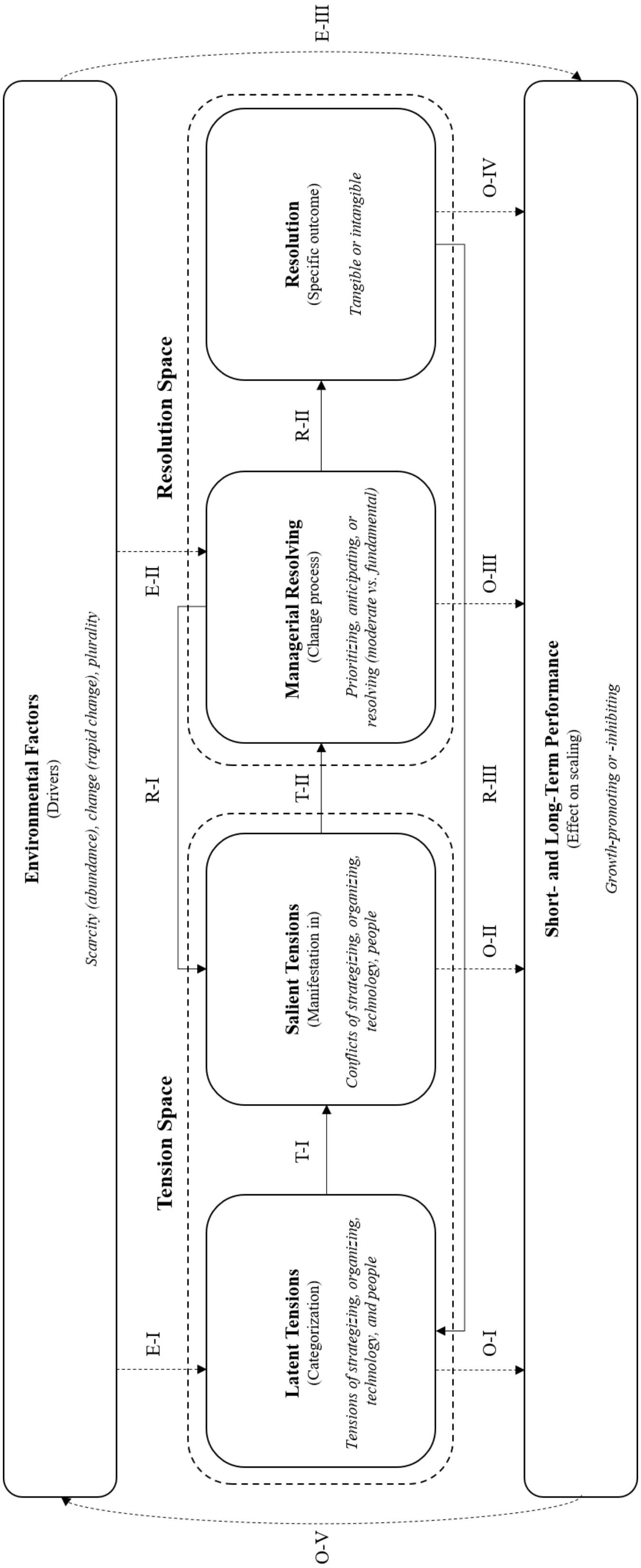


Figure 3. Tension Model for High-Growth Startups



4.1 Environmental Factors

Factors rendering latent tensions salient reflect the conditions that activate underlying tensions, making competing demands visible and consequential for high-growth startups as they scale. When examining how latent tensions became salient in high-growth entrepreneurial contexts, we began by building on the environmental factors of scarcity, change, and plurality (Smith & Lewis, 2011). As we compared these categories with our empirical data, we observed a broader set of conditions shaping this transition.

First, our data revealed that abundance operated alongside scarcity as an environmental factor. While many bootstrapped ventures experienced periods of financial, temporal, or talent scarcity, several cases showed the opposite pattern. Startups with access to substantial founder capital or early venture funding faced an abundance of resources that shaped how tensions surfaced. For instance, this is demonstrated by company XVIII which was embedded in a strong network of universities, incubators, startups, and incumbent firms and benefited from a three-digit pipeline of potential employees (e.g., through mandatory internships) for realizing rapid growth. This resource-rich environment altered the timing and intensity with which tensions emerged during rapid expansion.

Second, our analysis indicated that rapid change constituted a distinct environmental factor beyond gradual organizational change. Across cases, high growth accelerated the pace at which latent tensions became salient, often producing abrupt shifts in priorities or structures. In several startups, external triggers amplified this acceleration. For instance, company XXVII was forced to modify its business model almost overnight when the COVID-19 pandemic disrupted its primary customer base, rapidly exposing underlying contradictions that had previously remained dormant. We found that both gradual and rapid change shaped when actors experienced tensions, but rapid change surfaced them more immediately and urgently.

Third, although plurality manifested differently across startups depending on the stage of growth and stakeholder composition, we did not identify a contrasting condition comparable to scarcity–abundance or slow–rapid change. Plurality remained present across all cases but varied in scale as additional stakeholders, roles, and expectations entered the organization during growth. While our data did not warrant introducing an opposing category, several cases pointed to emerging dynamics surrounding founder influence and decision-making authority as organizations became more complex.

Hence, when relating the effects—or drivers—that lead to the rendering of latent tensions salient to our empirical data, we noticed a greater spectrum, particularly of scarcity and change, which we incorporated into the model. These made competing demands more visible and were particularly consequential for high-growth startups as they scale.

4.2 The Tension Space

During our investigation, we identified a wide range of tensions and their manifestation in conflicts (see Table 2 in the appendix). As we analyzed the data and compared patterns across cases, we grouped the tensions into four primary dimensions—strategizing, organizing, technology, and people. Each of these is illustrated by two representative tensions that we identified in the cases. These were defined and contextualized, linked to the existing knowledge from the tension literature, supplemented by the environmental factors that led to the manifestation in conflicts, and managements' attempts to resolve these.

In addition to the illustration of tensions from the four primary dimensions in Table 2—which also includes supplementary data at their intersection ("sub-dimensions")—, we have outlined one of the two representative tensions per dimension in the following for better understanding. Please note that, although carefully selected, these reflect only a small portion of the possible tensions in each dimension. Accordingly, the tensions are illustrative and not exhaustive, whereby further tensions emerged in the course of data analysis and—due to the sample size—other tensions, that were not evident, are conceivable, providing fruitful avenues for future research.

4.2.1 Strategizing

The strategizing dimension captures tensions arising from contradicting strategic orientations and choices in high-growth entrepreneurial settings. Across cases, we observed tensions that stemmed from competing demands in how firms set direction, allocated attention, and adapted their strategic positioning during rapid expansion. Two tensions appeared consistently in our data—persisting vs. pivoting and sophistication vs. minimum viability (Table 2)—one of which we illustrate below.

The tension persisting vs. pivoting reflects strategic decision-making on pivoting in startups. In light of rapid environmental change (e.g., due to COVID-19 as evident in company XXVII or even war (company XVI)), managers were pressured to decide on either relying on the existing business model or changing it (e.g., through adapting the existing or developing a new business model that better fits the rapidly changing environment or penetrates a new market). For instance, we noticed the tension between persisting and pivoting in the process of analyzing company XXVII, an Indian education company that showed exceptional growth rates before and after fundamentally changing their business model. Within eight years, the company grew to more than 200 employees and provided offline courses in several major Indian cities such as Delhi or Mumbai. In 2020, although the pressure slowly grew to enhance the business model with online courses, COVID-19 became a severe threat to the company, as illustrated by the CTO:

> *"We started out entirely as an offline institute. I do not think there were layoffs, but yes, there was a pay cut because of COVID-19 when offline operations were discontinued. Suddenly everything had to go online and the business model changed rapidly. This was followed by acquisitions of a few technology companies, which provided the fuel to grow exponentially. Technology is now an integral part of your business."*

As a result, the pivot led to hyper-scaling of the company as it quadrupled its workforce in a short period of time.

While this tension is not (yet) discussed as a tension in literature, it can be linked to the paradox of openness from the digital entrepreneurship discipline (Lin &

Maruping, 2022) or literature on (radical) pivots and business model innovation (e.g., Bohn & Kundisch, 2018; Sternad & Mödritscher, 2022). On a more abstract level, it can be linked to resource vs. routine rigidity in the context of inertia (e.g., Gilbert, 2005) or ambidexterity (e.g., Mathias et al., 2018). Given this example, the strategizing dimension encompasses long-term and, thus, fundamental decisions on strategically aligning and developing the startup and its business model while weighing up advantages and disadvantages.

4.2.2 Organizing

The organizing dimension captures tensions arising from contradicting views, choices, and modes of organizing in high-growth entrepreneurial settings. Across cases, we identified tensions that stemmed from competing demands in how startups structure work, assign responsibilities, and coordinate activities. Two recurrent tensions characterized this dimension—autonomy vs. control and centralization vs. decentralization (Table 2).

For instance, during periods of rapid employee growth, we observed the autonomy–control tension in company I and across other interviewed founders and managers, who described shifting role expectations and evolving organizational structures that brought this tension to the forefront. In several cases, we observed the emergence of contrasting leadership approaches as firms expanded. Some startups developed autocratic or hierarchical leadership styles, marked by centralized authority, strong task orientation, and limited autonomy. Others adopted democratic or participative styles, characterized by decentralized authority, reduced control, and greater autonomy, including hybrid forms used selectively or within ambidextrous structures.

Relatedly, the rapid increase in the number of employees surfaced another tension between hierarchical (mechanistic) and heterarchical structures (organic). As founders and managers introduced new structures, they repeatedly confronted the challenge of determining how much hierarchy or heterarchy to incorporate in order to support innovation, facilitate collaboration, and enable efficient operations. To give an example how growth—or change—rendered the latent tension of autonomy and control salient, we illustrate it by the shift toward greater hierarchization as described by the CEO of company C:

> *"We used to be a non-hierarchical company and always propagated that. Now we are on the threshold of introducing the second management level and are trying to keep the balance so that it does not turn into such a "hierarchical" and "dictatorial" mentality. We also initiated a beehive once a quarter to promote innovation at all levels of the company from interns to me as CEO. During this internal hackathon, all employees are encouraged to gather ideas for new products, as well as operational and organizational optimizations across departments."*

In the literature, the tension between autonomy and control is discussed manifold and "can be viewed through multiple lenses" (Hargrave & van de Ven, 2017, p. 320). This includes discourses on their nature as a dialectical or paradoxical tension (Hargrave & van de Ven, 2017; Smith et al., 2017). For instance, it has been investigated from a paradoxical view in several contexts (e.g., digital infrastructure (Tilson et al., 2010), IT project control vs. IT project autonomy (Gregory et al., 2015), or technology ecosystem governance (Wareham et al., 2014)). Regardless of its nature, it illustrates the managerial challenge of developing and potentially redesigning structures and policies conducive to growth, whether in the dimension of organizing or, for instance, related to the sub-dimension of organizing and technology. Given this example, tensions of organizing emerged as firms sought to balance the need for orderly processes with the flexibility required during rapid growth.

4.2.3 Technology

The technology dimension captures tensions arising from conflicting technological demands encountered during decision-making and implementation processes in high-growth entrepreneurial settings. Across cases, technological tensions and conflicts were often intersected with other dimensions, particularly the people dimension, as managers reported instances of user resistance when introducing new software or tools. Within this broader pattern, two recurring tensions characterized this domain—tight vs. loose coupling and standardization vs. differentiation (Table 2).

For instance, across the cases, tensions in the development of the digital infrastructure in light of the advantages and disadvantages of coupling software solutions either a) loosely or b) tightly during the company's early growth became evident. In terms of environmental factors, scarcity (e.g., lack of financial resources for developing a costly "state-of-the-art digital infrastructure") and rapid change in terms of growing organizational structures and increasing complexity often led to a structure-technology misfit in later stages due to non-integrated processes. In contrast, abundance (with regard to sufficient (venture) capital) proved to be beneficial for the development of a scalable and flexible state-of-the-art digital infrastructure in some cases. However, the fragmentation of the digital infrastructure during rapid growth and the corresponding integration efforts posed major challenges for some of the startups by significantly impacting data-driven decision-making and communication and collaboration between subsidiaries, business partners, and departments. Here, against the backdrop of growing organizational structures, new requirements (for example, for communication and collaboration) needed to be met by an integrated and scalable digital infrastructure.

Whereas all organizations relied at least partly on software as a service, and thus cloud solutions, the fragmentation of the infrastructure differed heavily in the startups. While some startups, such as companies VI or XVI, were organized in an integrated and scalable cloud infrastructure from the beginning and were thus able to add new "features" quickly and rely on data-driven decision-making, others, such as company I or X, achieved a high level of integration over time and through greater orchestration efforts. For instance, while loosely coupled software solutions sufficiently suited the needs of company I in the beginning, the company replaced most systems at a size of approximately 100 employees and introduced a cloud-based enterprise resource planning system as latent hurdles—such as redundant customer data or non-integrated processes—became severe and communication and collaboration requirements increased, which resulted in six-digit financial losses over a year. Moreover, this evolutionary process was often accompanied by shadow IT or best-of-breed solutions for individual departments, resulting in missing interfaces and additional integration hurdles. Thus, while some companies incrementally adapted the digital infrastructure in light of the tension between loosely or tightly coupled systems, others, such as company IX, radically replaced existing software solutions toward a higher degree of integration that supported data-driven decision-making, as illustrated by the COO:

“The integration into the group gave us the chance to start over again, and we have completely turned the systems upside down. We now rely on a central ERP system in the cloud and connect shops, service providers, and logistics there. Interfaces and individual customization options are becoming increasingly important for us.”

In the literature, the tension between loose and tight coupling is addressed, for example, in related contexts such as technology ecosystem governance (Wareham et al., 2014) or customer orientation (Andriopoulos & Lewis, 2009). Given this example, with regard to the digital infrastructure evolution of startups, particular managerial attention must be paid to tensions that arise in the process of aligning business with information technology in light of enabling scalability and flexibility that potentially spur rapid growth.

4.2.4 People

The people dimension captures tensions related to human resources and their interaction in high-growth entrepreneurial settings. Across cases, we noticed tensions with regard to evolving skill requirements, human resource sourcing, and shifts in the organizational culture. Two tensions appeared consistently in this domain—disclosure vs. intransparency and old identity vs. new identity (Table 2).

For instance, in terms of culture, a tension between the old identity and the new identity in light of a rapidly increasing number of employees emerged. Here, cultural change and a plurality of views and goals when hiring new employees led to a loss of organizational agility in light of cultural clashes and identity breaches during rapid growth in some of the startups. This is illustrated by the rapidly growing company XVII, in which the founders fired managers and employees that did not match existing values and beliefs, as one of the founders functioning as the COO revealed:

"*We made poor hires in key positions without them being consistent with our identity. These leaders brought their own culture with them and hired people who matched their cultural values. There was a big bang and we had to replace many people. This significantly hampered our growth and speed. To be honest, that has cost us a year, I would say. Sales and marketing, which were separated, are a prime example. So, the CEO, my co-founder, did sales and I did marketing because I have the better marketing background and we saw that this totally clashes, although we were actually super well aligned. However, the hired sales leader was not a good fit and the marketing leader was also not such a good fit. And then, of course, they hired people who represented their culture. And I took a bit of a shot at the sales leader relatively early on, but my two co-founders did not see it that way. At the end of the day, we kicked them out. We became much slower. We did not get anything done anymore.*"

In the literature, this tension is discussed, for example, during the mobile ecosystem evolution (Lindgren et al., 2015), linked to cultural uniformity and diversity (Bahrami, 1992), and related contexts (see also: Corley & Gioia, 2004; Jacobs et al., 2021; Mini & Widjaja, 2019; Smith & Lewis, 2011; Zuzul & Tripsas, 2020). Given this example, we observed that tensions of people and culture also had a significant impact on startups' growth, which was particularly evident in the process of scaling.

4.2.5 Sub-Dimensions

While these four dimensions provide initial insights into the emergence of tensions during the rapid growth of startups, our analysis of the empirical data revealed that many tensions were highly interrelated, often occurring at the intersection of two—or even more—dimensions. By focusing on their emergence in two interrelated dimensions, this analytical process led to six additional sub-dimensions. Because a detailed description of these would impair readability and exceed the scope of this paper—whose overarching research objective is theorizing tensions in entrepreneurial high-growth settings from a broader perspective—these are instead concisely illustrated in Table 2. In short, this revealed tensions between 1) strategizing and organizing (e.g., imbalances in the strategic planning vs. the operational implementation of structures), 2) strategizing and technology (e.g., strategically planning the development and use of the digital infrastructure and technologies), 3) strategizing and people (e.g., strategically planning the acquisition of human resources in light of global sourcing), 4) organizing and technology (e.g., leveraging digital technologies such as cloud computing or platforms for communication and collaboration), 5) organizing and people (e.g., efforts to build a structure that efficiently supports employees' skills and their training), and 6) technology and people (e.g., tools that support leading employees digitally).

On a side note, within these dimensions, humorous tensions were also revealed (Jarzabkowski & Lê, 2017). For example, as the CEO of company XIII anecdotally illustrated while being caught between holding great responsibility for the future of the startup including all employees and providing small-scale technological support: "We have 65 employees, but I need to fix someone's Bluetooth." Humorous tensions may therefore serve as an alternative lens to conduct research on emerging tensions and managerial responses in an entrepreneurial (high-growth) context.

4.3 The Resolution Space

The resolution space captures how management addressed tensions that had materialized as specific dilemmas or conflicts. Across all dimensions, we observed a wide range of responses. Some tensions were addressed through incremental adjustments, while others prompted fundamental, more radical changes, particularly in cases involving autotomizing. In several instances, managers set priorities that resulted in one tension being—temporarily—accepted or ignored without any action, whereas another was actively addressed. We also identified cases in which a tension faced by one company was prevented or mitigated by another through anticipatory measures implemented before conflicts surfaced. The following sections illustrate these patterns and the conditions under which each type of response occurred.

4.3.1 Fundamental Resolution

Across all dimensions, we observed instances in which management adopted radical measures to address tensions that had escalated into acute conflicts. In the strategizing dimension, several startups made fundamental shifts in their business models; for example, one firm transitioned from an offline to an online model in response to COVID-19. In the technology dimension, fundamental resolutions involved replacing core software systems, such as abandoning existing tools in favor of a new enterprise resource planning system. In the organizing dimension, companies adopted new organizational structures, including firm-wide agile sprint models or structures modeled on the Spotify approach, in which employees are organized into tribes, chapters, and squads. In the people dimension, fundamental measures became evident in cases where rapid growth amplified cultural tensions. Company XVII, for instance, expanded quickly and developed multiple subcultures that diverged from its original identity. As newly hired managers brought in employees aligned with their own values rather than the firm's founding culture, misalignment intensified and ultimately resulted in the dismissal of the sales and marketing managers. Although smaller conflicts and, thus, cultural tensions were apparent early on, these intensified over time and led to a radical resolution. In particular, this illustrates the finiteness and high intensity of change measures that led us to distinguishing between fundamental and moderate resolutions.

4.3.2 Moderate Resolution

In contrast, we classified resolutions across all dimensions as moderate when their impact led to comparatively smaller or non-significant changes. For instance, in the organizing dimension, startups often introduced selective agile practices to address emerging coordination challenges during rapid growth. This is illustrated by the co-founder of company XVI, who initiated the adoption of agile routines tailored to departmental needs. Weekly sprint planning provided a shared orientation and supported synchronization across several teams. While this approach proved useful for departments such as marketing, it was less effective in areas with more mechanistic requirements, such as sales. Cases like this illustrate how managers employed moderate adjustments to balance flexibility and routinization without fundamentally altering organizational structures or processes. This was also evident at company XVIII, as the co-founder illustrated:

> *"We use many agile elements that make sense for our use case. However, sprints make relatively little sense in hardware development, which is very B2B customer-driven and very project-driven."*

In contrast, in the case of company XIII, almost the entire company worked to the same sprint cycle, with regular stand-ups each morning, but without the pressure of having to deliver on fixed weekly deadlines. Thus, the company did not strictly adhere to agile methods but rather internalized a holistic agile philosophy adapted to the respective needs of the individual departments. This also applied to the approach in company III, which introduced daily updates and oriented itself to Scrum, but did not work according to this framework in a textbook manner. Thus, on the one hand, implementing agile practices potentially reinforced existing challenges and led to negative outcomes, if not tailored to the business needs. On the other hand, these also proved beneficial and supported sustaining organizational agility but, at the same time, potentially created new tensions. Given this, a plethora of moderate resolutions to tensions was evident in other (sub-)dimensions. For instance, this included minor adaptions of the business model within the strategizing dimension, initiatives aimed at fostering team cohesiveness within the people dimension, or addressing tensions within the technology dimension through incremental adaptions of the digital infrastructure with new modules (see Table 2).

4.3.3 Anticipatory Measures

Besides fundamental and moderate resolutions of tensions—and instances in which tensions were accepted or left unaddressed due to managerial prioritization—we identified cases in which startups avoided or minimized tensions through anticipatory actions taken before conflicts emerged. These patterns appeared across all dimensions and were often associated with founders who possessed prior experience in organizational development or had access to external guidance from mentors, incubators, or previous entrepreneurial activities. For instance, this was evident in the tension "opportunistic vs. strategic" in the development of digital infrastructure. In company I, rapid growth led to a misalignment between organizational structure and technological systems. As the firm approached roughly 100 employees, inefficiencies and lack of system integration led to significant performance losses. This led to implementing a new enterprise resource planning system, replacing numerous existing software tools. In contrast, company XXIII strategically planned the development of the digital infrastructure, which enabled scalability and flexibility from the beginning. Although this did not prevent all technology-related tensions, these anticipatory investments contributed to avoiding structural and technological misfits that later challenged other firms.

Given this, we observed across cases that both the process of resolving tensions and the resolutions themselves sometimes generated new latent or salient tensions. For instance, the planning process for the new enterprise resource planning system in company I also led to new salient tensions when immediate user resistance arose in individual departments due to the announcement that existing software solutions were to be replaced. Conversely, after the piloting of individual modules, new, latent tensions emerged that later became salient in terms of interface challenges with partners. In the same vein, the dismissal of the managers in company XVII directly led to new tensions in the management and recruitment of employees. Given this, environmental factors—such as scarcity or abundance—significantly influenced the range of options available to founders and managers, whether in implementing new software solutions or in hiring and dismissing personnel.

In sum, across cases, we observed that startups employed different approaches to addressing tensions depending on the urgency of the situation and the intensity of the required change. Tensions were resolved through fundamental or moderate responses; no change occurred when tensions were either accepted or prevented through anticipatory action. Most conflict-resolution situations reflected clear choices between competing demands, particularly when decisions had to be made quickly or under conditions of uncertainty. The data also showed that startups experiencing similar tensions often responded differently, influenced by their internal conditions, external pressures, and prior planning. In several cases, anticipatory measures eliminated the need for later intervention, whereas in others, urgent conditions prompted more substantial responses.

4.4 The Outcome

Across the cases, it became evident that both the process through which managers addressed tensions and the resulting solutions had direct implications for startups' short- and long-term performance. Managerial responses influenced whether firms sustained growth, transitioned into scaling, or entered periods of stagnation, decline, or failure. On the one hand, scaling was closely linked to how effectively managers resolved tensions, as the outcomes of these actions either preserved organizational agility or contributed to emerging inertia. This was evident, for example, in the tension between tight and loose coupling in developing the digital infrastructure and its implications for scalability, as well as in company XVII, where cultural tensions had far-reaching performance consequences. On the other hand, latent and salient tensions themselves affected performance, as ongoing or unresolved conflicts created varying levels of urgency that prompted or delayed organizational change. For instance, in light of the tension between flexibility and routinization, the COO of company II reflected on the slowly increasing need to establish organizational structures:

"From six people onwards, the chaos grew because you suddenly realize that nobody knows what is going on and nobody is coordinating anything."

Another externally induced conflict related to the tension space was rooted in rapidly mounting customer expectations in the dialectical relationship between opposing demands of specialized or generalized software products, and, thus, allocating human resources to product development, as stated by the CEO of company XI:

"One of the challenges we are currently facing is the development of new functions for various customers. There is no magic solution. Basically, it is just a lot of bullets. And it is going to take us about six months to implement a whole bunch of these things. That will definitely reduce our agility."

With regard to customer-induced product changes, the co-founder of company XIV described similar tensions related to avoiding performance losses:

"As a company, we are always turning down opportunities to do new things that are not related to what we do. Even though they may look very shiny and be very exciting, we have to ask ourselves if that does not take away the momentum and prevent us from moving forward with our core concept."

Hence, managers were constantly challenged to navigate tensions in light of sustaining the advantages of small-size and preventing the organization from becoming inert through internal and external forces.

In sum, our study shows that both the tensions themselves and the ways in which they were resolved had substantial impacts on startup performance. In particular, we observed that the environmental factors not only have an effect on the rendering of latent tensions and on the range of options for resolving tensions, but also have a direct effect on scaling. Conversely, positive changes in performance also affected the environmental factors, which is reflected, for example, by the factor plurality in light of increasing organizational complexity and, thus, a mounting number of employees.

5 DISCUSSION

As organizations can be considered as "admixtures of stability and change" (Poole & van de Ven, 1989, p. 564), these reflect a breeding ground for multiple tensions across the dimensions of strategizing, organizing, technology, and people. To better understand how these unfold in the process of rapid growth and how startups navigate these, we employed a multiple-case design including semi-structured interviews with 31 founders and executive managers of high-growth startups from nine countries. Given this, the findings of our study advance entrepreneurship research twofold.

First, we addressed the under-theorization of tensions in high-growth startups by systematically capturing their emergence across multiple dimensions. Here, we responded to the call for more qualitative research on how the high-growth process unfolds (Hamilton & Ng, 2025; Lange et al., 2023). In doing so, we extended, for instance, the findings of Moedt et al. (2024) regarding the drivers and consequences of scaling, and demonstrate how tensions serve as a useful analytical lens for understanding entrepreneurial high-growth processes. However, research on tensions in entrepreneurial high-growth settings remains scarce (see, e.g., Lange et al., 2023; Tschoppe et al., 2023; Watkowski et al., 2025). Moreover, studying tensions in an entrepreneurial setting tends to be selective, focusing on specific tensions and lacking contextualization in high-growth environments (see, e.g., von Briel et al., 2018). To address this, we proposed a model that better captures the underlying mechanisms that lead to the emergence of tensions and the managerial resolving of manifested conflicts in entrepreneurial high-growth settings. In particular, we provided a framework that facilitates the systematic mapping of high-growth tensions across the four interrelated dimensions of strategizing, organizing, technology, and people. By building on and extending established approaches to categorizing tensions (e.g., investigating organizational tensions of belonging, performing, learning, organizing, and their interrelations through a paradox lens (Jarzabkowski et al., 2013; Lewis & Smith, 2022; Lüscher & Lewis, 2008; Smith & Lewis, 2011; Weiser & Laamanen, 2022)), we contributed to a broader, more systematic understanding of tensions in entrepreneurial high-growth settings. Rather than merely approaching them selectively, we respond to the call for a better understanding of how startups fail more comprehensively (Coviello et al., 2024).

Second, we examined how founders and managers navigate tensions in entrepreneurial high-growth settings. Here, we responded to calls for more research that adopt a holistic perspective on how the growth process unfolds and, in particular, how challenges and opposing demands are resolved (see, e.g., DeSantola & Gulati, 2017; Kindström et al., 2024). This also relates to the call of Lin & Maruping (2022) for more research on the management of tensions, particularly highlighting their outcomes. Adding to this, our findings suggest to view rapid growth as an inherently tension-laden process. By referring to Es-Sajjade et al. (2021), our tension model supports a better understanding of the effects in the process resolving tensions, potentially leading to vicious cycles. Given this, existing literature on paradox and dialectics has informed our findings by proposing multiple approaches for addressing tensions and conflicts. In view of tensions' manifestation in conflicts, our study particularly draws attention to a dialectical understanding of opposing demands in the process of organizational change in contrast to paradoxical tensions that might not be inherently resolvable and rather reflect a process of "working through" (see, e.g., Lüscher & Lewis, 2008). For instance, Farjoun & Fiss (2022, p. 343) introduced the notion of "disciplined incoherence," defined as "a set of practices that allow them to thrive on contradictions and conflicts within their strategies and configurations while mitigating their potential risks." This sheds light on the dual nature of prioritizing and navigating tensions to achieve superior performance.

In sum, we advance entrepreneurship theory that deals with responses to tensions by shedding light on the intensity of change (none, moderate, fundamental), the urgency to resolve manifested conflicts, and the relevance of anticipatory measures which prevented some startups from facing tensions that emerged in other startups. We have focused on resolving these rather than the acceptance of opposing elements or anticipating future tensions, which also offer interesting avenues for future research in the context of the rapid growth of startups. Here, it must be noted that the process of resolving tensions was usually viewed in light of their manifestation in specific conflicts or challenges. In particular, we identified 20 representative tensions that support entrepreneurs in anticipating future challenges in light of rapidly increasing organizational complexity and provide guidance on categorizing managerial responses to manifested conflicts according to their urgency and intensity. Here, we paid greater attention to incremental and radical solutions—or moderate and fundamental change—usually reflecting either-or approaches. Referring to the latter contribution, we were able to demonstrate radical responses to tensions manifested in conflicts, thereby proving that startups actually do pull it off as a crab if pressured by selected environmental factors.

At the same time, this reveals a plethora of opportunities for practice, as a better theoretical understanding paired with empirical evidence may offer valuable insights for policy-makers (i.e., how to effectively support startups with targeted measures in light of their exposed role for (regional) economic growth), as well as founders and top managers in anticipating and addressing future challenges in a fast-paced, dynamic, globalized, and digitalized environment.

6 CONCLUSION AND FUTURE RESEARCH

With our study, we pave the way for scholars in the field of entrepreneurship by providing novel empirical insights and, thus, guidance on the categorization and managerial responses to tensions in high-growth startups. In particular, we contribute to a better understanding of entrepreneurial scaling by framing phases of rapid growth as an inherently tension-laden process. These tensions may constitute risks that hinder growth, yet they can also foster dynamism and creativity. Accordingly, founders' and managers' ability to manage and prioritize such tensions emerges as a key determinant of successful growth.

We would also like to draw attention to two limitations—the limited triangulation between cases, as we opted for a broad rather than an in-depth investigation and, thus, limited knowledge on whether the materialization of selected tensions unfolds in all startups. Considering these, three avenues for future research seem particularly promising to advance research on tensions in entrepreneurial high-growth settings.

First, in light of theoretical advancement, dialectics and paradox research provided initial insights on how to categorize and navigate tensions in entrepreneurial high-growth settings. A deeper investigation of these, for instance, with regard to the concept of disciplined incoherence and, thus, how rapidly growing startups can thrive on contradictions, seems particularly compelling (Farjoun & Fiss, 2022). Moreover, with regard to outcomes, we highlighted how the tension and resolution space affect scaling, and, ultimately, success and decline (or even failure) of rapidly growing startups in light of volatility. Although we were able to empirically prove a connection between tensions and managerial responses with regard to an improvement in agility or a rise in organizational inertia in some cases, this observation requires additional investigations. In light of quantifying their effect on performance, special attention might be paid to cases of autotomizing.

Second, by outlining the potential of further empirical studies that aim at advancing our understanding of this phenomenon, scholars might investigate the specific tensions that emerge in purely virtual high-growth startups. In particular, further in-depth longitudinal case studies could provide valuable insights into these and beyond. Moreover, while most of the startups demonstrated—at least in phases—high growth, we also noticed cases of temporal and (rapidly) progressing organizational decline, bearing interesting avenues for future research when investigating specific tensions in this context.

Third, methodologically, design science (Seckler et al., 2022) and qualitative meta-studies (QMS) (Habersang & Reihlen, 2025) offer complementary avenues for deepening insights into how tensions materialize across startups. Design science enables the iterative creation and evaluation of artifacts—such as heuristics or governance mechanisms—that address how actors identify and navigate tensions in high-growth contexts. QMS, in turn, synthesizes dispersed qualitative evidence and uncovers broader patterns, boundary conditions, and contradictions that both inform theory building and managerial practice. Together, both approaches help to advance our understanding as well as design knowledge on tension management in high-growth entrepreneurship.

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PAPER VII – APPENDIX

Note: For reasons of space and clarity, the following table has been reduced to a font size of 9 in this manuscript.

Table 2. Empirical Evidence of Emerging Tensions During Organizational Change

Dimension	Tension	Narrative	Empirical Evidence (Selected Quotes)
Strategizing	**Sophistication vs. Minimum Viability** Related Literature *Not (yet) discussed as a (dialectical) tension but addressed in the practitioner literature in the context of experimentation/lean startups (e.g., Blank, 2013; Ghezzi & Cavallo, 2018; Ries, 2011).*	Description *Tensions due to bringing either a) sophisticated or b) minimum viable products or services to the market during the venture creation process.* Rendering Factor and Manifestation *Scarcity (financial resources) affects product- and service-development and created urgency in both cases to release unfinished products (time-to-market).* Moderate Resolution *Managers of company VIII and XI balanced customer demands through experimenting and often refrained from sophisticated solutions in light of finding a market fit.*	*1) "We live this philosophy of working with pilots, even if not always to perfection. We try out new products with selected customers and measure different aspects in this process. An example of this was an app that we built back then, where we worked intensively with dummies at the beginning, conducted many interviews and made our first practical observations. This meant we knew early on whether we were moving in the right direction. Before we put our resources into development and wrote the code, we could be sure to a high percentage that the product we are designing actually meets the customer's needs. However, there must be a thousand examples where it was not done that way after all."* (Co-founder, company VIII) *2) "Developing a product that was good enough to sell drove me crazy. Basically, I spent two years emailing customers and asking them to take a look at our product. That was the hardest part for me. Especially as I could alternatively get a real job, as my wife kept reminding me. But I held on to this idea and prayed that I had made the right decision. Over time, this has changed and customers are enthusiastic about our products. It was a big relief when we had our first paying customers."* (CEO, company XI)
	Persisting vs. Pivoting Related Literature *Not (yet) discussed as a (dialectical) tension but linked to the paradox of openness from the digital entrepreneurship discipline (Lin & Maruping, 2022), literature on (radical) pivots and business model innovation (e.g., Bohn & Kundisch, 2018; Sternad & Mödritscher, 2022), resource vs. routine rigidity in the context*	Description *Tensions related to weighing up advantages and disadvantages of* ***a)*** *relying on the existing and* ***b)*** *adapting the existing or developing a new business model in light of rapid growth.* Rendering Factor and Manifestation *COVID-19 in light of rapid change became a severe threat to the business model of company XXIII. However, sufficient financial resources enabled quickly changing the business model and establishing new partnerships while retaining*	*1) "We started out entirely as an offline institute. I do not think there were layoffs, but yes, there was a pay cut because of COVID-19 when offline operations were discontinued. Suddenly everything had to go online and the business model changed rapidly. This was followed by acquisitions of a few technology companies, which provided the fuel to grow exponentially. Technology is now an integral part of your business."* (CTO, company XXVII) *2) "We thought the market would be smaller. We thought the technology would be more difficult. We thought it would be easier to win customers, you know, all these things. And so, we refine our strategy regularly. It is not about big pivots but rather small changes based on observations. In the early stages of the company, there are these big pivots where*

	of inertia (e.g., Gilbert, 2005), and ambidexterity (e.g., Mathias et al., 2018)	*the majority of the workforce. In contrast, change in customer demands led to smaller pivots over time in the evolutionary process of company XIII.* <u>Moderate/Fundamental Resolution</u> *Induced through COVID-19, company XXVII radically pivoted as its business model was highly threatened, but switched to a hybrid (online/offline) business model when the crisis momentum. Here, pivoting led to hyperscaling of the company as it quadrupled its workforce in a short period of time. In contrast, company XIII incrementally changed the business model in light of experimentation.*	*you think about whether you should use this or that sales channel. And then, as you get further along in your development, these pivots that you make become smaller and smaller, but they just happen a lot more frequently. In addition, I had coached startups and tech businesses on how to prove and validate an idea. So, when we started obviously with the spreadsheet and the one-page website, the whole idea was to probably let go in terms of build-measure-learn methodology, that kind of lean startup way of thinking. Everything that we do is kind of customer-led and customers engage heavily in the creation of new products and services. But yes, we very much will look at what is the finished slice of something that we can deliver to go out and test our hypothesis. And everything that we do from a product perspective is about kind of validating those hypotheses."* (CEO, company XIII)
Technology	**Loose vs. Tight Coupling** <u>Related Literature</u> *Referred to as a tension (e.g., in technology ecosystem governance (Wareham et al., 2014) or customer orientation (Andriopoulos & Lewis, 2009)).*	<u>Description</u> *Tensions in the development of the digital infrastructure in light of advantages and disadvantages of coupling software solutions either **a)** loosely or **b)** tightly during the company's early growth.* <u>Rendering Factor and Manifestation</u> *Scarcity (e.g., lack of financial resources for developing a state-of-the-art digital infrastructure) and rapid change in terms of growing organizational structures and increasing complexity often led to a structure-technology misfit in later stages due to non-integrated processes. In contrast, abundance (sufficient (venture) capital) often supported the development of a scalable and flexible digital infrastructure.* <u>Moderate/Fundamental Resolution</u> *While some companies incrementally adapted the digital infrastructure, others, such as company IX, radically replaced existing software solutions toward a higher degree of integration that supported data-driven*	*1) "The integration into the group gave us the chance to start over again, and we have completely turned the systems upside down. We now rely on a central ERP system in the cloud and connect shops, service providers, and logistics there. Interfaces and individual customization options are becoming increasingly important for us."* (COO, company IX) *2) "We have a mix of diverse software solutions that are not harmonized. Over the years, we chose what suited us best."* (CTO, company V)

		decision-making.	
	Standardization vs. Differentiation <u>Related literature</u> *Discussed as a paradox in different fields (e.g., platforms (Gregory et al., 2015), standard vs. variety (Wareham et al., 2014), or standard vs. flexibility (Hanseth et al., 1996))*	<u>Description</u> *Tensions due to* ***a)*** *standardized and integrated software solutions in contrast to* ***b)*** *non-integrated (department-specific) software solutions that address individual needs.* <u>Rendering Factor and Manifestation</u> *Plurality of goals (e.g., on individual or departmental level) potentially led to the implementation of shadow IT. While this may hamper integration efforts and, thus, impede data-driven decision-making, it may also support performance due to software solutions tailored to the department's needs.* <u>Moderate/Fundamental Resolution</u> *Companies standardized processes when growing, which included relying increasingly on integrated software solutions (e.g., supporting data-driven decision-making). The implementation of non-integrated and department-specific software solutions in the beginning was often accompanied by rationalization efforts in later stages.*	*"We have a variety of tools that are used by different departments or teams, and are used more by some and less by others. Fortunately, we also have a few people who are very skilled in this area. We do have one or two people who are deeply involved in tooling, but ultimately it is more decentralized and controlled by the teams."* (Co-founder, company VIII) *"Our engineering team has a whole suite of tools that it uses and our product team has a suite of tools that it uses. So, it is almost like there is a core that runs through everything, which represents our shared ways of working across the business. Then, other areas of the business have their own subset of tools that only they use."* (CEO, company XIII)
Organizing	**Autonomy vs. Control** <u>Related literature</u> *Discussed as a dilemma (Bahrami, 1992) and in the literature on the paradoxical role of leadership (e.g., Denison et al., 1995; Putnam et al., 2016).*	<u>Description</u> *Tensions due to conflicting demands of enabling* ***a)*** *teams' autonomy while* ***b)*** *aligning these with company-wide goals in light of (necessary) control efforts.* <u>Rendering Factor and Manifestation</u> *Change due to growth led to challenges in organizing and controlling teams while leaving space for creativity and innovation.* <u>Moderate Resolution</u> *While companies often promoted autonomy in early stages, these increasingly relied on control mechanisms in later stages (e.g., with regard to the OKR*	*"We are still working on creating space for creativity and freedom or autonomy for the individual teams. But they have to be committed to the overall strategy. They have power. They have their own voice to say that it can be done a little bit differently. We then give feedback on this. So, we want to keep that culture, the startup culture, even as we continue to grow."* (Co-founder, company XVI) *"We encourage autonomy and accountability within staff. So, you do not need leadership approval to do really anything. It is a balance that works well but I am sure there will be some problems with that in the future."* (CEO, Company XI)

		management framework).	
	Centralization vs. Decentralization <u>Related literature</u> *Not (yet) discussed as a dialectical tension but, for example, linked to information technology governance (Sambamurthy & Zmud, 1999) or decentralized versus centralized decision-making (Khalil & Winkler, 2023)*	<u>Description</u> *Tensions related to forms of **a)** centralized or **b)** decentralized decision-making (authority) in light of heterarchically or hierarchically structuring the maturing startup.* <u>Rendering Factor and Manifestation</u> *Rapid change due to a growing number of employees significantly slowed down decision-making.* <u>Moderate/Fundamental Resolution</u> *Establishing organizational layers and hierarchies while transitioning from a family of generalists to specialized roles during rapid growth.*	*1) "However, as the company grew rapidly, the ELT (executive leadership team) decided to introduce a middle management layer. Here, a paradoxical tension became evident; while it allowed the ELT to move faster by avoiding too many minute things to make decisions on, it significantly decreased the flexibility of response and reduced the speed of decision-making in the middle and lower levels."* (CEO, Company X) *2) "We used to be a non-hierarchical company and always propagated that. Now we are on the threshold of introducing the second management level and are trying to keep the balance so that it does not turn into such a 'hierarchical' and 'dictatorial' mentality. We also initiated a beehive once a quarter to promote innovation at all levels of the company from interns to me as CEO. During this internal hackathon, all employees are encouraged to gather ideas for new products, as well as operational and organizational optimizations across departments."* (CEO, company III)
People	**Disclosure vs. Intransparency** <u>Related Literature</u> *Not (yet) discussed as a dialectical tension but linked to communication studies and organizational research (e.g., on democratizing organizations (Groth, 1999) or transparency as a cultural value (Goncalves et al., 2020))*	<u>Description</u> *Tensions within the democratization of decision-making, which **a)** involves the communication of all information and **b)** withholding selected information at the same time.* <u>Rendering Factor and Manifestation</u> *Sharing all information including the financial situation of the startup negatively impacted the behavior of employees in light of scarcity and cultural change when maturing as a startup.* <u>Moderate Resolution</u> *Managers of company X began to withhold selected information in light of organizational growth.*	*"We wanted to move from what we call a family of generalists to a team of specialists. We needed to be more mature. And so, we created a management team while quickly growing from 33 to 58. But we lost a lot of culture on the way. So, we certainly started out very much as a democracy this year. However, we have become a lot less of that but we still keep the same communication forward. We share practically everything that is going on apart from how much cash is in the bank. So, we used to do that as well but it scared people and they changed the way they work. So, they made decisions based on how much cash is at the bank. Then I said that is none of your concern. It is my job to make sure we have got enough cash. So, you know, never let them know the money you have got in the bank."* (CEO, company X)
	Old Identity vs. New Identity <u>Related Literature</u> *Discussed, for example, as a tension during mobile ecosystem evolution (Lindgren et al., 2015) or in light of*	<u>Description</u> *Tensions related to **a)** the old or **b)** new (cultural) identity.* <u>Rendering Factor and Manifestation</u> *Cultural change and a plurality of views and goals when hiring new employees led to a loss of organizational*	*"We made poor hires in key positions without them being consistent with our identity. These leaders brought their own culture with them and hired people who matched their cultural values. There was a big bang and we had to replace many people. This significantly hampered our growth and speed. To be honest, that has cost us a year, I would say. Sales and marketing, which were separated, are a*

	uniformity and diversity (Bahrami, 1992). See also: Corley & Gioia, 2004; Jacobs et al., 2021; Mini & Widjaja, 2019; Smith & Lewis, 2011; Zuzul & Tripsas, 2020	*agility in light of cultural clashes and identity breaches/ ambiguity.* <u>Fundamental Resolution</u> *The founders of company XVII fired managers and employees that did not match existing values and beliefs.*	*prime example. So, the CEO, my co-founder, did sales and I did marketing because I have the better marketing background and we saw that this totally clashes, although we were actually super well aligned. However, the hired sales leader was not a good fit and the marketing leader was also not such a good fit. And then, of course, they hired people who represented their culture. And I took a bit of a shot at the sales leader relatively early on, but my two co-founders did not see it that way. At the end of the day, we kicked them out. We became much slower. We did not get anything done anymore."* (COO, company XVII)
Strategizing: :**T**echnology	**Leasing vs. Buying** <u>Related literature</u> *Not (yet) discussed as a (dialectical) tension but linked to strategic and digital entrepreneurship literature (e.g., digital infrastructure and technologies that enable flexibility and scalability are, for example, discussed by Giustiziero et al., 2021; Zaheer et al., 2019).*	<u>Description</u> *Tensions related to **a)** buying (purchasing) or **b)** leasing software solutions (or hardware) in the process of scaling.* <u>Rendering Factor</u> *Scarcity (in light of potential savings) led to decision-making on purchasing or leasing software solutions to support flexibility when growing.* <u>Moderate Resolution</u> *While some companies preferred to purchase software solutions, company X, for example, was solely built on SaaS solutions from the beginning to remain flexible while growing (rapidly). In some cases, this led to a mixture of purchased vs. leased software solutions, which usually impaired integration efforts.*	*1) "We have always had this virtual mindset. Being a SaaS company, we always choose SaaS products for ourselves as well. In the last couple of years, we have looked at how we can grow in a more cost-effective way. In terms of technology, you should rely on software and hardware you can pay for on a monthly basis. That is the beauty of SaaS and cloud, right? All of our laptops were bought on a lease agreement, too. Thus, machine learning and AI support our rapid growth without having to increase the number of employees so quickly."* (CEO, company X) *2) "We have a classic stack of SaaS tools that we use as a business, everything from collaboration tools to documentation, reporting, accounting, and so on."* (CEO, company XIII)
	Opportunistic vs. Strategic <u>Related Literature</u> *Discussed as a tension (long-term value creation vs. short-term value appropriation) by Woodard et al. (2013) and linked to the concept of long-term vs. short-term performance from strategic management/entrepreneurship.*	<u>Description</u> *Tensions related to developing the digital infrastructure **a)** opportunistically to address short-term needs or **b)** strategically to better accommodate growth-related change.* <u>Rendering Factor and Manifestation</u> *Rapid change potentially leads to structure-technology misfits (i.e., open-source solutions that suit the startup's business needs in the beginning may inhibit*	*1) "I do not think we were necessarily wrong to use free tools when we founded the company. At some point, however, we reached a point where it was no longer optimal for us. There were no interfaces, projects were created twice by different departments, we became more and more people, and the requirements for digitally integrated processes grew. Scalability and integration were therefore crucial for choosing the new system."* (CEO, company I) *2) "We are currently in the process of bringing some processes, such as accounting, back in-house. In this process, we also implemented a new system from Oracle. And that is actually*

		their agility in later stages due to redundant or non-integrated software and processes). Fundamental Resolution *While company III addressed this issue early, company I faced significant financial losses when growing to over 100 employees due to amplifying structure-technology misfits. Both companies invested in a highly integrated software solution that allows scalability and flexibility when the organization matured.*	*the first system where we said: it is perhaps a bit too advanced, both in terms of functionality and in terms of the cost factor. On the other hand, it allows us to scale better. It might accompany us forever. So even constellations with parent companies, subsidiaries and stock corporations, different offices, branches in other countries et cetera, we would be safe with it. This was the first system where we said: okay, we are going to do this once, we are going to invest money, time and resources, and then we will be safe for a long time."* (CEO, company III)
Strategizing: :**O**rganizing	**Rules-Based vs. Case-by-Case** Related literature *Not (yet) discussed as a dialectical tension but linked to paradoxical tensions of organizational improvisation* (Cunha et al., 2024) *and literature on growth-related challenges and growth models (e.g., in terms of retaining the advantage of small size, such as flexibility of response and the entrepreneurial spirit (Churchill & Lewis, 1983)).*	Description *Tensions due to **a)** introducing formal rules to manage complexity while **b)** allowing enough space for individualization through case-by-case decisions.* Rendering Factor and Manifestation *(Rapid) Change in terms of organizational growth required introducing formal rules and new communication forms to avoid inertia.* Moderate Resolution *Company XVI and XVII incrementally introduced new rules and standardized communication processes.*	*1) "The biggest challenge in the transition from a startup to a mature company is to move from experimentation to processing. Establishing clear processes and procedures in terms of standardization is crucial for growth."* (Co-founder, company XVI) *2) "That was also a bit of this 'hyperscaling.' It just felt so crappy. There were way too many people in the meetings. Everybody wanted to babble somehow, but no one took ownership of any topic. The ones who took ownership threw up on us because they said, some, sorry for the expression, jerks, want to have a say here all the time and be in some meetings, but block me all the time. So, up to a hundred is somehow the limit where, I think, the culture is still quite good. Up to 30 is totally easy; it is somehow like a family, honestly. And we also have some employees who have been with us for a long time, and now they also come to the office on weekends and drink here and there, but that is only done by the first ones who are there. Some of the others join every now and then, as it is not a closed circle. Everyone is allowed to join, but most of them do not do it. Some even do not come into the office anymore. So, I would say 30 to 50 is kind of easy. Information flows. Everything fits and you do not have to pay much attention to communication or anything. When you get up to 50, it is more difficult. Then you have to hold regular meetings like town halls or whatever. You go into team meetings and say a bit about strategy and so on, you have to pick up the people thematically more. Not everybody understands what the organization is doing and where we want to go. At a hundred, it just gets more complicated*

			and we have town halls every two weeks." (COO, company XVII)
	Rigid vs. Agile Planning Related literature *Not (yet) as a dialectical tension but linked to conflicting short- and long-term needs addressed in strategic entrepreneurship (e.g., Zahra & Nambisan, 2012) and strategic management (e.g., Mintzberg, 1979, 1994; Whittington, 1996).*	Description *Tensions related to **a)** adhering to (long-term) strategies and **b)** adapting these in light of dynamically responding to internal and external change as a startup.* Rendering Factor and Manifestation *(Rapid) change led to the need of frequently adapting strategic directions under entrepreneurial uncertainty.* Moderate Resolution *Company XIII balanced the need to strategically outline the startup's aspirations while continuously changing the scope.*	"*Before I joined startups, I was a management consultant and used to make a living out of selling people very long-term strategies for things. But even I knew at the time, as soon as you finish your strategy, as soon as the ink is dry, it is already out of date. So, we do not tend to put huge plans in place that say in three years, this is what things are going to look like. We might whiteboard out the next 24 months how we think the engineering team is going to look like. But we do not have public strategies around that kind of stuff because then you need to keep updating strategies the whole time, because things from the outside always have an impact on the business. So, we have a strategic direction that we are heading to from a product and growth perspective. We know where the team is roughly going to be and we plan ahead what we are going to do when growing to a 150-person business. But it tends to be more of an organic process rather than sitting down and updating documents all the time. Maybe we will in the future. Maybe that is what we need to start thinking about. But we are sort of agile as a business and writing strategy and documenting something always feels like it is going to be a bit of a waste of time.*" (CEO, company XIII)
Strategizing: :**P**eople	**Local vs. Global** Related literature *Not (yet) discussed as a dialectical tension but linked to the born global phenomenon of startups (e.g., Andersson, 2011; Rialp et al., 2005).*	Description *Tensions due to local restrictions in terms of human resources in the continuum of **a)** local sourcing **b)** global sourcing.* Rendering Factor and Manifestation *Scarcity of local talents in light of abundance (increasing customer projects) led to global sourcing.* Moderate/Fundamental Resolution *Both startups began attracting talents from abroad due to local scarcity. However, while company III gave up their local presence in this process, company VIII hired talents from all over Europe under the condition that they move to their offices.*	*1) "We had quite a few problems keeping up with the growth in terms of personnel. Originally, we had a two-location strategy and we tried to recruit at both locations. Both were not really the hub of the world and, especially when it came to technical positions such as software developers, we only had one or two applications per advertised position. However, staff growth was important in order to meet customers' requirements. At the same time, we are bootstrapped and do not have 10 million euros in the bank that we could spontaneously spend solely on personnel. On the one hand, we are doing well financially, but on the other hand, we were struggling with too few staff. As a result, we have effectively given up our offices, with the exception of a storage room and a postal address, and operate not only hybrid, but almost 100% remotely. We now have access to a pool of staff from all over Europe. In fact, we no longer have a local connection to either region."* (CEO, company III) *2) "If we only had to rely on the German or Dutch market, then growth would not be possible. So, we actually bring people*

			from abroad to Hamburg or Amsterdam, as it would not work otherwise." (Co-founder, company VIII)
	Myopic vs. Sustainable <u>Related Literature</u> *Not (yet) discussed as a dialectical tension but, for example, linked to the concept of volatility in the high-growth literature (e.g., Birch & Medoff, 1994).*	<u>Description</u> *Tensions in the continuum between* ***a)*** *rapid (myopic) and* ***b)*** *efficient (sustainable) growth.* <u>Rendering Factor and Manifestation</u> *The abundance of financial resources allowed to significantly increase the number of employees, but also entailed the risk of losing efficiency in this process.* <u>Moderate/Fundamental Resolution</u> *While some startups managed to grow rapidly and efficiently in light of venture capital, others opted for slowly increasing the number of employees (e.g., in terms of expected cultural challenges) or outsourced processes, such as software developing or customer support to third parties, in this process.*	*1) "Being able to raise more funding, we could afford to go and hire 50, 20, or 30 more staff now. But we have always been an efficient business and you do not want to hire too quickly."* (CEO, company XIII) *2) "For us, success means growing as quickly as possible with as few employees as possible. Growth in sales should therefore not be in linear to the number of employees. In recent years, we have been looking at how we can grow in a more cost-efficient way. As a result, we now have a development team in Sri Lanka, managed by a third party, and have outsourced our Tier 1 support to the Philippines."* (CEO, company X)
Technology: :**O**rganizing	**Trust vs. Control** <u>Related literature</u> *Discussed as a paradox in several contexts (e.g., digital infrastructure (Tilson et al., 2010), IT project control vs. IT project autonomy (Gregory et al., 2015), or as a tension in technology ecosystem governance (Wareham et al., 2014))*	<u>Description</u> *Tensions due to* ***a)*** *trusting and, thus, supporting the autonomy of employees and teams while* ***b)*** *implementing control mechanisms in light of digital leadership.* <u>Rendering Factor and Manifestation</u> *(Rapid) Changes in organization forms, leading to new challenges in digitally leading employees.* <u>Moderate Resolution</u> *Startups began to implement frameworks such as OKR to manage new demands on leadership and measuring productivity in the digital realm.*	*1) "We live in a time one might call a war of talents. As we are based in several cities, abroad but also in France, we have early established a remote culture which is really important for collaborating. I think that managing people in a remote way is obligatory in the new time post COVID-19. You do not have choice. You just do not have the luxury. You need to adapt to it."* (CEO, company VI) *2) "With a high degree of remote work, you need to be able to measure whether employees are actually doing what they are supposed to be doing, or not. So, you need to make sure you have the appropriate reporting tools or processes in place. Like Google, we use OKR as our management framework."* (CEO, company X) *3) "Leadership, both online and offline, is a constant challenge for us. We are currently in the process of introducing a middle management, including more team leads and 'head-ofs.' The challenge is to find the right communication tools, to shape the exchange with middle management, and to ensure the right flow of information without getting lost in*

			thousands of meetings. The introduction of OKR, however, was a gamechanger." (Co-founder, company VIII)
	Operating vs. Innovating Related Literature *Discussed as a paradox in ambidexterity research (exploration vs. exploitation); in the information systems discipline and in a technology context also addressed by the concept of bimodality (e.g., Haffke et al., 2017)*	Description *Tensions related to **a)** enabling stability to technologically support business needs while **b)** supporting digital innovations.* Rendering Factor *Growth-related change led to the need of adapting the IT function in terms of stability and experimentation.* Moderate/Fundamental Resolution *Startups, such as VIII, split the IT function with regard to maintaining the digital infrastructure on the one hand, and supporting digital innovations organized in product teams on the other.*	*"The organization of the IT and technology landscape is an interplay between our CTO and our head of product. The CTO is primarily responsible for the basic infrastructure, while the head of product designs the digital products, deals with the features, processes customer requirements, and so on. Our IT is now completely divided into product teams. Each topic has its own dev team, including QA and PM, so that the various topics do not cannibalize each other. And one team is actually also the infrastructure team, which is quite small. There are now two or three people, but they only deal with infrastructure issues et cetera."* (Co-founder, company VIII)
Technology: :People	**Automated vs. Manual** Related Literature *Not (yet) discussed as a dialectical tension but linked to literature on (digital) technology-driven changes in business processes and the automation of tasks (e.g., Legner et al., 2017; Wessel et al., 2021).*	Description *Tensions related to **a)** process automation and **b)** manually resolving tasks.* Rendering Factor and Manifestation *Scarcity of financial or human resources often led to the automation of tasks and processes when the startup matured.* Moderate Resolution *While the digitization and automation of processes were a crucial element in the growth process of many startups, it was in selected cases cheaper to complete tasks manually instead of putting effort in process automation in light of development costs.*	1) "*In our business, automation, and therefore the digitization of processes, plays a major role. However, in some cases, such as the automatic recognition of the still relatively small number of trips through toll booths, it is cheaper to hire people either on contract or part-time to do this work instead of digitizing this process or to build software for that*." (Co-founder, company XIV) *2) "It is a really good tool because you can automate a lot of things with it. For example, what we used to do manually for each applicant, we can now do automatically for 500 people at the same time. It is crazy."* (CEO, company VI)
	Cooperating vs. Competing Related Literature *Discussed as a paradox (e.g., Smith & Lewis, 2011; Woodard et al., 2013).*	Description *Tensions due to either **a)** cooperating or **b)** competing in light of differing opinions and goals in the context of (IT) product development, both internally at different organizational levels and externally between the company and customer.* Rendering Factor and Manifestation	*"We followed a Kanban approach in development. Initially without tool support but with sticky notes, then with a digital pad. This supported a number of processes on the software engineering side that functioned like code reviews. From my point of view, this ensured a high level of quality. At the same time, however, this has repeatedly led to discussions among management, as time was invested in things that were not always immediately visible to the customer and, let us say, to people who*

		Scarcity of human resources and a plurality of competing goals led to discussions related to product development (costs vs. quality). Moderate Resolution *Managers of company IV weighed up costs with quality in product development.*	*are not close to IT."* (Co-founder, company IV)
Organizing:: **P**eople	**Adherence vs. Adaptation** Related literature *The dialectical relationship of flexibility and rigidity is discussed, for example, by Buzzanell & Liu (2007) in the context of flexible and fixed work arrangements; see also: Putnam et al. (2016). Moreover, it can be linked to (practitioner) literature on organizational agility (e.g., in the context of scaling agile: Gerster et al., 2018; Kniberg & Ivarsson, 2012) or the paradox of stability and change in ambidexterity (e.g., Farjoun, 2010; Montealegre et al., 2019)*	Description *Tensions due to either* ***a)*** *strictly adhering (agile) methodologies and frameworks or* ***b)*** *tailoring these to the individual needs and capacities of the startup.* Rendering Factor and Manifestation *Change in light of organizational growth led to a decrease of organizational agility and the need for structural adaption.* Moderate Resolution *Companies, such as XIII, adapted agile methodologies to better suit individual needs, which integrated flexibility into existing frameworks.*	*"The entire company works in the same sprint cycle. We do not work with an overblown methodology; we are not doing agile with a big A where everyone comes in and wants to do burndown charts and velocity that basically kills the innovation that comes from working quickly. We empower our teams to work on a weekly sprint cycle with regular morning standups, but we are not forcing them to release only on Fridays at the end of the sprint. This agility permeates the entire company, starting with empowering employees to make small changes, iterate on them, and measure the outcome of those. This is what makes us agile in our decision-making."* (CEO, company XIII)
	Functional vs. Cross-Functional Related literature *Not (yet) discussed as a dialectical tension but linked to research on cross-functional teams in light of heterarchical structures (e.g., Aime et al., 2014; Shane, 1994).*	Description *Tensions related to organizing teams in the continuum between* ***a)*** *functional or* ***b)*** *cross-functional roles during (rapid) growth.* Rendering Factor and Manifestation *(Rapid) change led to challenges in the organization of teams, while scarcity (financial and human resources) often required cross-functional roles.* Moderate Resolution *While some startups began to develop cross-functional roles, others developed rather hierarchical structures*	*1) "We have sales, account management, and marketing—these are all functional teams. But we try to organize everything else into product teams wherever possible. Each product team has its own captain, so a bit like a mini-CEO per product. And this is already bearing fruit and shows that this speed and agility are being maintained despite the larger company as a whole."* (Co-founder, company VIII) *2) "I tried having a leadership team comprised of the heads of the faculties and that did not really work. The reason for that was you are still thinking functionally and I really wanted the company to be cross-functional right at the core. That means all our chiefs had to be cross-functional in their role scope. The actual work happens in the squads and the squads are always cross-functional. So, squads do not have a*

		to address changing demands of roles.	*nominated lead, but they do have specific roles. In a product delivery squad you will have a product manager, but that is nobody's boss. The faculty heads work across the company in squads as well, but they also facilitate the faculty meetings and conversations and decision-making process."* (CEO, company XII)

– EIGHT PUBLICATION –

Linking Digital Entrepreneurship and Digital Infrastructure Research: Four Archetypes of the Early Digital Infrastructure Evolution

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Under Review

ABSTRACT

To better understand the growth of digital startups, we empirically investigated factors influencing their trajectories in early development phases. Besides well-known factors from the entrepreneurial growth literature, we discovered that the evolution of digital infrastructure has a significant impact on the growth of digital startups in early phases. By unpacking the role of digital infrastructure in these startups' genesis, we underline the need of further integrating digital entrepreneurship and digital infrastructure research. Based on semi-structured interviews with founders and executive managers of 31 digital startups from nine countries and a data analysis employing the grounded theory method, we discovered four distinct archetypes of digital infrastructure evolution in digital startups' early stages of growth. Each of these is based on three distinct pre-conditions and four dominant characteristics. By paying special attention to the mechanism of scaling, this study advances theorizing on digital startups' different approaches to developing

DI and related challenges in the course of rapid growth. In addition, our findings support founders and executive managers in anticipating digital infrastructure requirements in the growth process and—from a macroeconomic perspective—the support of digital startups through targeted policy measures.

1 INTRODUCTION

In the current shift from entrepreneurship to digital entrepreneurship, digital technologies—such as artificial intelligence and cloud computing—carry the potential to significantly shape entrepreneurial pursuits (Nambisan, 2017; Steininger et al., 2022; von Briel et al., 2021). For instance, digital technologies enable new forms of coordination and collaboration (Bailey et al., 2022; Lin & Maruping, 2022; Sahut et al., 2021), support entrepreneurs in seizing business opportunities and external partnerships for the joint development of innovative products and services (Chan et al., 2020; Nambisan et al., 2018; Pergelova et al., 2019), and form the technical foundation for scaling digital startups (Coviello et al., 2024; Griva et al., 2023; Huang et al., 2017). This technology perspective sheds light on new startup processes and outcomes realized by leveraging digital artifacts, platforms, and infrastructures that may differ from traditional startups (Zaheer et al., 2019). Moreover, it highlights that applying existing entrepreneurship theories might not be sufficient for digital startups (Steininger et al., 2022; Zaheer et al., 2019). While seeking to understand the mechanisms that cause the evolution of digital infrastructure (DI) is of increasing research interest (Fürstenau et al., 2019; Henfridsson & Bygstad, 2013, 2024; Yeow et al., 2025), investigating the development of DI in the growth process of digital startups has been widely neglected. This is particularly critical as the planning and development of DI—due to its socio-technical nature (Koutsikouri et al., 2018; Yeow et al., 2025)—occupies a prominent position in the process of scaling (Huang et al., 2017; Nambisan et al., 2018).

From a theoretical perspective, scholars have already provided valuable insights into the DI evolution in general. For instance, Henfridsson and Bygstad (2013, p. 925) propose "three generative mechanisms (adoption, innovation, and scaling) that serve as causal powers in digital infrastructure evolution" in light of the increasing interconnectedness of information systems and the diffusion of digital technologies in contemporary organizations. Although this serves as a starting point for theorizing on this phenomenon, the specific characteristics of new ventures—and digital startups in particular—tend to be overlooked. This research interest is reinforced by recent studies on the dynamics of entrepreneurial growth trajectories, which call for more empirical evidence on this topic (e.g., Ingley et al., 2017; Levie & Lichtenstein, 2010; Sternad & Mödritscher, 2022). Hence, categorizing different approaches to the development of DI in the early stages of digital startups' organizational growth contributes to a better understanding of underlying dynamics and the mutual influence of people and technology within social and technical systems in this process. Moreover, with a stronger focus on practical outcomes, DI affects multiple areas of entrepreneurial activity. For instance, DIs support digital product innovation (Constantinides et al., 2018; Lyytinen et al., 2016), foster borderless collaboration and communication (Nambisan, 2017; Yeow et al., 2025), and enable the emergence of new work structures such as non-hierarchical or agile organizations (Bailey et al., 2022; Nambisan et al., 2019). From this perspective, one of the most interesting research objectives relevant for practitioners deals with DI's inherent potential to inhibit or enhance the scalability of digital startups (Huang et al., 2017; Nambisan et al., 2018) while potentially accommodating their dynamic growth trajectories with flexibility (Yoo et al., 2010). Thus, by paying special attention to DI's potential to support scaling, investigating the DI evolution of digital startups carries multiple implications for theory and practice. We address this by the following research question:

How does the evolution of the DI influence digital startups' early growth phases?

To approach this phenomenon, we conducted an exploratory qualitative interview study with founders and executive managers of 31 digital startups from nine countries to better understand different mechanisms that drive the evolution of DI in early growth phases. As a result, we discovered four distinct archetypes of digital startups' DI evolution in early phases of growth, each viewed in light of three pre-conditions (social, human and financial capital) and four dominant characteristics (role of DI for realizing the business model, approach to developing DI, business-DI alignment, architectural integration).

Thus, with our study, we close ranks between DI and digital entrepreneurship research by investigating the role and evolution of digital startups' DI in the growth process. Here, we provide empirical evidence on the underlying mechanisms that drive the DI evolution, paying special attention to its relevance for scaling. Moreover, it supports founders and executive managers in anticipating socio-technical challenges and requirements (e.g., aligning DI with business needs in a fast-paced and turbulent market environment) to prepare digital startups for next phases of growth.

2 THEORETICAL BACKGROUND

2.1 The Growth of Digital Startups

During their growth, digital startups face a plethora of challenges in the social and technical realm. These can be derived from classic entrepreneurship literature and organizational studies, as well as specifically related to the discipline of information systems. For instance, challenges in a) developing products and services, b) hiring a professional management, or c) implementing formal systems must be addressed in the course of further growth (Ingley et al., 2017; Kindström et al., 2024; Wimelius et al., 2023). At the same time, this also concerns the digital equivalents of the aforementioned challenges, such as a) designing digital innovations and market offerings, b) establishing digital collaboration and leadership, and c) the development of a DI tailored to digital startups' business needs (Eberl & Drews, 2022; Huang et al., 2017; Lehmann et al., 2022). High-growth digital startups and organizations—also known as digital gazelles—face particular challenges due to rapid internal and external change (Tschoppe et al., 2023; Watkowski et al., 2025). Hence, in light of the inherent duality of digital technologies as both enabler (e.g., in terms of fostering efficient collaboration and communication) and hindrance (e.g., through non-integrated processes or structure-technology misfits) of growth (see, e.g., the discourse on how digital technologies—or more generally IT—affect organizational agility (Lu & Ramamurthy, 2011; Trinh-Phuong et al., 2012)), the planning and development of DI occupies a central position in the trajectories of digital startups.

Building on this key challenge, there are other mechanisms to be noted that link entrepreneurship with information systems research. For instance, von Briel et al. (2018, p. 47) provide six enabling mechanisms that aim to explain "how and when digital technologies enable new venture creation processes." With a particular focus on hardware startups, this sheds light on the role of digital technologies (e.g., 3D printers, social media, platforms) in the venture creation process (referring to the stages of prospecting, developing, and exploiting). Moreover, Lehmann et al. (2022, p. 1454) propose "three designing mechanisms—bounding the technology scope, transposing through digital objects, and probing the solution space" in light of designing digital market offers. However, while these make valuable contributions to advance the field of digital entrepreneurship, these only touch on our aim of better understanding the evolution of digital startups' DI during (rapid) growth.

2.2 Defining the Evolution of Digital Infrastructure

From an evolutionary perspective, DI can be viewed as an artifact (Tilson et al., 2010). In this context, the notion of infrastructure builds on the increasing interconnectedness of information systems (Henfridsson & Bygstad, 2013, 2024). Rather than focusing on stand-alone information systems, DI refers to the "collection of interconnected foundational technologies and information systems that support the operations of digital products, services, and applications" (Henfridsson & Bygstad, 2024, p. 10). However, it is important to note that the understanding of DI and its evolution varies (see Table 1).

Table 1. Definitions of Digital Infrastructure

Reference	Definition of DI
Tilson et al. (2010, p. 748)	"The basic information technologies and organizational structures, along with the related services and facilities necessary for an enterprise or industry to function."
Yeow et al. (2025, p. 68); reference to Tilson et al. (2010)	"An evolving sociotechnical arrangement comprising an installed base of heterogeneous digital objects, systems, processes, and their users that enable the focal entity to function."
Fürstenau et al. (2019, p. 1319)	"A set of interconnected information systems."
Henfridsson & Bygstad (2013, p. 908); reference to Braa et al. (2007) and Tilson et al. (2010)	"The collection of technological and human components, networks, systems, and processes that contribute to the functioning of an information system."

Building on this, the evolution of DI can be understood as a "gradual process by which a digitally enabled infrastructure changes into a more complex form" (Henfridsson & Bygstad, 2013, p. 908). As organizations are inherently interconnected with technologies (Bostrom & Heinen, 1977; Emery & Trist, 1960; Tilson et al., 2010), this process comprises elements from the social and technical system (Henfridsson & Bygstad, 2013; Tilson et al., 2010; Vaast & Walsham, 2009). Hence, adopting a socio-technical systems lens supports a better understanding of the evolution of DI and the intertwinement of social and technical elements in the (rapid) growth process of digital startups.

2.3 Unfolding Underlying Mechanisms of the Digital Infrastructure Evolution

Against this backdrop, DIs underly a self-reinforcing socio-technical mechanism, whereas its evolutionary process is reflected by the key mechanisms of scaling (i.e., expanding its reach), adoption (i.e., higher usage), and innovation (i.e., creation of new products and services) (Henfridsson & Bygstad, 2013). Paying special attention to the mechanism of scaling, DIs "shape new ventures' reach and scope of innovation and operations, thereby radically transforming the nature and process of venture scaling" (Nambisan et al., 2018, p. 363). In this context, cloud services may support scalability with minimal management effort (Khalil & Winkler, 2023). Moreover, modular architectures—that are "characterized by its standardized interfaces between components" (Yoo et al., 2010, p. 727)—build on customized or reusable modules, potentially enabling strategic agility (Ross, 2003). In light of this, Fürstenau et al. (2019) identified three processes (parallel, competitive, and spanning) by which individual systems become embedded into a siloed, regenerated, or unified DI, bearing implications for different patterns of digital startups' DI evolution.

Considering the existing body of knowledge on the mechanisms that cause DI evolution, previous studies have reported on multiple tensions in the socio-technical realm (e.g., dealing with the paradoxical nature of DI (Tilson et al., 2010), ambidexterity in the evolution of DI (Montealegre et al., 2019), or, more generally, how technology affects organizational transformation, as it is paradoxically both "an engine and barrier for change" (Star & Ruhleder, 1996, p. 111)). In the context of digital startups, these tensions supported a better understanding of DI's role and the technological challenges faced by founders and executive managers (e.g., the CIO or CTO) in the growth process accompanied by increasing organizational complexity (e.g., due to the interconnectedness of systems). Here, opposing logics of stability and flexibility (paradox of change) and central and distributed control (paradox of control) (Tilson et al., 2010) shed light on different needs in the DI evolution of digital startups. Moreover, as a contradictory tension, introducing DI can be perceived "as a means to save resources, but also as a distraction that could drain resources" (Montealegre et al., 2019, p. 660), reflecting the pertinence of a business-aligned DI considering the socio-technical systems principle of joint optimization. Hence, taking into account the existing body of knowledge of both entrepreneurial challenges and underlying mechanisms, shedding light on the DI evolution in digital startups' early stages of growth contributes to contemporary theorizing in the nexus of DI and digital entrepreneurship research.

3 RESEARCH METHODOLOGY

3.1 Research Approach

To better understand the DI evolution of digital startups, we adopted a qualitative research design. This supported a) generating new insights of underlying processes of this phenomenon, b) investigating particular contexts (e.g., different pre-conditions such as founders' social capital or different national systems of innovation), and c) modifying the research design and focus due to the inherent openness and flexibility as this evolved over several iterations and new insights led to a greater focus on the characteristics of DI evolution (Maxwell, 2013). In this context, we were guided by the grounded theory methodology to enhance qualitative rigour and interpret first-hand, deep insights in the phenomenon studied (Strauss & Corbin, 1998). This features a "recursive, process-oriented, analytic procedure" (Locke, 1996, p. 240). Moreover, grounded theory entails theoretical sampling (i.e., "sampling on the basis of emerging concepts" (Strauss & Corbin, 1998, p. 73)), which was particularly helpful as—although all interviewees were polled with regard to the characteristics and evolution of DI—new concepts emerged over time (e.g., based on the maturity of DI or digital technology use).

While this study follows a predominantly inductive approach, the large body of knowledge from information systems and entrepreneurship streams was not neglected (e.g., providing valuable knowledge on the role of digital technologies and the dynamics in growth trajectories of digital startups). This refers to the misconception of grounded theory in entering a field without prior knowledge on the topic (Suddaby, 2006). It draws attention to the blurry boundaries of inductive and abductive research and was particularly relevant for our work in better understanding the role of DI in entrepreneurial growth trajectories. Against this backdrop, we build on the concept of archetypes (i.e., "foundational and distinguishable types or classes underlying the phenomenon or objects of interest" (Baier et al., 2023, p. 338)). These have a long history in related disciplines (e.g., in management science illustrated by the work of Miller & Friesen (1978), who provide ten archetypes on strategy formulation). Moreover, they also served as a structure for contributions to the disciplines of digital entrepreneurship and information systems. For instance, Weber et al. (2022) provide four archetypical business model patterns of artificial intelligence startups, while Baier et al. (2023) reflect on purpose-related digital technology archetypes and Haffke et al. (2017) identified four bimodal information technology archetypes. The conceptualization through archetypes was particularly useful in approaching this phenomenon, as it guided us in investigating different patterns in DI development, understanding the underlying mechanisms, and highlighting archetype-related challenges (e.g., in terms of early and late integration efforts that support data-driven decision-making and efficient communication and collaboration).

3.2 Data Selection

Understanding the nature of non-digital startups and, in contrast, digital startups, had a decisive impact on the selection of interviews for this study. For instance, Huang et al. (2017, p. 301) consider digital startups as "startups growing by drawing on and adding to digital infrastructures." Building on this, we followed the definition of Lin & Maruping (2022, p. 212) which define digital startups as "startups that that have digital artifacts at the core of their business model for value creation and capture." Note, that this deliberately allows digital startups also to develop or distribute traditional goods if they rely on digital artifacts. Thus, we selected startups that reflect a high degree of digitality in terms of their internal and external processes and/or their products/services. For example, with regard to the technical system, cloud computing supported the business activities of the digital startups to a large degree, although these varied in their classification as process-digital, product- or service-digital, or both.

In addition, most of these digital startups can be classified as a gazelle—or digital gazelle—due to their rapid growth (Birch & Medoff, 1994; Tschoppe et al., 2023). Focusing on these supported a better understanding of the increasing organizational complexity in the evolutionary (rapid) growth process. While recently founded ventures bore interesting insights in terms of their pre-conditions and early phases of DI development, we also included few digital startups older than 10 years for deriving DI evolution patterns based on a longer period of organizational growth. In light of this, there is an inconsistency among studies to be noted that deal with startups' definition and underlying criteria (Luger & Koo, 2005). While Davila et al. (2003, p. 690) simply use the notion of "recently formed companies" for startups, a rigorous data selection and collection for this study required the inclusion of more detailed criteria. To classify startups, Luger & Koo (2005) propose three criteria in their comparative study: new, active, and independent. According to these, a startup can be defined as "a business entity which did not exist before during a given time period (new), which starts hiring at least one paid employee during the given time period (active), and which is neither a subsidiary nor a branch of an existing firm (independent)" (Luger & Koo, 2005, p. 19). While being active in terms of hiring at least one paid employee would neglect the increasing complexity of the organization and DI that need to be taken into account during phases of (rapid) growth, the definition clearly excludes subsidiaries or branches of existing firms. This was relevant for our study, as, for example, one of the interviewees held two roles: On the one hand, he was a serial founder and, before recently exiting, grew one of his startups within three years to 43 employees. On the other hand, he was later employed as head of global sales in an Indian multinational technology company founded in 2016. As a subsidiary of an Indian multinational conglomerate, it grew to more than 14.000 employees in the beginning of 2025, leaving room for theorizing on the boundaries of underlying startup criteria (e.g., in terms of being independent, size, or age). In addition, Kollmann et al. (2016) define startups in the European Startup Monitor by applying three criteria. Here, the age (< 10 years), a penchant for innovation (in terms of technologies and/or business models), and the striving for considerable growth (in terms of employees and/or sales) contrasts "startups from conventional businesses and small to medium-sized enterprises (SMEs) that do not promote innovative products/services or business models that exist primarily to secure the livelihood of the founders without any substantial growth perspective (e.g., a hairdressing business)" (Kollmann et al., 2016, p. 15). This is relevant for our study, as it sets a boundary on age, manifests the intention to grow beyond a small number of employees, and emphasizes the role of digital technologies for both promoting products/services and internal/external processes. However, against the background of the inconsistency of definitions in the literature, crossing the age boundary in carefully selected cases yielded important implications for the DI evolution of digital startups (e.g., due to a varying growth rate and size).

3.3 Data Collection

After combing through numerous startup databases, websites, and platforms (e.g., using the LinkedIn Sales Navigator) in search of fast-growing and digital startups (digital gazelles) that range in size from 10 to 100 employees, this resulted in over 400 personal interview requests via LinkedIn and email. Supplemented by two research stays in New Zealand and India in which additional interviews were conducted, as well as the acquisition of several contacts from our private and professional network, the final sample (Table 2) consists of 31 semi-structured in-depth interviews with the digital startups' (co-)founders, chief executive officers (CEOs), or long-time employees from the C-suite (e.g., the chief operating officer (COO), the chief financial officer (CFO), or the chief technology officer (CTO)).

TABLE 2. Sample of Startups

#	F*1	E*2	Country	Interviewee	I*3	Industry
I	2009	150	GER (-)	CEO	63	Marketing
II	2015	42	USA (ZAF)	COO	62	Renewable energies
III	2015	37	GER (-)	CEO	73	eCommerce
IV	2014	59	GER (-)	Co-founder	41	Advertising
V	2015	16	GER (-)	CTO	60	Tech
VI	2018	40	FRA (MGA)	CEO	55	Education
VII	2015	85/35*4	GER (-)	CFO	70	Electronics
VIII	2015	98	GER (NLD)	Co-founder	61	Fashion
IX	2013	33/18*4	GER (-)	COO	55	Medicine
X	2014	58/55*4	NZL (CAN, USA*5)	CEO	54	Marketing
XI	2018	22	NZL (AUS, ITA)	CEO	53	Software
XII	2007	87	NZL (USA, IRL)	CEO	54	Market research
XIII	2017	65	NZL (AUS)	CEO	53	Accounting
XIV	2014	52	NZL (-)	Co-founder	62	Automotive
XV	2008	25/22*4	NZL (-)	CEO	55	Payroll
XVI	2019	40	EST (-)	Co-founder	60	Last mile delivery
XVII	2015	198/160*4	GER (USA, GBR)	COO	51	Marketing
XVIII	2021	30	GER (-)	Co-founder	52	Automotive
XIX	2019	13	FIN (-)	CEO	62	Automotive
XX	2023	6	NIG (-)	CEO	51	Electrical engineering
XXI	2011	30	EST (-)	Co-founder	78	Education
XXII	2016	30/1*4	EST (-)	CEO	59	Robotics
XXIII	2015	201	FIN (USA +7)	CMO	61	Process automation
XXIV	2018	35/7*4	POL (USA*5)	CEO	49	IT recruiting
XXV	2012	25	DNK (USA)	Co-founder	68	Social
XXVI	2021	23	IND	CTO	56	Lifestyle
XXVII	2012	950	IND	CTO	67	Education
XXVIII	2022	60	IND (USA)	CEO	63	Fintech
XXIX	2019	43	IND	Co-founder	51	Education
XXX	2015	380	IND (USA, ARE)	CEO	54	Fintech
XXXI	2019	11	IND	CEO	57	Logistics

*1 = founding year; *2 = total number of employees; *3 = interview duration (in minutes); *4 = highest number of employees vs. date of the interview; *5 = eventually closed

This ensured a retrospective on digital startups' social (e.g., in terms of choosing a heterarchical over a hierarchical organizational structure) and technological development (e.g., tight versus loose coupling when developing the DI that aligns with business needs). The selected digital startups are based in nine different countries which allows us to better understand digital startups' socio-technical evolution in different national systems of innovation (Lundvall, 2007). This refers, for example, to investigate local restrictions such as the availability of human resources and venture capital, or the role of and access to digital technologies, and included purely virtual organizations that operated without physical offices and coordinated their tasks through digital means (e.g., through cloud computing).

3.4 Data Analysis

We used an iterative process of collecting, coding, and categorizing "empirical material as a resource for developing theoretical ideas" (Alvesson & Sandberg, 2011, p. 12) in our study. In doing so, we rigorously followed underlying principles of conducting inductive research and followed open, axial, and selective coding (Strauss & Corbin, 1998). The first step followed an open-ended coding of the data, facilitating an inductive discovery of emerging concepts. This enabled the transition from a mass of descriptive codes to fewer, conceptually abstracted codes (Strauss & Corbin, 1998). We closely followed the guideline that Strauss and Corbin (1998) specified for constant comparison techniques, where data collection is iteratively intertwined with its actual analysis. The coding process of the transcribed interviews was supported by the MAXQDA software. Secondary data (e.g., websites and press reports, financial and funding statements, social media posts, and curricula vitae of interviewees) were incorporated into the development of first-order concepts, particularly adding to the development of distinctive pre-conditions as the foundation of the evolutionary process of DI. Second, after discussing these codes, we used axial coding to identify preliminary patterns and generated second-order themes among the first-order concepts. This was based on the phenomenon of DI evolution (which, at that state, inhibited similar concept such as DI development or IT evolution). In this process, we also discussed variants and invariants of patterns (pre-conditions and dominant characteristics) and excluded other initial characteristics.

At the same time, this led to a deeper investigation of the three pre-conditions social capital (e.g., due to codes related to founders' embeddedness in professional networks), human capital (e.g., due to codes related to founders' previous startup experience), and financial capital (e.g., due to codes related to founders' acquisition of venture capital) within additional literature research. Based on this, we understand social capital as a product of embeddedness (Maurer & Ebers, 2006; Portes, 1995) which refers to founders' and executive managers' ability to "extract benefits from their social structures, networks and memberships" (Davidsson & Honig, 2003, p. 307). While robust business networks, communities, or the extended family in general play a crucial role in strategic advantage and entrepreneurial success (Davidsson & Honig, 2003; Elfring & Hulsink, 2003; Spiegel et al., 2016; Weiler et al., 2022; Zaheer et al., 2019), we noticed that these—to some extend—also have an impact on founders' decisions related to the selection of software solutions. In terms of human capital, we particularly refer to founders' and executive managers' previous business ownership or startup experience (e.g., industry-specific as a manager, investor, or serial-founder), and formal education (e.g., gaining knowledge through technology or business classes) (Baptista et al., 2014; Davidsson & Honig, 2003). While a high technical education without managerial capabilities does not significantly impact companies' performance (Ganotakis, 2012), we noticed, for example, that serial founders' and long-term executive managers' rich experience in organizational development was not necessarily but often accompanied with early professionalization efforts of the digital infrastructure (e.g., implementing a state-of-the-art DI which is tailored to the business needs and supports scaling, or an early hiring of enterprise architects). Moreover, venture capitalists and their investments can heavily affect growth and innovation (Breznitz et al., 2018; Dos Santos et al., 2011). For example, venture capital-backed startups have an increased likelihood of an initial public offering (IPO) (Hsu, 2006). In contrast, bootstrapping (i.e., self-financing) as a financing model is widely used by startups (Müller et al., 2019), which "refers to the use of methods for meeting the need for resources without relying on long-term external finance from debt holders and/or new owners"

(Winborg & Landström, 2001, p. 235). However, our sample includes several cases of bootstrapping in which the founders—while not being dependent on external capital—have a wealthy family background or were able to leverage financial means from a previous exit, affecting DI design options to a certain degree.

After multiple rounds of cross-checking our draft and in the process of selective coding, we generated a set of core categories (aggregate dimensions) as DI evolution pre-conditions and dominant characteristics, that reflect a continuum (e.g., between a digital-first versus progressive approach to developing DI). Here, we also reflected on outliers and other potential DI evolution archetypes, which are addressed in the discussion. To enhance validity and to create an in-depth picture of the DI evolution of digital startups, we used triangulation by discussing anonymized data and preliminary findings with other founders and fellow researchers from different disciplines (e.g., information systems, entrepreneurship, strategic management) in international colloquia and leading information systems conferences (e.g., at the international conference on information systems).

4 FINDINGS

The most salient finding of our analysis are the four archetypes of DI evolution—namely the orchid bee, the model pupil, the architect, and the late bloomer—that reflect digital startups' early stages of organizational growth. In the following, we first provide an overview of digital startups' pre-conditions and dominant characteristics that led to the development of the archetypes. Then, we elaborate on their reasoning and illustrate each archetype by a vignette representing one digital startup from our sample.

4.1 Patterns of Digital Startups' DI Evolution

We clustered the digital startups from the sample according to their pre-conditions (i.e., social capital, human capital, and financial capital) and dominant characteristics in the DI evolution (the role of DI for realizing the business model, the approach to developing DI, the business-DI alignment, and the architectural integration). Here, the dominant characteristics were distinctive for each of the archetypes, whereas the multifaceted nature of pre-conditions complements this logic and is captured through tendencies (low, medium, high). Taken together, these depict archetypes that aim to provide a better understanding and categorization of the different DI evolution paths of the 31 digital startups in our sample. However, the dominant characteristics are to be understood as a continuum with a prevailing tendency (i.e., while some of the startups tended more strongly toward one extreme, other startups' tendency was potentially weaker). In addition, the archetypes reflect digital startups' early stages of growth. This is noteworthy as, for example, the demand for a mature DI that is aligned with business needs increased as well in all archetypes in later growth phases (e.g., due to increasing complexity and significant employee growth).

4.1.1 Pre-Conditions

Founders' embeddedness in networks (e.g., in startup hubs or incubators), their professional experience in terms of developing organizations or DI (e.g., as a senior manager in an incumbent firm or as a serial-founder), or the availability and amount of startup or venture capital significantly influenced the way the DI of the digital startup evolved. This is crucial for understanding the evolution of DI in digital startups' early stages of growth and, thus, the classification as archetypes, as it bears implications in terms of capabilities for building a state-of-the-art DI which supports business needs such as flexibility and scalability. In the following, we discuss these pre-conditions from a social, human, and financial capital perspective.

Social capital. The embeddedness of founders in social networks was closely related to the financial and human capital and played a significant role in the growth of digital startups. From a technical perspective, the founders of company I, for example, benefited from the knowledge exchange with competitors in the process of selecting software solutions in light of redesigning their loosely coupled digital infrastructure. At the same time, university networks, business angels, and experiences from family businesses and acquaintances often provided valuable insights for developing a business-aligned technological foundation. The relevance of social capital was also evident in company XXVIII with regard to obtaining substantial funding that supported hiring experts and building a cutting-edge DI, or company XIII's access to mentors that supported strategically developing the business model and DI (see Table 3). In addition, social capital was crucial for the employee growth of company XVIII due to a pipeline of potentially available (tech-savvy) employees from the network, as the co-founder demonstrates:

"You cannot know everything and be prepared for everything. Accordingly, it is important to have a strong network of people with whom you can regularly coordinate and challenge yourself. We maintain good contact with almost all of the big Munich startups or scaleups, and have robust relationships with many established companies in the industry. For the next growth spurt, we have a pipeline of 150 people who all come from this network. When someone joins us, we ask who the ten best people they have ever worked with are, what they do, for example in terms of technical or sales expertise, and then we call them. In other words, we hire almost exclusively from the network."

Human capital. The human capital of the founders and executive managers is reflected, amongst others, by their previous experience in incumbent companies, startup hubs, or developing (their own) startups. For example, the co-founder's technological expertise in the field of software development and beyond, which he previously gained in several incumbent companies, did not only affect the planning and later development of DI, but was also a key factor in the product development of company XVI. At the same time, a lack of technological expertise might also lead to technical hurdles in the growth process, which the co-founder of company XXV experienced (see Table 3). Another human factor in the professional development of DI can be linked to the expertise of founders who previously coached technology startups in incubators, as illustrated by the co-founder of company XIV:

"For about three years, I worked for a startup accelerator that is basically responsible for fostering new businesses ideas in the region. In these programs, we bring founders together, develop ideas further, try to give them some formalization, for example frameworks like lean startup, design thinking, all these things. And we take them through processes to validate their concepts. They actually build a scalable business and then take funding, for example, from local angel groups. After

around 150 start-ups, you really learn a lot about what the successful companies have in common."

Financial capital. The availability of startup capital carries the potential to significantly impact how DI evolves. Although a direct correlation between a high availability of financial capital (e.g., early venture capital investments) and a high investment intensity in DI was not evident and holds potential for future research, it emerged from the interviews that this was decisive for the design options (e.g., in terms of financial constrains limiting DI investment options). Limited financial resources also affected the feasibility of hiring professional (IT) managers, as, for example, evident in company XXI. In addition, this relates to digital startups that used bootstrapping but at the same time had an entrepreneurial family background or high personal savings (e.g., from previous exits) that enabled punctuated (e.g., costly software solutions relevant for product development) and, if necessary, comparatively high DI investments as demonstrated by company XXVII (see Table 3).

Table 3. Pre-Conditions of Digital Startups

Dimension	Selected Quote(s)
Social capital	• *"You cannot know everything and be prepared for everything. Accordingly, it is important to have a strong network of people with whom you can regularly coordinate and challenge yourself. We maintain good contact with almost all of the big Munich startups or scaleups, and have robust relationships with many established companies in the industry. For the next growth spurt, we have a pipeline of 150 people who all come from this network. When someone joins us, we ask who the ten best people they have ever worked with are, what they do, for example in terms of technical or sales expertise, and then we call them. In other words, we hire almost exclusively from the network." (Co-founder, company XVIII)* • *"He had two children and we both held senior roles, so we could not get out so easily. One big advantage was that many senior people knew us. His friend from McKinsey invested a large sum and also the first 50 customers came from our network. In total, we received an early venture capital investment of five million [US$] and recently another five. This money made it easy to hire experienced employees right from the start. We may even have overinvested, but on the whole things are going really well." (CEO, company XXVIII)* • *"Next to the official advisory board consisting of investors and*

	shareholders, we had a kind of informal advisory board in which non-investors and confidants came together to advise us." (CEO, company XIII)
Human capital	• *"For about three years, I worked for a startup accelerator that is basically responsible for fostering new businesses ideas in the region. In these programs, we bring founders together, develop ideas further, try to give them some formalization, for example frameworks like lean startup, design thinking, all these things. And we take them through processes to validate their concepts. They actually build a scalable business and then take funding, for example, from local angel groups. After around 150 start-ups, you really learn a lot about what the successful companies have in common." (Co-founder, company XIV)* • *"Most of my co-founders worked previously quite a long time in corporate IT, in particular for a big software development company. And this company worked mostly with automotive producers all over the world. And then the core team decided to move to startup field. The previous startup was quite successful and led to a favorable exit. So, our team was already experienced in terms of combination of corporate and startup experience." (Co-founder, company XVI)* • *"It was a mess in the beginning, and it is super difficult to be a non-technical CEO and have external tech because I could not quality-check the work being done by the external developers. After some time, we took tech from being external to internal." (Co-founder, company XXV)*
Financial capital	• *"Right from the start, we wanted to build something like a unicorn. In other words, a global company with a success story. The capital required for this came from the founders, from the previous exit. Then, we did not receive much, but a certain amount of venture capital in the initial phase. And overall, we have quite a large amount of funding which comes from Google, from Amazon, from the government and others. So yes, we have grants as high as mountains." (Co-founder, company XVI)* • *"This is my second software company. I want things to just run. I want people to do the things that they are actually hired to do. The calculation is very simple. A senior engineer does six to eight times the work of a junior engineer. The salary difference is usually twofold only. It is more effective and cheaper to hire seniors straight away." (Co-founder, company XXI)* • *"The company did not need venture capital because the founders were rich. In the first two or three years, they invested a lot of money on their own." (CTO, company XXVII)*

Moreover, this was pertinent to the DI development in heavily venture capital-funded startups with rich financial resources in contrast to limited resources of late bloomers, illustrated by the co-founder of company XVI:

"Right from the start, we wanted to build something like a unicorn. In other words, a global company with a success story. The capital required for this came from the founders, from the previous exit. Then, we did not receive much, but a certain amount of venture capital in the initial phase. And overall, we have quite a large amount of funding which comes from Google, from Amazon, from the government and others. So yes, we have grants as high as mountains."

4.1.2 Dominant Characteristics

We clustered the digital startups according to four characteristics, each of which represents a continuum between two extremes. These reflect digital startups' early phases of growth in terms the role of DI for realizing the business model (integral part vs. enabler), the approach to developing DI (digital-first vs. progressive), the strategic alignment of the DI with business needs (strategic vs. opportunistic), and the architectural integration (tight vs. loose coupling).

Table 4. Pre-Conditions and Characteristics of Archetypes (Early Growth Phases)

	Orchid Bee	**Model Pupil**	**Architect**	**Late Bloomer**
Sample:	*IV, VIII, X, XI, XIV, XVI, XVII, XVIII, XIX, XXIII, XXIV, XXVIII, XXX*	*VI, IX, XXI, XXXI*	*II, VII, XII, (XIII), (XV), XXVI*	*I, III, V, (XX), XXII, XXV, XXVII, (XXIX)*
Dominant characteristics:				
Role of DI	*Integral*	*Integral*	*Enabler*	*Enabler*
Approach to developing DI	*Digital-first*	*Digital-first*	*Progressive*	*Progressive*
Business-DI alignment	*Strategized*	*Opportunistic*	*Strategized*	*Opportunistic*
Architectural integration	*Tightly coupled (early integration)*	*Loosely coupled (early integration*[1])*	*Tightly coupled (late integration*[2])*	*Loosely coupled (late integration)*
Pre-conditions (tendency):				
Financial capital	*Medium to high*	*Low to medium*	*Low to medium*	*Low*
Social capital	*High*	*Low to medium*	*Medium to high*	*Low to medium*
Human capital	*High*	*Low to medium*	*Medium to high*	*Low to medium*

*[1] = compared to the late bloomer; *[2] = compared to the orchid bee

Role of DI for realizing the business model. Digital startups attributed varying degrees of pertinence to DI for realizing their business model. These were found in the continuum of being an integral part or an enabler for the realization of the business model. As an integral part, the DI played a crucial role both for supporting product-/service development (e.g., developing digital product innovations such as virtual reality solutions) and internal/external processes (e.g., supporting collaboration and communication through platforms and cloud computing, or enabling digital product innovations) from the outset. This was evident in company VI, as illustrated by the CEO:

"This software is my second brain. It changed my life and is an integral part of our business. All of our employees, our own mission, and every product is managed in it. Everything is managed by it."

As an enabler, DI held a less significant role in product-/service development and served rather as a "means to an end" (e.g., in processual terms of providing the necessary technological means for the customer journey from initial customer interaction to billing). This assigns DI a more enabling and supporting function, which was considered to be of secondary importance for the realization of the business model, as demonstrated by the CEO of company XIII (see also Table 5):

"We grew as a business and acquired customers when we had no platform, no systems, no integration. The software will always grow in line with the business but it is not the driver of that growth, it is just the enabler. Now, we have three or four software tools for collaboration and customer communication that are pretty critical to our business and on that we heavily rely."

Approach to developing DI. Digital startups pursued different approaches in the development of DI, which we categorized along the continuum of digital-first and progressive. Companies that followed a digital-first approach digitized (almost) all internal and external processes from the beginning. Some of these can be considered fully digital from the outset (e.g., purely virtual companies). Thus, digitization of processes was inherently intertwined with organizational operations, which—

theoretically and besides blue-collar activities—were able to operate entirely remote while relying extensively on cloud computing. This included digitizing the whole customer journey and integrating underlying processes that support data-driven decision-making (e.g., for placing marketing campaigns). For example, this is illustrated by the COO of company IX:

"From the beginning, we did not have a single process that was manual or on a piece of paper; instead, we took a digital-first approach."

In contrast, companies which followed a more progressive approach achieved digital maturity in their processes or products/services rather over time. For instance, this covered emerging business requirements such as increasing global collaboration or communication, as well as exploiting opportunities presented by digitalization (e.g., using artificial intelligence for data-driven decision-making or cloud computing for co-creating digital innovations) (see also Table 5). This was, amongst others, evident in company XII, as the CEO states:

"It has been a fairly gradual IT evolution in the sense that we have shifted our architecture several times to make it more sustainable or whatever is required."

Business-DI alignment. When aligning the DI with business needs, both strategic and opportunistic approaches were evident. In terms of a strategic approach, digital startups stood out through intensive strategic planning of the DI to prepare the organization for further growth (e.g., through early hirings of enterprise architects or the development of detailed digital (transformation) roadmaps). Though these did not always cover a fixed strategic horizon (such as five years due to the dynamics in the evolution of digital startups) and were adapted rather regularly, meticulously planning the development of DI to support business potentially led to a competitive advantage (e.g., due to integrated software solutions that allow data-driven decisions, optimized internal and external processes, or efforts that support flexibility and scalability). This was evident, amongst others, in company II, as stressed by the COO:

"With more than 30 years of experience in the tech industry, including as CEO, I knew about the relevance of enterprise architecture. Our enterprise architect does a great job when it comes to developing our digitalization strategy, designing the IT landscape with interfaces, and operating our platform."

In contrast, digital startups that followed a more opportunistic approach in terms of aligning the DI with business needs frequently faced higher transformation efforts when redesigning the DI to address increasing complexity. This is illustrated by the CEO of company I:

"Initially, we were quite opportunistic and did not plan IT strategically. We came to a point where planning and consolidating the IT landscape became a strategic decision, as we were threatened with performance losses in the 6-digit range over the next few years due to a lack of integration of our systems."

While this did not exclude efforts to align the DI with business needs, a lack of strategy (e.g., due to missing financial or human resources and respectively technological expertise) often led to a greater structure-technology misfit in later stages of growth (e.g., in terms of redundant data or inefficient processes) (see also Table 5).

Architectural integration. Digital startups followed two different approaches in terms of the architectural integration: a tight coupling (i.e., usually reflected by a tendency to centralization) and loose coupling (i.e., usually reflected by a tendency to decentralization). In terms of a more tightly coupled approach to developing DI, digital startups invested early in software solutions that were highly integrated either through a central digital platform or multi-functional software solution (e.g., an enterprise resource planning system), or due to application programming interfaces that supported modules from different software providers to be integrated in terms of their data (e.g., to enable data-driven decision-making by aggregating fragmented data points into a larger data ecosystem through building an integrated DI that aligns with business needs).

Table 5. Dominant Characteristics of Archetypes

Dimension	**Selected Quote of Code Categories**
Role of DI for realizing the business model	Integral part: • *"We were highly digital and software-oriented right from the start. We wanted to build the best-in-class product, the best-in-class technology, architecture, and so on. Although technology is at our core, marketing and sales are also crucial to success and sometimes even more crucial than a good product in the early stages." (Co-founder, company XVI)* • *"This software is my second brain. It changed my life and is an integral part of our business. All of our employees, our own mission, and every product is managed in it. Everything is managed by it." (CEO, company VI)* Enabler: • *"Before 2020, we were a pure education company in which technology played a subordinate role. Then, we evolved into an education technology company in which developing the digital infrastructure became essential." (CTO, company XXVII)* • *"We grew as a business and acquired customers when we had no platform, no systems, no integration. The software will always grow in line with the business but it is not the driver of that growth, it is just the enabler. Now, we have three or four software tools for collaboration and customer communication that are pretty critical to our business and on that we heavily rely." (CEO, company XIII)*
Approach to developing DI	Digital-first: • *"From the beginning, we did not have a single process that was manual or on a piece of paper; instead, we took a digital-first approach." (COO, company IX)* • *"We have been totally digital from day one." (CEO, company XI)* Progressive: • *"It has been a fairly gradual IT evolution in the sense that we have shifted our architecture several times to make it more sustainable or whatever is required." (CEO, company XII)* • *"Previously, the company worked with external partners. Anyway, the old system was not optimally aligned with business needs and, in my view, needed to be changed. Over time, we also began to act more in a technological sense as a company and to handle more processes internally." (CEO, company XXVII)*
Business-DI alignment	Opportunistic: • *"Initially, we were quite opportunistic and did not plan IT strategically. We came to a point where planning and consolidating the IT landscape became a strategic decision, as we were threatened with performance losses in the 6-digit range over the next few years due to a lack of integration of our systems." (CEO, company I)*

	• *"In the past, employees tried everything out independently in a shadow IT manner. There was virtually no orchestration or administration. And that is what we are trying to do now, or tried to do last year, step by step." (CEO, company III)* Strategic: • *"With more than 30 years of experience in the tech industry, including as CEO, I knew about the relevance of enterprise architecture. Our enterprise architect does a great job when it comes to developing our digitalization strategy, designing the IT landscape with interfaces, and operating our platform." (COO, company II)* • *"We pursue [IT] strategies, which means that we model our infrastructure with software tools, review it regularly and ask ourselves: Which systems are interconnected? Where do data and information flow? What communicates with each other, where do we perhaps have too much communication, where too little? Is there middleware that we do not need, or software that we once used but no longer need? In other words: We sit down and take a close look at how the company is structured, which really includes everything. E-mail, telephone, MS Outlook, MS Teams, service providers, the enterprise resource planning system, the online store and so on. Thus, we analyze the entire architecture for pain points, potential bottlenecks and set about optimizing it. But in the end, it has to be aligned with the company as a whole." (CFO, company VII)*
Architectural integration	Tight coupling (centralization tendency): • *"It was important to us that we set up the whole thing stringently, that we have clearly defined processes. To this end, we set up an ERP system very early on and constantly assessed its suitability for individual departments." (CFO, company VII)* • *"In our case, everything is organized in a large system, including subsystems. Since all processes are digital and we work 100% remotely, this is very important for us." (Co-founder, company XVI)* Loose coupling (decentralization tendency): • *"We prefer to stick with small best-of-breed solutions, to give it that name, rather than having such a holistic, integrated solution." (CEO, company III)* • *"We have a mix of diverse software solutions that are not harmonized. Over the years, we chose what suited us best." (CTO, company V)*

This is illustrated by the CFO of company VII:

"It was important to us that we set up the whole thing stringently, that we have clearly defined processes. To this end, we set up an ERP system very early on and constantly assessed its suitability for individual departments."

In terms of a more loosely coupled approach to integrating software solutions, digital startups put less effort in architectural integration from the outset (e.g., due to DI's role as an enabler and, thus, less relevance in the venture creation process). For instance, this was evident in company V as reported by the CTO:

"We have a mix of diverse software solutions that are not harmonized. Over the years, we chose what suited us best."

In particular, the degree of integration affected the ability to rely on data-driven decision-making (e.g., for placing marketing campaigns) or to enable cross-country collaboration (i.e., with customers, partners, or subsidiaries). A high degree of integration through integrated data points and interfaces enabled data-driven decision-making (e.g., when launching new products), leading to synergies but also complementarities between data-driven decisions and human judgment (see also Table 5).

4.2 Reasoning of Archetype I: The Orchid Bee

The orchid bee can be considered a heavyweight among archetypes for DI evolution, as this eponym reflects a fully mature and crucially fertile organization when born. With significant amounts of financial capital combined with a professional background in organizational development of the founder and a strong network, this archetype is geared towards growth (Figure 1).

In terms of financial capital, early venture capital investments, a previous exit, or family-backed investments laid the financial foundation for comparatively high investments in a state-of-the-art DI which supported digital startups' rapid growth. With regard to human capital, (top-level) management positions in incumbent companies or startup experience (e.g., as a serial-founder) facilitated establishing professional organizational structures that build on best practices and a DI that is strongly aligned with business needs.

Figure 1. Vignette of Archetype I

Vignette of Archetype I: The Orchid Bee

Illustrated by company XXIII (quotes from the CEO in quotation marks)

Business model. The company started with developing robotic process automation software which “was the hottest thing on the market.” Later, it additionally acquired other software from tech vendors, bundled that into a service, and sold it to clients.

Pre-conditions. The three founders were “extremely experienced in IT services and all held several top management level positions in large IT companies such as IBM.” Years of experience in developing organizations were accompanied by an early and multimillion-euro venture capital investment, and a flourishing business network (“they were important people and knew everybody”) that supported setting up a state-of-the-art DI as the technological foundation for rapidly scaling the business model, leading to an IPO years later.

Dominant characteristics. The role of DI can be considered an integral part for realizing the business model with regard to its relevance for the development and distribution of product innovations in the field of RPA. In this context, “it was the first company to introduce RPA from the cloud,” which necessitated a digital-first approach. Moreover, the company’s DI was strongly aligned with business needs such as scalability and flexibility. In terms of its architectural integration, it showed a centralization tendency as “we selected our ERP as a project management system pretty early on and it served perfectly the purpose of supporting professional services projects in 2015.”

From a social capital perspective, a flourishing professional network, the embeddedness in conducive national systems of innovation (e.g., a digitally advanced startup ecosystem as found in Estonia) or startup accelerators and mentorship (programs) supported not only a professional approach to developing the business model, but also to build a solid technological foundation. The technological expertise was usually achieved either due to a member of the founding team, early professional hirings (e.g., a CIO, CTO, or enterprise architects), or consulting external service providers.

Thus, against the professional background of founders and executive managers and strong growth intentions (e.g., due to venture capitalists' influence), the role of DI for realizing the business model was predominantly considered as an integral part due to its great relevance for enabling flexibility and scalability in the growth process. To accommodate these, orchid bees predominantly followed a digital-first approach, highlighting the need for an advanced technological foundation from the outset. At the same time, this reflects a high degree of business-DI-alignment and integration efforts based on a strategic approach to developing DI.

4.3 Reasoning of Archetype II: The Model Pupil

The model pupil reflects digital startups with a high digital maturity from the beginning. Usually, the integral role of DI for realizing the business model and the digital-first approach were paired with ambitious growth intentions. However, in contrast to orchid bees, this archetype tended to but followed a more explorative approach to integrating and strategically aligning DI with business needs (Figure 2).

In terms of financial capital, venture capital was proportionally less compared to the orchid bee and acquired later or not at all. With regard to human capital and social capital, model pupils often varied in their pre-conditions (e.g., due to little experience in organizational development but the early support of mentors), but typically not to a high degree.

Figure 2. Vignette of Archetype II

Vignette of Archetype II: The Model Pupil

Illustrated by company VI (quotes from the CEO in quotation marks)

Business model. The business model rooted in the idea of “making tech education accessible for everyone.” Incorporating virtual reality and gamification, the company offered IT certificates (information was stored in a blockchain) reflecting the learning of technical skills demanded by international companies through online work on IT micro-tasks.

Pre-conditions. The founder and CEO (“I am an ambitious person and I want to change the world”) had little experience in organizational development, but was later trained in accelerator programs (“working with partners from the Silicon Valley”) and has “diversified her mentors” over time. Moreover, she raised smaller early funds from business managers and institutions, and later higher sums through venture capitalists (e.g., series A funding).

Dominant characteristics. The company relied fully on cloud computing and showed a high degree of digital technology use from the outset, reflecting the pivotal role of the DI for realizing the business model. To support internal and external processes, and product development, a digital-first approach was necessary. However, in the beginning, the company’s investments in DI were comparatively lower compared to orchid bees. This is demonstrated by the intensive use of free and open-source software, which changed over time to the extent that a centralized software solution was crucial for the integration of the second branch (“we have a remote culture which is really important for this”). In this process, the CTO, which was hired after about three years, “did a lot of work in one year” in terms of strategically developing and streamlining the DI.

Model pupils understood DI as an integral part of realizing the business model from the outset, both for communication and collaboration and for digital product or service innovations. This is reflected by a digital-first approach that strongly builds on digital technologies such as cloud computing or digital platforms. While the business-DI alignment varied to a certain degree, it tended to be rather opportunistic than strategized and was predominantly associated with comparatively lower DI investments. This aligns with the architectural integration, which tended to be loosely coupled from the outset despite a certain degree of variation. However, due to a high degree of digitality from the beginning, growth-related requirements for a tighter coupled DI were usually implemented with less effort compared to late bloomers.

4.4 Reasoning of Archetype III: The Architect

The architect reflects digital startups that strategically plan the development of DI early on, though its role is rather understood as an enabler for realizing the business model (Figure 3).

In terms of financial capital, there was no clear tendency in terms of relying on venture capital or not. Generally, the availability of financial capital was not as high at the beginning as with orchid bees, and venture capital was often acquired at later stages. Human capital was particularly important for developing DI as the technological foundation for the business, usually reflected by early hirings of technological experts, literate founders flanked by experienced mentors, or a founding team embedded in robust business or startup networks.

Figure 3. Vignette of Archetype III

Vignette of Archetype III: The Architect

Illustrated by company II (quotes from the COO in quotation marks)

Business model. The company started its business by offering non-digital products and services in the energy sector and quickly developed towards a platform company (“our clients simply pay for the solar energy produced while we take the risks out of adopting solar, which includes financing, designing, selecting, installing, insuring, monitoring, operating, and maintaining the solar system”).

Pre-conditions. The founder “surrounded himself with people who were very experienced in their own fields” and had “incredible entrepreneurial zeal as he started several companies.” Moreover, he was enthusiastic about using technologies to support business activities (e.g., “he was passionate about blockchain which is why we started to use it for payment processing”) and raised small amounts of seed funding, later followed by a significant sum though crowdfunding.

Dominant characteristics. The role of DI for realizing the business model changed over time. In the beginning, it was understood a means to an end. When the company developed towards a platform company, it became crucial (“now, the software drives the whole business”). This evolution is reflected by a more progressive approach to developing DI, as, in the beginning, “there was a sort of Microsoft Excel backend to run the company” and the website was “poorly written by his next-door neighbor’s boyfriend for a thousand rand.” However, the company early acknowledged the need for a strategic digital roadmap that was built on enterprise architecture principles. Thus, the founder made early professionalization efforts by hiring a CTO and an experienced enterprise architect and building a technical team that quickly grew to five people after three years.

The role of DI was predominantly understood as an enabler from the outset (e.g., in terms of collaboration, communication, or payment processing). While some digital startups that fall into this archetype paid greater attention to digital technologies (e.g., relying on artificial intelligence to enable data-driven decision-making) in later stages, the relevance of DI in relation to product development and innovations was comparatively lower. However, this archetype can be characterized by a strong focus on strategically developing DI to support business needs. This was due to the need of achieving a high structure-technology fit by an early hiring of enterprise architects, or establishing dedicated (IT) departments responsible for the architectural integration of DI.

4.5 Reasoning of Archetype IV: The Late Bloomer

The late bloomer reflects digital startups which follow are more opportunistic approach to developing DI, and can be associated with usually less experience in and financial capital for professionally developing the DI from the outset.

In terms of financial capital, venture capital investments were not the norm. While venture capital was acquired in later stages or not at all, bootstrapping was frequently used in the venture creation process. This, however, did not exclude the possibility of becoming a digital gazelle due to rapid growth rates in later stages. Though the embeddedness of the founding team in business networks had an impact on the development, the technological expertise of the founders was usually lower compared to orchid bees or architects.

In addition, late bloomers assigned the DI a predominantly supportive function for realizing the business model in the beginning, accompanied by comparatively late professionalization efforts and investments in DI. Moreover, the archetype can be characterized by a more progressive development of the DI associated with less depth of strategically planning the DI until later stages, while the architectural integration predominantly followed a loosely coupled approach with a higher degree of fragmentation and, thus, less integrated software solutions.

Figure 4. Vignette of Archetype IV

Vignette of Archetype IV: The Late Bloomer

Illustrated by company I (quotes from the CEO in quotation marks)

Business model. The online marketing company began with search engine optimization and search engine advertisement. Later, it became a flourishing full service online marketing agency.

Pre-conditions. The two founders were freshly graduated Master's students and built up the company organically. Originally, they "wanted to earn some money on the side." Although they were mentored to some extend (e.g., from university), their experience in business development was rather sparse. This was accompanied by a shortage of skilled workers in the region and scarce resources.

Dominant characteristics. In the early stages of growth, the company's software solutions (mostly freeware and open source) sufficiently suited the business needs. However, while individual software solutions were relevant for the provision of services, the DI as a whole played a subordinate role back then. Moreover, advancing the DI followed a progressive approach ("we were quite opportunistic and did not plan IT strategically") as many processes were still handled offline and were not integrated (e.g., within the customer journey from initial customer contact to billing). Later, due to a lack of orchestration and strategic planning of the DI, missing software interfaces led, among other things, to a lack of transparency and miscommunication in customer project implementation as soon as several departments were involved. This eventually necessitated a comprehensive reorganization of the DI after reaching about 100 employees, as the impact on project and company performance became severe.

5 DISCUSSION

Our study started with the goal of investigating the growth trajectories of digital startups in their early phases. The results show that the evolution of DI in these startups significantly influences their development besides factors which are well-known from entrepreneurship research (e.g., the availability of financial resources). The four archetypes presented position DI as a key dimension in the growth process, thereby emphasizing the need to link the research areas of digital entrepreneurship and DI more closely. Thus, from a theoretical perspective, we contribute to the growing research interest in the dynamics of entrepreneurial growth trajectories with a focus on digital startups. The results of our study are a response Nambisan's call for a "careful consideration of digital technologies and their unique characteristics in shaping entrepreneurial pursuits" (Nambisan, 2017, p. 1029). The four archetypes presented address this demand by drawing attention to the different development paths of DI and their impact on the growth and, ultimately, the success of digital startups. Moreover, the study advances theorizing about the role and underlying mechanisms of DI in the process of scaling. While Henfridsson and Bygstad (2013) proposed scaling as a key mechanism in the DI evolution, our research transfers this mechanism to the realm of digital startups and unfolds it by identifying key factors (dominant characteristics and pre-conditions) influencing the development. In particular, we focus on the early growth phases, whereby the development paths of DI are strongly linked to socio-technical challenges that arise later on.

At the same time, we expand on the contributions of von Briel et al. (2018) and Lehmann et al. (2022) on the role of digital technologies for new and digital ventures by examining them more closely from an evolutionary perspective. Finally, we highlight the need to close ranks between digital entrepreneurship and DI research. While Huang et al. (2017) demonstrated the importance of DI for scaling, we substantiate this finding with empirical evidence. By paying special attention to the case of high growth, our study reveals that a symbiosis of both research disciplines makes a significant contribution to a better understanding of the growth of digital startups and beyond.

Furthermore, this study bears several practical implications. While it may be leveraged to inform targeted policy measures (e.g., to financially or technologically aid digital startups on a macroeconomic level), it also supports founders and executive managers of digital startups in anticipating upcoming socio-technical challenges in phases of (rapid) growth. This, for example, became evident as the fragmentation of the DI during rapid growth and the corresponding integration efforts posed major challenges for digital startups by significantly impacting data-driven decision-making and communication and collaboration between subsidiaries and departments. Here, against the backdrop of growing organizational structures, new business requirements (e.g., for communication and collaboration) needed to be met (e.g., by an integrated, cloud-based, and scalable IT infrastructure). Thus, the need for creating an integrated DI to realize efficient process structures, to explore new digital business opportunities, and, against the backdrop of communication and collaboration requirements, to scale the business, increased over time. Additionally, the development of DI in the startups was often accompanied by shadow IT or best-of-breed solutions for individual departments, resulting in missing interfaces and integration hurdles. For example, while orchid bees achieved an early and high digital maturity which was necessary to accommodate rapid growth and included a tight coupling to enable data-driven decision-making, late bloomers tended to experience a structure-technology mismatch (e.g., due to missing interfaces, redundant data, and inefficient processes) in later stages of growth. Moreover, while an opportunistic selection of software solutions was of comparatively less relevance in early stages of growth, the lack of investing in and planning the DI for later growth stages (e.g., in terms of integration) often necessitated higher efforts in restructuring the DI and comparatively higher costs due to not matching the business needs adequately.

However, this study has some limitations. In terms of selecting digital startups for the study, we collected the interviews in several iterations over a longer period of time, which partly reflects relying on different technological standards. For example, the CTO of company XXVII reported that, due to generative artificial intelligence, there was no need to hire additional employees, as the work could be done with fewer despite the company’s growth. Cloud computing has also evolved over time. While a small proportion of the digital startups did not (extensively) use cloud computing (e.g., due to their early funding), we approached this by the notion of a digital-first approach, reflecting a digital state-of-the-art approach to using information systems for supporting business needs. Here, with regard to the digitality of startups, the distinction between process and product/service digitality illustrates the multifaceted nature of digital startups. In addition, while we were able to locate most digital startups from the sample in one of the archetypes, we also noticed a small number of companies where the classification was imprecise due to their small size. While company XX was barely more than a year old at the time of the interview and exhibited characteristics of a late bloomer, it might also become an architect through professionally developing the DI. Moreover, along with demonstrating a high degree of product digitality through its digital platform, company XXXI tended towards the pupil model. However, significant parts of communication took place via WhatsApp or the presence of the entire team in the office, which diminished the role of an integrated DI for supporting collaboration and communication in this phase. In addition, with regard to the pre-conditions affecting the development of DI, some founders had little experience in organizational and technological development, but were intensively supported by accelerator programs or mentors (e.g., company VI), or possessed extensive experience as a serial entrepreneur, but an integrated DI aligned with business needs was of less relevance in early stages (e.g., company XXIX). This highlights the importance of dominant characteristics for better understanding the DI evolution in early growth phases, while allowing some flexibility in the pre-conditions to avoid adding to the existing complexity with a plethora of variants. For example, digital startups that a) assign DI an integral role but follow a progressive approach to its development or b) assign DI an enabling role but pursue a digital-first approach are theoretically conceivable. This supports theorizing on the role of DI in the growth process as a) the integral role of DI would potentially correlate negatively with a progressive development and b) may contradict potential high digitalization efforts in relation to its subordinate role. In this context, company XIII shed light on temporal boundaries in the development of DI. While offering a digital product, the CEO perceived the role of software solutions in the venture creation process as an enabler. However, through the early acquisition of significant amounts of venture capital ("*in 2018, we raised around a million dollar locally; 2019, we raised about NZ$2.1 million; 2020, we raised about NZ$4.2 million; finally, in December last year, we raised NZ$16 million from a U.S. venture fund*") and new requirements on the DI due to rapid growth, it was redesigned early and became critical for the business. In addition, late bloomers tended to have little venture capital or other financial resources from the outset, with company XXVII being an outlier. The CTO reported that it evolved from an education company to an education technology company under the impact of COVID-19 on the business model, which led to rapid growth. However, during the first years, the company had significant monetary resources without being dependent on venture capital ("*the founders were rich*"), which illustrates both the blurred theoretical boundaries between digital and non-digital startups in the light of digital transformation, and potential diverging DI requirements (e.g., in terms of high architectural integration) for (evolving) non-digital business models.

6 CONCLUSION AND OUTLOOK

We contribute to the nexus of DI and digital entrepreneurship research by shedding light on the socio-technical patterns and dynamics of digital startups' growth trajectories. Based on semi-structured interviews with founders and executive managers of 31 digital startups from nine countries, we discovered four archetypes that reflect digital startups' DI evolution in early stages of growth, paying special attention to DI's role in scaling. In particular, we elaborate on the pre-conditions of the founders and executive managers in terms of the role of social, human, and financial capital in this evolutionary process and distinguish the archetypes by four dominant characteristics. Each of these reflect a continuum of two diametral characteristics (i.e., the role of DI for realizing the business model (integral part vs. enabler), the approach to developing DI (digital-first vs. progressive), the strategic alignment of the DI with business needs (strategic vs. opportunistic), and the architectural integration (tightly vs. loosely coupled)), which supports a better understanding of this phenomenon and, thus, the nature of DI evolution.

Finally, our study reveals several avenues for future research at the intersection of digital entrepreneurship and DI research. For instance, due to the qualitative nature of the study and, thus, by depicting reality based on a sample of 31 digital startups, the findings might be condensed with regard to their accuracy (e.g., in terms of pre-conditions' tendencies) through a quantitative study. At the same time, this holds potential for further in-depth studies that relate capital availability to DI investment intensity. In this context, with regard to the orchid bee, it seems interesting to investigate the role and approach to developing DI in contrast to non-digital startups, as these might be of less relevance for thriving traditional businesses (e.g., property development or agricultural projects supported by a high amount of financial capital). In addition, by interviewing founders and executive managers, we shed light on the DI evolution from a single angle, whereby the assigned relevance of the DI for the realization of the business model had to be weighed objectively and carefully depending on the function of the interviewee (e.g., CEO versus CTO). In this process, from a socio-technical perspective, a deeper investigation of the interplay of the social and technical system seems to be promising (e.g., conducting longitudinal, in-depth case studies that include different levels—or hierarchies—of the organization). Furthermore, given that the archetypes are predominantly based on an inductive development of categories, considering an exhaustive list of DI characteristics from the information systems literature in addition to their underlying logics and mechanisms or through a qualitative meta-analysis seems promising for future research as this could enrich these archetypes with more depth while contrasting inductive with deductive reasoning. In light of these avenues for future research in the nexus of DI and digital entrepreneurship research, this study serves as the empirical foundation and starting point for further theorizing on digital startups' DI evolution in their early stages of growth, specific socio-technical challenges in the context of scaling, and dynamics in their growth trajectories.

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